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BUSINESS INFORMATION SYSTEMS

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PAUL BEYNON-DAVIES

Professor of Organisational Informatics,
Cardiff Business School, Cardiff University

macmillan international HIGHER EDUCATION

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MESSAGE TO STUDENTS

WHY IT IS IMPORTANT TO READ THIS BOOK

This book introduces both the current and the aspiring business professional to three topic areas that are critical to their working life.

First, **information** is so important to the modern world that some have even referred to it as the global information society. In this book we help the reader unravel the ways in which information is related to, but different from data, and how both data and information underpin organisational activity of many forms. We shall demonstrate that data and information are critical to the work of not only managers but also of shop-floor workers.

Second, organisations establish **information systems** in order to control their current activities and also as the basis for changing and improving their ways of doing things. We describe a number of typical information systems within business which drive their operation. We also describe the ways in which information systems are now critically important for managing activities and relationships with customers, suppliers and partners.

Third, **information and communication technology** (ICT) has been used to increase the efficiency and effectiveness of both information systems and business practice. Much of the way modern business works is embedded or encoded in its ICT. Without ICT systems many organisations would cease to function.

But these topics are not isolated areas of concern for the modern business. For instance, the modern business organisation may have the aim of improving its performance through better information. But in order to do this the business must develop an efficient information system, which is likely to require the use of ICT. This book provides a guide to best practice in each area, as well as an understanding of the relationships between these areas.

This book is based on my experience of teaching various undergraduate, postgraduate and commercial courses in the area; it has also been enhanced by my consulting and professional practice. Hence, the concepts and frameworks described in this textbook have been 'field-tested' not only in an educational context but also in practical work.

WHY THIS BOOK IS DIFFERENT

My aim in writing this book has been to create a coherent path through the subject of business information systems which addresses some of the needs I have identified during many decades of experience in the field. This textbook has been tested at academic institutions around the world and we have taken the opportunity in this third edition to include several improvements suggested by users of the book; both teaching staff and students.

The book covers essential core material relating to business information, systems and technology. Care has been taken to ensure that only material that is critical for the student is included.

Many business information systems textbooks consist of a collection of interesting but disconnected topics. This book is different in that we consider the material as an integrated and seamless web of ICT application in organisations. This book therefore makes it easier for you to make sense of the subject as an integrated whole. It also makes it easier for you to see how different elements of the subject interrelate.

The book provides a balanced coverage of both theory and practice. The aim is to use precise definitions of foundation concepts to provide an understanding of the place of information, information systems and ICT within all forms of organisation. This understanding then makes it possible to show you some practical uses and applications of information systems. It also identifies and explains why an understanding of the design of business systems is increasingly important to business professionals of many kinds.

So, what you will get from this book is a *rounded* but *grounded* conception of this important area of business. The book will equip you with knowledge which will enable you to better perform as a business professional in the modern, complex organisational world.

In the psychologist Edward de Bono's words, creativity involves '*breaking out of established patterns in order to look at things in a different way*'. Most of all this book is designed to get you to think differently; not only about the issue of organisation, but particularly about the place of information and information technology within such organisations. After all, thinking differently is a necessary precondition for any successful innovation, certainly any digital innovation.

For more details on the book's structure, learning features and companion website, please see the 'About the book' section on page xxviii.

MESSAGE TO LECTURERS

MOTIVATION

My aim in writing this book has been to create a coherent path through the subject area which addresses some of the needs I have identified in many decades of experience in the area. *Business Information Systems* includes the following distinctive characteristics:

- **Coverage of core material**. The book covers essential core material on business information, systems and technology which will be useful not only for academic but also commercial courses. As such, we have taken care to exclude material present in other texts in the area that is not critical for a relevant, introductory exploration of the subject. However, we have taken great care to ensure that the material provided covers all the core topic areas defined in standard, international curricula.
- **Use of clear terminology**. The book uses a more precise set of terms than competing texts for explaining the area. For instance, we make a clear distinction between data and information in the book. This allows us to be clearer not only about the differences between but also the relationships between ICT systems and information systems.
- **Integrated account**. It is unfortunate that many textbooks in this area appear to consist of a collection of interesting but disconnected topics. This book presents a much more integrated and holistic account. We believe that the area covered by this book is not a series of interesting but independent organisational and technological issues; rather, it is a seamless web of ICT application in organisations. This book enables students to make sense of this as an integrated whole and to gain an appreciation of the interrelationship between elements of the subject. This approach has been tried and tested many times, not only in my own teaching but in the teaching of many others. Feedback from students suggests that they find such an approach provides a more rounded and lasting educational experience. Students are better able to appreciate the interconnectedness of different topics within the subject area and their critical importance to all forms of organisation.
- **Based in theory**. Over the last two decades, Information Systems has achieved greater coherence as a discipline. However, most introductory texts as well as intermediate texts on the subject tend to de-emphasise the coverage of theory. Here, the aim is to provide a stronger theoretical foundation than competing texts. Foundation concepts discussed in earlier chapters are used throughout the book to provide coherence to the description of current practice. For example, the distinctions between an ICT system, an information system and an activity system are not simply a matter of convenience: we believe that such distinctions have practical implications in the sense that the design and use of an ICT system is affected very much by the context of communication (the information system) in which it is placed and the activity system it is meant to support.
- **Broad nature of application**. This book pays great attention to the way in which concepts discussed have a much broader application than just purely digital computing technology. We deliberately introduce what may appear at first glance to be several 'strange' cases, such as those of the Inka khipu and the Royal Air Force's warning network during the Battle of Britain. These cases are designed to get

students to think differently about our current 'information and communications technology' and how it relates to other technologies used both historically and by other cultures. It also establishes the usefulness of applying the lens of systems, patterns and signs to help bring into better focus the nature of organisation itself.

- **Practical emphasis**. Having stronger theory does not mean less relevance to practice. In fact, I would argue the opposite. Theory must guide good practice in the area we are considering. Throughout the book we have highlighted good practice of relevance to organisational practitioners who are aiming to innovate through ICT.
- **Design emphasis**. We see much of what is discussed in this textbook as 'design science' in the sense that what we are primarily discussing is the effective design and construction of sociotechnical systems of organisation of various kinds. This book takes the position that it is no good just teaching students what they should know; it is equally important to show them how to do things with this knowledge. Therefore, this book provides coverage of design as an overall orientation that needs to be applied not only to digital innovation but to any form of organisational change. The emphasis is very much realised in the modelling of systems and using such models as the basis not only for understanding current issues within organisations but also for describing possible futures for organisational life.
- **Field-tested**. As well as being based on my experience of teaching various undergraduate, postgraduate and commercial courses in the area, the book has also been enhanced by my consulting and professional practice. Hence the concepts and frameworks described here have been 'field-tested' not only in an educational context but also in practical work. Both the first and second editions of the book have been adopted as a core teaching text at many education institutions around the world. Adopters of the text kindly provided much feedback on their experiences of using the text, which has helped improve this third edition.

USING THE BOOK AS PART OF A COURSE OR MODULE

The coverage in this book emphasises the interconnected nature of the subject and presents material in a deliberate sequence: the explanation of later concepts are based upon an understanding of key concepts covered in earlier chapters. It is therefore ideally suited for an intensive undergraduate or postgraduate course or series of modules on **business information systems**.

Since the coverage is necessarily broad, there are several ways in which this material might be used within educational courses or modules at different levels:

- The book deliberately attempts to demonstrate the importance of considering business data, information and information systems in isolation from ICT. Hence, it is possible to use the first three chapters of the book to build a coherent account of **business information management**.
- A module on **digital business** can be built around the content in the *digital environment* and *digital business, electronic marketing, procurement and government* and *mobile commerce and social media* chapters. The chapter on *ICT infrastructure* supporting contemporary business may also be used for this purpose.
- A module on **information systems and ICT management** would use the chapters on *the infrastructure of organisation* and *managing, operating and developing digital infrastructure*.
- Various chapters from both the foundation chapters and the chapter on *digital business* could be used within a module on **business ICT**.
- This book introduces the design orientation within business in the *designing digital organisation* chapter and covers various ways in which notions of a design science

composed of design theories and associated artefacts offers a productive way of approaching both notions of **digital strategy** and **digital innovation**. The book's emphasis on modelling may also be useful in modules covering **business design** and **business analysis**.

For more details on the book's structure, learning features and companion website, please see the 'About the book' section on page xxviii.

COVERAGE OF IS2010 CORE CURRICULUM

IS2010 is a model curriculum for undergraduate degrees in Information Systems developed by the Association for Information Systems (AIS) and the Association for Computing Machinery (ACM). This curriculum specifies seven core courses and a number of elective courses. The material presented in this book provides a systematic introduction to the learning outcomes as specified in the seven core courses of IS2010. The relationship between the various chapters and the seven core courses of the IS2010 curriculum are illustrated in Figure L.1.

RELATIONSHIP TO THE AACSB LEARNING STANDARDS AND TO THE AMBA MODEL CURRICULUM

The Association to Advance Collegiate Schools of Business (AACSB) is a not-for-profit corporation devoted to the promotion and improvement of higher education in business administration and accounting. Any higher education institution wishing to gain AACSB accreditation must provide courses which meet certain learning standards as far as the student experience is concerned. These standards include reference to the following curriculum content, which is addressed in various chapters within this book:

- understanding of systems and processes in organisations (Chapter 2)
- ethical use and dissemination of data, including privacy and security of data (Chapters 3 and 6)
- understanding the role of technology in society, including behavioural implications of technology in the workplace (Chapters 6, 8 and 9)
- demonstration of technological agility, including the ability to rapidly adapt to new technologies (Chapters 7, 9 and 11)
- demonstration of higher-order cognitive skills to analyse an unstructured problem, formulate and develop a solution using appropriate technology, and effectively communicate the results to stakeholders (Chapter 10).

The Association of MBAs (AMBA), as part of its specification for its model Master of Business Administration curriculum, stresses that MBA students should be able to *think critically and make decisions based upon complex information*. This book provides a sound introduction both to the accomplishment of information through technology and the ways in which organisational decision-making and action is increasingly reliant upon an ensemble of human and machine actors.

		IS2010 core courses						
		IS2010.1: IS strategy, management and acquisition	IS2010.6: Systems analysis and design	IS2010.5: IT infrastructure	IS2010.4: IS project management	IS2010.3: Enterprise architecture	IS2010.2: Data and information management	IS2010.1: Foundations of information systems
Chapter 1	Introduction: the domain of business information systems	●	●	●	●	●	●	●
Chapter 2	Systems of organisation		●					●
Chapter 3	Data and information		●				●	●
Chapter 4	The infrastructure of organisation					●		●
Chapter 5	ICT infrastructure			●		●		
Chapter 6	The digital environment			●				●
Chapter 7	Digital business	●						●
Chapter 8	Electronic marketing, procurement and government	●		●				●
Chapter 9	Mobile commerce, social media and disruptive innovation	●	●					
Chapter 10	Designing digital organisation	●	●					
Chapter 11	Digital innovation and digital strategy	●			●	●		
Chapter 12	Developing, managing and operating digital infrastructure	●		●				
Chapter 13	The changing nature of digital infrastructure	●		●			●	

Figure L.1 The relationship between book chapters and the IS2010 core curriculum

EMPLOYABILITY AND INFORMATION SYSTEMS

Employability is normally defined in terms of the attributes of a person that make that person able to gain and maintain employment. However, whether someone is employable involves not only the attributes or skills of the person but their fit with existing jobs, or jobs that are likely to emerge in the short-term future. What organisations are clearly looking for in terms of employability is a range of competencies that you can display and which will enable you to perform work effectively both now and in the future.

We argue throughout the book that some competency in information systems is essential for workers at all levels within organisations. This competency is also relevant to a vast range of different work positions. So a knowledge of how systems of information operate is important not only to the company executive but to the production operative. It is important to the nurse and medical doctor just as it is important to the hospital administrator. It is important to the worker coordinating international aid as it is to the worker providing advice to citizens on claiming benefits.

This is because the core topics of the book affect work of all forms, not only in the private sector but also in the public and voluntary sectors as well. Data, information and activity are interrelated in all forms of modern employment. Information systems are essential for the operation of not only current activity but the planning of future activity as well as the auditing of past activity. ICT provides an important component element of contemporary information systems and as such is important to the way in which work is designed, executed, evaluated and controlled.

Within this book we shall cover a number of competencies that have been demonstrated to improve current employability. It is likely that such competencies will become even more important over the next decade. These include the ability to:

Think critically about issues arising from the contemporary application of ICT. We make the point that the reader of this book is likely to be a digital native – someone who has not known of a time when ICT was not present. But digital natives frequently forget that ICT as a set of technologies is always designed with certain intentions in mind. Some of the ways in which modern ICT has been designed are coming under question from numerous angles and we set a number of points of reflection throughout the book which are meant to get you thinking critically about not only how ICT is currently designed but more importantly how it should be designed.

Analyse problem situations as systems. This book gives you a way of thinking about organisations as complex systems of action. This perspective on organisation gives us a way of better understanding problems of organisation as well as developing better ways of organising. In other words, this book provides a number of tools, techniques and approaches for engaging more effectively with issues of organisation both at the micro and macro levels. This means that we can analyse small problems of internal organisation as to how to improve operations, and we can also analyse more global challenges such as how to cope with a rising elderly population.

Appreciate the importance of effective communication to action. Within this text we lay out two fundamental pillars which support systems of information. The first is clearly that of a system – patterns of action. The second is the important notion of a sign. Signs are units of communication. Signs are used to build data structures that form messages or records and not only have content but are always used with a certain communicative intent. The important point here is that communication is critical for getting things done and so the study of effective communication is central to the study of information systems.

Understand and evaluate the role of ICT within systems of organisation. After reading this book you should end up with a unique way of thinking about what ICT is and what role it plays. ICT is seen as an important contemporary actor within ways of organising. This means that both the role and value of ICT cannot be properly understood without a proper understanding of the context within which such technology acts – what we refer to as the infrastructure of organisation. As we shall see, such infrastructure is not only enabling, it can also be constraining.

Think creatively and design ways of organising that exploit digital innovation. Towards the latter part of the book we start portraying the domain we are considering as a design science. Design science is a third type of science alongside natural (physical) and social science, which is concerned not with *what is* but *what might be*. In this sense, we frame digital innovation as a design exercise which is inherently value laden and impacts upon critical features of the work that you either are doing currently or will do in the future. Digital innovation is likely to impact not only upon the nature of your work but how enriched it is and consequently whether you get satisfaction from it. We shall convince you within this book that any way of designing ICT necessarily impacts on the way in which we organise ourselves – not only how we engage with the world but how we construct it.

ABOUT THE BOOK

CHANGES TO THE THIRD EDITION

A number of substantial changes have been made to the third edition in response to feedback received from users and reviewers of the second edition and the draft of the third:

- The structure of the book has been changed to reflect an increased integration of topics.
- Many more examples and cases have been included and embedded within chapters.
- Increased coverage of technology topics such as big data, digital currency and the commercial Web has been provided.
- A separate chapter on social media and mobile commerce is included.
- We have reduced coverage of certain technical issues to allow increased coverage of business issues.
- More focused and integrated coverage of design, innovation and strategy as it relates to the digital organisation is now provided.
- The chapter on planning and management has changed into a chapter on digital strategy and digital innovation.
- The chapter on information systems development has been replaced with a chapter on business analysis and design, and a section within the chapter on managing, operating and developing digital infrastructure.
- There is much more emphasis throughout the book on consideration of the ethical implications of digital change.
- The last chapter has now been changed to cover some key technological trends that already impact upon digital infrastructure or are likely to do so in the near future. We also include a review of some of the key theory imparted in the book and how this relates to the practice of information systems.

The material in the third edition is now organised in 13 rather than 12 chapters.

CHAPTER OVERVIEWS

Chapter 1 Introduction: the domain of business information systems

The opening chapter considers how important an understanding of information systems is to the effective performance of organisations of various kinds. It then introduces a model of the domain, which is used to emphasise the necessary multifaceted and interconnected nature of information systems in business. This model is useful in helping demonstrate that the successful adoption and application of ICT in organisations relies on the positive interaction between different elements.

Chapter 2 Systems of organisation

This chapter considers the important context for any information systems, that of organisation. It considers what organisation is and comes to the conclusion that

organisation is best thought of as a system of interrelated patterns. The idea of a system is used to distinguish between three different but interrelated types of system which serve to create the concept of organisation – activity, information and data systems. Systems thinking is also important to understanding many other issues seen as critical to the modern organisation, such as strategy, management and performance.

Chapter 3 Data and information

This chapter examines not only the important distinction between but also the relationship between data and information. Data are considered in terms of differences made in some substance, while information is the differences that data make to some actor. This helps us understand more clearly the relationship between data structures and how they are used to communicate. It also helps us understand how data and information relate to decision-making and instrumental activity performed within and between domains of organisation.

Chapter 4 The infrastructure of organisation

This chapter introduces the notion of infrastructure as a way of understanding the nature for ICT application within organisations. Data, information and activity systems may be coupled vertically as well as horizontally. An information system is a specialised and formal communication system used to support a given activity system, often through use of technology. An ICT system is a system of digital computing and communications used to enact a data system. Understanding infrastructure is important for the manager because it both enables but also constrains change within any organisation.

Chapter 5 ICT infrastructure

The adoption of ICT is promoted within the public, private and voluntary sector as a means of improving the efficacy, efficiency and effectiveness of the delivery of services and goods to internal and external stakeholders. Modern organisations therefore rely on effective ICT infrastructure. This book considers such infrastructure in terms of access devices and channels, communication networks, front-end and back-end ICT systems and data management. The chapter also considers some developing aspects of ICT infrastructure such as cloud computing, big data and cyber-security.

Chapter 6 The digital environment

In this book an organisation is seen primarily as an activity system (or more accurately a collection of interacting activity systems) that is affected by forces in its environment. Organisations are not isolated entities – they are open systems. This means that the success of any organisation will depend on how well it integrates with aspects of its environment. This chapter focuses primarily on the economic environment of the organisation and describes ways in which organisations can be considered as systems producing value that travels within and between them. Hence, activity systems provide supportive mechanisms for the customer, supply and internal value chains of organisations. The chapter outlines the key elements of these value chains and describes how they act as conduits within a wider value network and serve to coordinate the flow of goods, services and transactions.

Chapter 7 Digital business

We use the term 'digital business' to refer to any ICT application within business. As such it encompasses two older terms, 'electronic business' and 'electronic commerce'. In this chapter we focus upon electronic business and electronic commerce, considering the use of ICT using the concept of the value network to help distinguish between various forms of electronic business. Electronic business (eBusiness) involves any ICT enablement of an organisation's internal value chain, as well as its external value network. In contrast, electronic commerce is a subset of eBusiness, and refers to ICT enablement solely of aspects of the external value network of some organisation.

Chapter 8 Electronic marketing, procurement and government

Within this chapter we look at two important subsets of eCommerce: electronic marketing and electronic procurement. As more interaction with organisations occurs online, more and more potential exists for use of electronic channels for marketing purposes. Electronic procurement as a form of digital innovation is seen as a means of reducing major supply chain costs to companies and to public sector organisations. Digital innovation has also clearly not only impacted upon the private sector but has been a major catalyst for change in the delivery of public sector services. This is part of the developing nature of digital or electronic government.

Chapter 9 Mobile commerce, social media and disruptive innovation

Within this chapter we consider some of the more recent digital innovations that have or are impacting upon organisations of many different forms. We have a look not only at some more established areas such as mobile commerce and social media as key examples of digital business but also some innovations that are likely to impact upon organisations in the near future. The design of ICT systems always involves choices which affect the way in which work is conducted. In this sense, ICT is seen as a catalyst for what some see as disruptive change within certain segments of the economic system.

Chapter 10 Designing digital organisation

Equifinality is an important property of open systems, of which organisations are key examples. This means that an open system can achieve its goals or purpose in a number of different ways. So there are likely to be a multitude of different patterns of organisation that meet the same defined objectives or goals. The consequence of this is that we should be able to *design* different patterns of organisation and then evaluate which is the most appropriate pattern for resolving aspects of some problem situation. In this chapter we consider business and organisation more generally in terms of what is known as the design orientation. As we shall see, this fits well with the systemic and action-oriented view of organisation promoted in this book.

Chapter 11 Digital innovation and digital strategy

In this chapter we consider several related topics that all centre around organisational change – motivation, strategy, innovation and evaluation. The notion of the organisation as a complex and adaptive system is inherently one which accommodates change. This book is all about innovation and, in particular, digital innovation – introducing change

with or through ICT. In this chapter we consider how to do digital innovation effectively and avoid commonplace failure. Crucial to managing change and innovation is the concept of a business model. The notion of a digital business model allows us to relate the motivation for innovation as well as the strategy for change.

Chapter 12 Developing, managing and operating digital infrastructure

This chapter considers the ways in which information systems and ICT as an organisational function is delivered as a service, or more accurately as a collection of services. Since ICT is embedded in modern organisational life as well as in the wider environment, not surprisingly ICT is a vast industry of both producers and consumers, which forms an important part of the service sector in an economy. In consuming organisations there is normally a function charged with developing, maintaining and operating the ICT infrastructure in support of information systems, which we for convenience refer to as the ICT service. One of the crucial services provided by this function has traditionally been the development of new information systems. However, technology has enabled organisations to transform the ICT service as they have transformed other organisational functions. The outsourcing of various aspects of ICT infrastructure, and how to manage this effectively, are therefore critical issues for modern organisations.

Chapter 13 The changing nature of digital infrastructure

In this final chapter we provide an overview of certain aspects of ICT change that are likely to affect the nature of organisation infrastructure over the next decade or so – such as ubiquitous computing, Artificial Intelligence and new architectures for computation. As a direct consequence, such technological change is likely to contribute to the way in which humans organise themselves in areas as diverse as the economy, society and polity.

We can better make sense of the changes to digital infrastructure if we can apply coherent theory. This is why we bring together elements of a theory of information systems in this final chapter. This not only summarises our perspective on what information and information systems are, but also indicates what we think information and information systems are not. We suggest that this theory helps us not only better understand the potential digital future but also presents us with better ways of approaching the design of such future.

TOUR OF THE BOOK

PEDAGOGICAL FEATURES

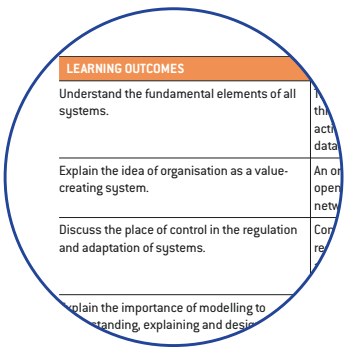
This book contains a range of carefully thought-out features designed to enhance learning, engage student interest and provide the lecturer with a variety of sources for discussion and case study analysis.

At the start of each chapter

A set of features is designed to orient the reader and prepare them for what follows:

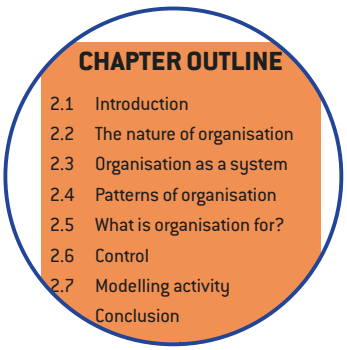
Learning Outcomes

These set out what you can expect to gain. Each is linked to a core principle which can be applied to business, so you can see how each piece of knowledge is relevant.



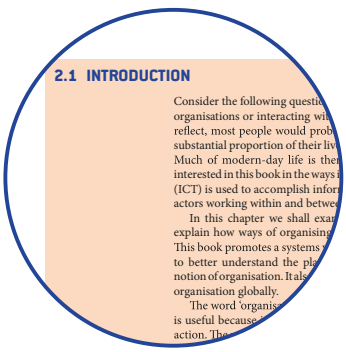
Chapter Outlines

These give an overview of the content of the chapter.



Introduction

A brief introduction sets the scene.

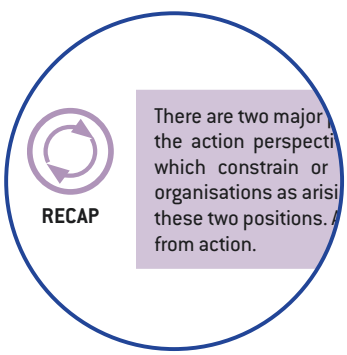


Throughout each chapter

Throughout the text, the following are used to aid learning:

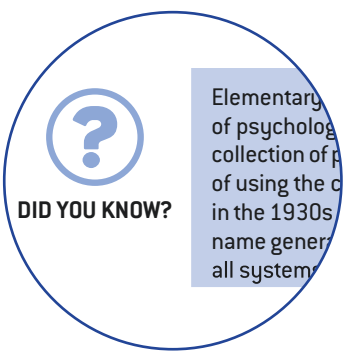
Recap

Regular recap features appear at the end of each main section to remind you of the key issues and how they relate to previous and subsequent information.



Did you know

'Did you know?' features highlight interesting or intriguing facts related to the subject to inform and entertain readers.

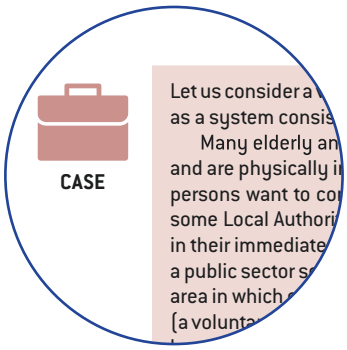


Reflect

Reflect comments and questions encourage you to consider how the subject relates to real-world issues.

Case

Regular case sections encourage you to relate a number of different issues discussed throughout the book to real-world examples.

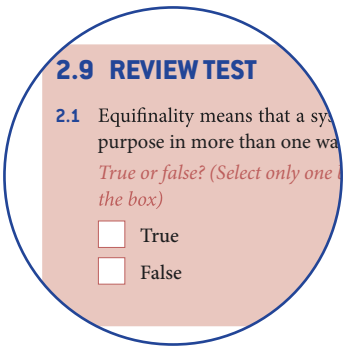


At the end of each chapter

Throughout the text, the following are used to aid learning:

Review Test

The review test questions are designed to test understanding and the ability to recall appropriate answers. Answers can be obtained by re-reading the chapter (and full answers for lecturers are provided on the companion website).



Exercises

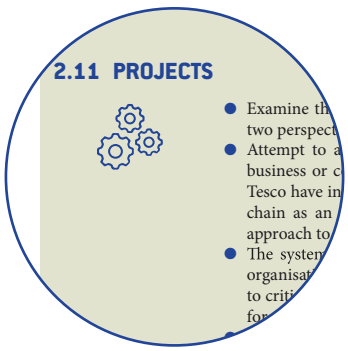
Exercises are opportunities for you to take what has been learnt and extend knowledge or apply it to some other situation. They are deliberately open-ended and may be used in tutorials or other learning opportunities to structure more extensive learning about a topic.

Projects

Student research projects outline a larger piece of work (in both effort and duration) than a student exercise. These involve:

- independent investigation, including formulating a project proposal
- production of a plan of work
- data collection
- analysis and presentation of the results.

Ideally, a student research project should display elements of independent and critical thinking. It should be noted that what are provided here are outlines of interesting research questions; they will demand much further work to develop into a working project proposal.



At the end of the book

A series of **specially written case studies** provides more detail on the application of concepts discussed to real-world experience. Each describes an organisation, project or technology relevant to the topic. The case studies are deliberately written as independent but rich resources of educational content. This means they can be used as sources of consolidation and for discussion across a range of chapters and topic areas. They are referred to throughout the book and each is supported by a list of issues for discussion. Further case studies are available online.

At the end of the book you will find **summaries of a number of selected cases from the *Journal of Information Technology Teaching Cases***. These cases provide insight into a number of information systems applications from around the world. The full case material is available to download from the book website. Finally, a **glossary** and **index** are provided to make it easier to search for coverage of particular topics.

CAREERS VIDEOS

As you will learn from reading this book, information systems are key to business success and therefore play a crucial role in many business and management jobs. To give you an idea of the wide range of job roles related to IS, the companion website for this book provides a number of video interviews with professionals working in the field. The interviewees talk about their educational and professional background, discuss some of the topics outlined in the book and offer you career development advice.

Three of these careers videos are integrated with this book. Each of these three interviews is presented with a box in a relevant chapter of the book. These boxes include a number of questions that encourage you to reflect on some of the themes discussed by the interviewees. The interviews integrated with the book are as follows:

Chapter 8: Interview with Mark Francis, founder of digital enablement company, Blue Flamingo Solutions, who talks about his marketing career, setting up his own business, the impact of mobile devices, digital marketing campaigns, SEO campaigns and the future importance of such technologies as virtual and augmented reality.

Chapter 10: Interview with Stephen Cohen, Director of Project Management at the academic publishing company, Springer Nature, who discusses leading a business systems team, the value that an understanding of IS can bring to organisations, concepts such as 'agile' and 'Scrum', and how to develop the right skills and experience to impress future employers.

Chapter 13: Interview with Steve Lockwood, who has worked in a variety of roles at IBM, and who speaks about working in important areas such as analytics, big data, AI and the Internet of Things, while explaining the various benefits these technologies and IS can bring to companies who embrace them.

These video interviews and interviews with other professionals, can be accessed online on the companion website for this book at **www.macmillanihe.com/beynon-davies-BIS3**.

GUIDE TO THE WEBSITE

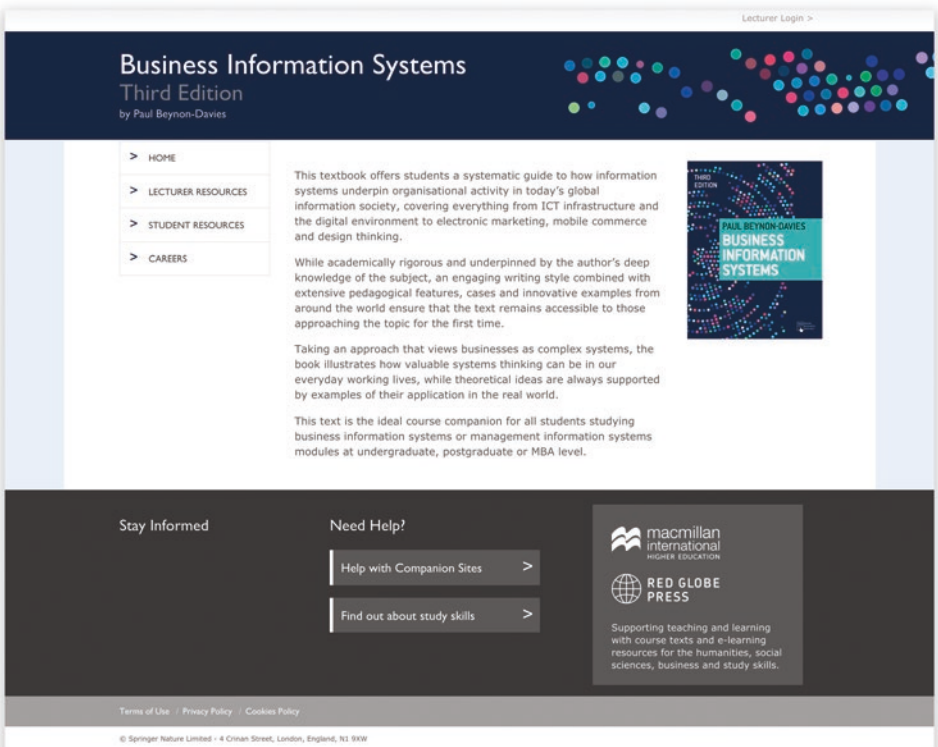
Business Information Systems is accompanied by extensive online materials, accessible to lecturers and students at **www.macmillanihe.com/beynon-davies-BIS3**. This companion website is packed with valuable features to aid teaching and learning, including the following resources:

FOR LECTURERS:

- PowerPoint slides for each chapter of the book, containing figures.
- Visualisations covering key themes from the book which can be used to help structure teaching. Accompanied by a short lecturer guide on how to use them.
- Sample module outlines for various types of courses.
- Three kinds of assessment material, including MCQs, structured exams and essay questions. All with answers or sample solutions.

FOR STUDENTS:

- Additional case studies.
- Mindmaps visualising the key themes from each chapter.
- Interactive multiple choice questions.
- Seven full articles from the *Journal of Information Technology Teaching Cases*.
- Careers zone featuring videos with professionals in the field and Q&As with BIS graduates.
- Flashcard glossary.
- Web links and descriptions of key online resources.

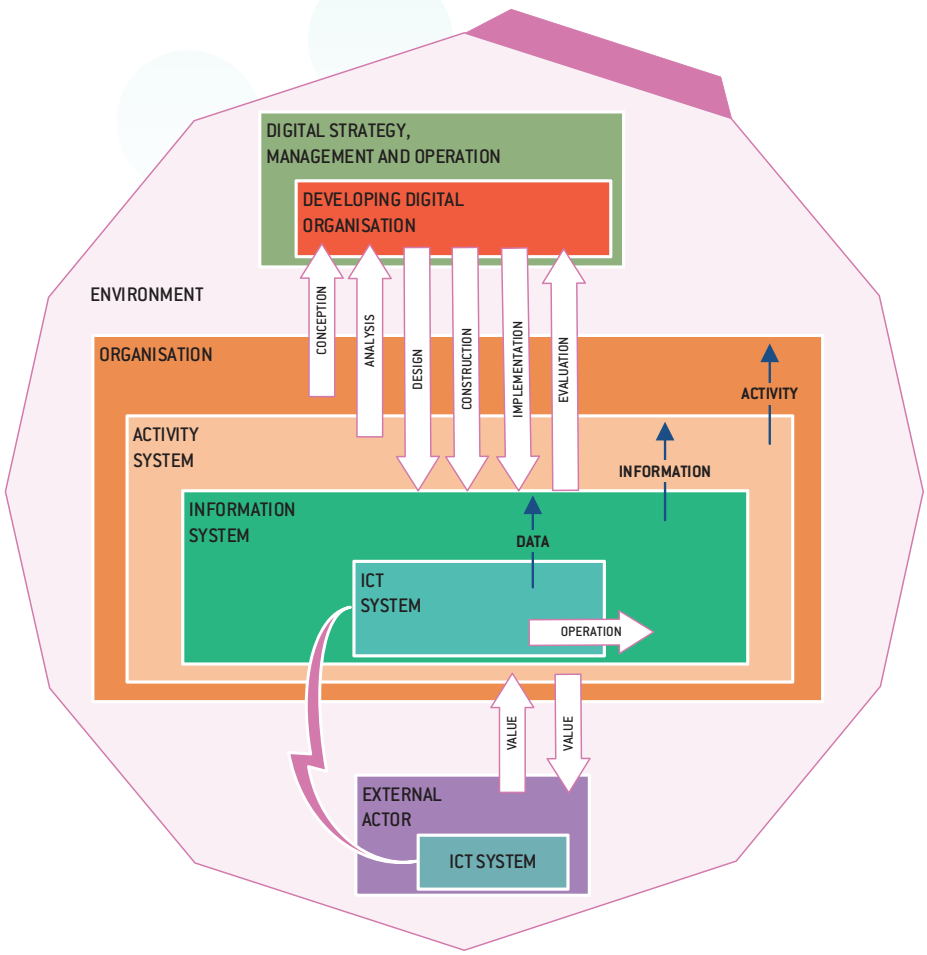


1 INTRODUCTION: THE DOMAIN OF BUSINESS INFORMATION SYSTEMS

'When I use a word', Humpty-Dumpty said in a scornful tone, 'it means what I choose it to mean – neither more or less'.
– Lewis Carroll (1832–1898) *Through the Looking Glass* (1871)

CHAPTER OUTLINE

1.1 Why study business information systems?
1.2 The domain model
1.3 Data
1.4 Information
1.5 Infrastructure
1.6 ICT infrastructure
1.7 The digital environment
1.8 Digital business
1.9 Social media
1.10 Mobile commerce
1.11 Designing digital organisation
1.12 Digital innovation and digital strategy
1.13 Conclusion



1.1 WHY STUDY BUSINESS INFORMATION SYSTEMS?

You the reader will be engaging with the topic area of this book, probably every waking hour of your life. You may be using your mobile phone to text, message or email friends, or to access your page on a social networking site. You might use your personal computer at home to order goods online, pay your taxes to government as a banking transaction or apply for a job using a company website. You might use your interactive digital television to download and watch a movie. You might use your tablet or eBook reader on the train to read the latest crime thriller or perhaps even a textbook.

Information and communication technology (ICT) is constantly present as it underpins so many aspects of our modern daily life. But you probably have never pondered on the way in which such technologies work or how such technologies support the activities we pursue. Why should you? The very presence and contribution of ICT frequently only comes to attention when there is a breakdown in its appropriate use or a malfunction in the technology itself.

So when you find that you cannot access the Internet because your broadband connection has failed, you are likely to feel frustrated. When your personal details have been accessed on your social networking profile by a potential employer, you might feel somewhat uncomfortable. When you are sent targeted emails by companies who have analysed your web surfing activities, you might feel somewhat aggrieved. When someone steals your online identity to pilfer funds from your bank account, you might feel very angry. When you cannot do any work because the central ICT systems are down, you might feel helpless.

So it may be that, when things are running smoothly, ICT is effectively 'invisible' to all but ICT professionals. But to achieve such smooth running, organisations must anticipate future needs, plan and implement the relevant developments and continuously seek to protect their employees and customers. And to do this, they need people able to understand and reconcile the needs of the market and the organisation with the ever-evolving capability of ICT.

1.1.1 The infrastructure of contemporary society, economy and polity

In this book we consider the interaction of ICT, information systems and information with organisational activity of all forms – within the private sector, within the public sector and even within the voluntary sector. These three things together form critical infrastructure for all forms of modern organisation – not only in terms of the internal operations of the organisation but more widely in terms of the interaction between an organisation and its customers, suppliers, regulators and partners. The modern business organisation needs to store data, for example, about its customers, orders, sales, stock and inventory. It needs this data to be integrated, and it needs it to be accurate and up to date. As a result, the management of data and the information it communicates is critical to business success. Therefore, an understanding of this area is important to both current and aspiring business professionals of all forms – from the shop-floor worker to the modern executive.

But an understanding of this area is also important for ourselves as individuals who live and work in the digital age. As individuals, an increasing proportion of both our working life and our leisure activity is conducted through interaction with ICT. Indeed, it is increasingly true that our very existence as workers, citizens and even family members is dependent upon our access to ICT and the consequent skills required to use it. For example, much of our personal identity is now bundled up in the large range of authentication tokens that we need to gain access to organisational ICT systems – passports, driving licences, credit cards, debit cards, library cards, employee identity

cards and so on. ICT has also caused changes to the way in which we work. A substantial proportion of individuals now work from home or on the move, using ICT to keep in contact with an organisational hub wherever they are. But our life as consumers is also reliant upon ICT infrastructure. Increasingly, shopping for goods and services is done online rather than offline, causing subtle changes to the ways in which retail organisations adapt to such changes in consumption practices.

ICT forms critical infrastructure for modern organisations and individuals; as a technology it is converging around common standards, and this is leading to increased integration and interoperability of electronic devices and systems. For example, we can now access pretty much the same material from our smartphone or tablet computer as we can from our Internet-enabled personal computer. However, many people are worried that this type of convergence could enable governments (or other groups) to take greater control over people; and about the dangers if personal data falls into the wrong hands. In many countries there is continuous debate and negotiation over what data the government or other bodies should be allowed to collect about individuals, what purposes the information these data communicate can be used for, and how the integrity of these data can be protected.

1.1.2 How business information systems relates to other academic disciplines

The term 'information systems' is used in a number of different ways. It can refer to:

- A **product**: a system of communication between members of a group of people. (These days many communication systems involve technology, although there are ways of communicating without technology too, of course, and have been for thousands of years. But an information system as a product really refers to a technological information system.) For example, an orders and sales processing system is an information system, used to communicate between members of the selling organisation, and between them and their customers.
- An **academic field of study**. Some of the first courses in information systems were run in Stockholm in the 1960s. Over the last three decades the field of information systems has become established in many centres of higher education around the world, in both teaching and research.
- An **area of industrial practice**. Many organisations across the world work in planning, managing and developing information systems for other organisations. Some of the largest and best-known business consultancies do a lot of their work in this field. Organisations in other fields, which originally developed their expertise in setting up their own systems, also sell their know-how to others.

Since information systems are essential in so many ways for modern organisations and individuals, this area is very interdisciplinary in nature. Business information systems can be regarded as being made up of five interdependent areas of interest, as shown in Figure 1.1.

- **Environment**. To understand the value of information systems to organisations we need to understand the economic, social, political and physical environment within which the organisations using them operate.
- **Organisations**. One of the main focuses of the book is on how modern information systems contribute to organisational performance: supporting traditional organisational forms and leading to new ones being introduced.
- **Management**. The promise of the technology is only achieved when managers find effective ways of managing information, information systems and ICT in their organisations.

- **Technology**. Of course, those studying this field need to know something about the technology involved. This includes both the use of technology and the principles that underlie it.
- **Design**. This concerns appropriate ways of analysing, designing and constructing information systems that support human activity.

This way of dividing the subject area enables us to consider more clearly how business information systems overlaps with five other established disciplines. These are known as reference disciplines (Keen, 1980) in Figure 1.1, since they provide us with major frames of academic reference.

- **Economics**, **politics** and **sociology** overlap with the subject through its emphasis on context, particularly the social and economic effects of information systems and ICT.
- **Organisational theory** (and particularly **organisational behaviour**) overlaps with the subject through its emphasis on organisational issues.
- **Management science** and **operations management** overlap with the subject through its interest in appropriate management.
- **Computer science** overlaps with the subject because of the need for knowledge about the workings of contemporary ICT.
- **Software engineering** overlaps with the subject through its interest in the process of analysing, designing and constructing information systems.

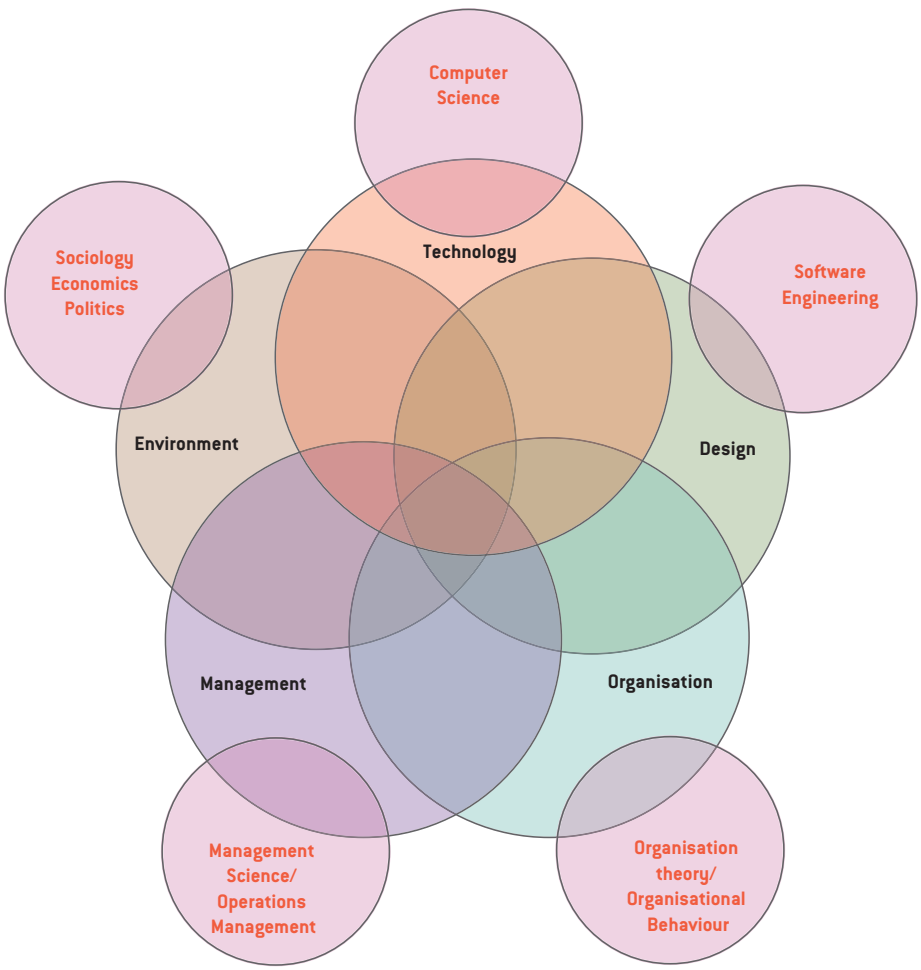


Figure 1.1 Reference disciplines

Within the area of business and management itself, the concepts of information and system are both integral and integrating. This means that information systems are critical to understanding contemporary operational practices in marketing, sales, customer relations, production, finance, human resources, procurement and distribution. An understanding of information, information systems and ICT is particularly important to management practice in these areas, so there is a strong argument for placing an understanding of this area at the heart of operating and managing the modern business.

1.1.3 How this book will help

To summarise, information systems are critical to the modern world: in business, in other sectors, and to individuals as well. It is important to appreciate their importance and to understand their founding principles. This book shows you how to use best practice to ensure that you and your organisation get the most value out of your ICT investment, now and in the future.

The focus here is on the application of information systems in organisations, and because this is so intimately tied up with other aspects of organisational management, we look at some of those as well. We introduce a number of key skills that are important not only for information systems professionals, but also for general business management. These are intended to provide an appreciation of important approaches and techniques in the area.

Models are useful, to help us understand what is going on, and plan how to change it. A consistent set of modelling techniques are used throughout the book. Together, they provide a good grounding in the applications of modelling, especially for the analysis and design of many kinds of business systems.

Overall, this book should enable you to develop an understanding and practical appreciation of information systems. It will serve you well, both in the study of related disciplines and in your working career.

1.2 THE DOMAIN MODEL

The field we are considering is very much a systemic discipline. It is interested not in ICT, information systems, information and organisations in isolation, but in their interaction. To make sense of systems of any kind it is useful to create models which illustrate the interactions of their components, interdependencies and their effects. This book is structured around a core model which captures the key elements of the field as well as the interaction between these elements. As a map of the entire area or domain, we refer to as the domain model.

Our model is founded on the premise that the effects of an information system for an organisation emerge over time, as the result of interaction of the system and its organisational context. We need to understand these effects in order to design and run systems that provide benefits for the organisation, and avoid the hazards that information systems are sometimes prone to.

The domain model illustrated in Figure 1.2 forms the basic structure for the book. Each of the component elements contained in the model is covered in much more detail in further chapters within the book. So you might not understand all the concepts introduced here right away, but you can explore them throughout the book, and follow links to further chapters at any time if you want to delve into one facet of the model. This chapter not only introduces the domain model, it acts as a summary and reference for it.

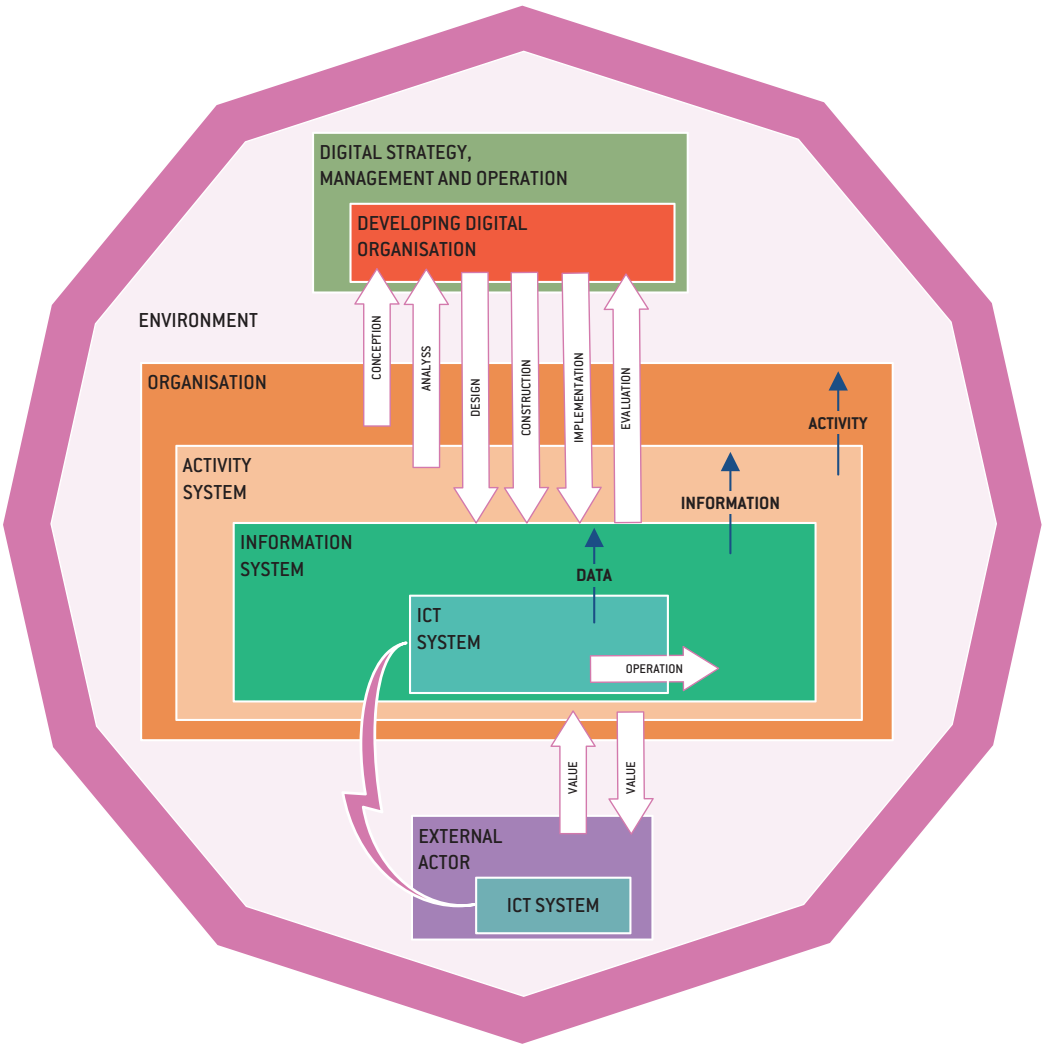


Figure 1.2 The domain model

The model begins with the key context for the application of information systems: the organisation itself. Within this book we need to provide you with a different way of thinking about what organisation is to understand why ICT is so important to organisation. Any organisation is considered as a series of interdependent activity systems (see Figure 1.3). Hence we nest the activity system box within the box labelled *organisation* on the domain model. When activity systems are combined in action within some organisation they produce value of some form. Value is the key flow between an organisation and actors in its environment. Hence we express value as a broad arrow on the domain model flowing from the organisation to an external actor or from an external actor to the organisation.

The value produced by a business organisation is typically the products (goods) or services it provides for its customers. So customers are key actors in the environment of the business organisation. The organisation also receives value from other actors in its environment, such as its suppliers or partners. Hence a business organisation is a value-creating system which interacts with a wider value network that makes up its environment.

A system is a coherent set of interdependent components that exists for some purpose, has some stability and can usefully be viewed as a whole. We are particularly interested in what are generally referred to as open systems. These are systems that

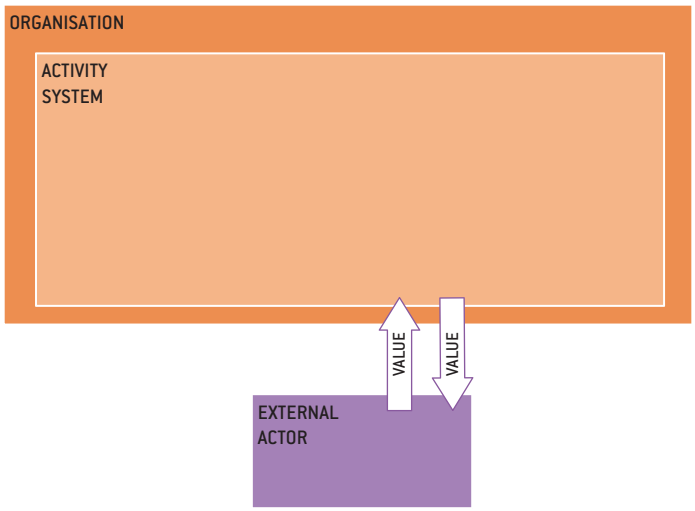


Figure 1.3 Organisation, activity systems and environment

interact with their environment through inputs and outputs. By the environment of a system we mean anything outside the system that has an effect on the way the system operates. We usually identify a number of actors with which the system interacts, to help define this environment. The inputs to the system are the resources it acquires from actors in its environment. The outputs from the system are those things that it supplies back to actors in its environment.

1.2.1 Goronwy Galvanising as a value-creating system

CASE

Consider a manufacturing organisation, Goronwy Galvanising, which specialises in galvanising steel products such as lintels, crash barriers and palisades. As a value-creating system we might consider Goronwy Galvanising in the following way and as illustrated in Figure 1.4. The central system of activity undertaken by this organisation is galvanisation, which involves dipping steel products in large baths of molten zinc, to provide a rustproof coating. The main actors in Goronwy's environment are its suppliers and customers. Goronwy uses large amounts of zinc as its raw material and which it receives from its owning company, Rito Metals. The company also receives ungalvanised material from its customers and refers to this as 'black' material. Both zinc and 'black' material are inputs into this system. The key value created by this organisation is galvanised product which is referred to as 'white' material and constitutes the key output from this system. Along with the flow of value through this system there is a corresponding flow of data. As we shall see, a delivery advice note identifies and describes incoming 'black' material, while a dispatch advice note identifies and describes outgoing 'white' material.

A key advantage of thinking of organisation in systems terms is that we can unpack organisation at various levels of abstraction. In other words, we can open up the box on Figure 1.4 and peer within. Any system of organisation is established to achieve one or more goals, which is typically to produce value of some form. For commercial organisations that value becomes concrete when they sell their products or services and make a profit. We can also think of the organisation as part of a value network, in which there are flows of value between the organisation and the actors in its environment (its customers and suppliers). So, as well as creating value itself, Goronwy adds value to the outputs of other actors in its value network. Steel producers, steel fabricators and zinc producers are all part of Goronwy's value network.

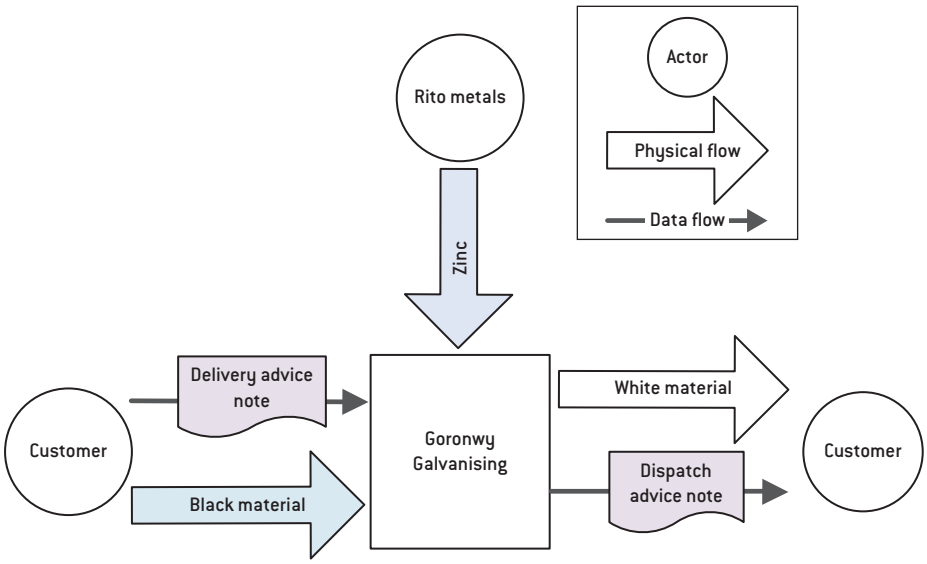


Figure 1.4 Goronwy Galvanising as a value-creating system

1.2.2 The activity system at Goronwy

CASE

Numerous organisational actors undertaking coordinated activity transform value in various ways. We use the term 'actor' to refer to anything that can act (both people and machines) – that can transform something. Each system of coordinated action performed by actors we refer to as an activity system. An activity system is a social system, sometimes referred to as a 'soft' system. It consists of a collection of activities, processes or tasks performed by a group of people in pursuit of a goal. The precedence or order of activities is normally critical, as this determines the flow necessary for the coordination of work.

To achieve the goal of creating value, people and machines must continually perform a series of activities at certain times and in certain places, as illustrated in Figure 1.5. Various visualisations such as this are used throughout the book to unpack the key systems of interest to us. Each box or cell is used to represent one or more actions enacted by one or more actors. The dotted arrows indicate the sequence of action within the pattern or system under consideration. In Figure 1.5 the dotted arrows indicate the coordination (the workflow), which activities take place before certain other activities, and which take place after certain activities. The open circles with dotted arrows emerging from them indicate the start of some pattern of action while the open circles with arrows ending on them indicate the end of some pattern of action.

The 'black' material – steel fabricated products of various forms – is delivered to Goronwy on large trailers in bundles referred to as batches. It is unpacked by an inbound logistics operative and checked for discrepancies or problems that would make it unsuitable for galvanising. Such unsuitable material is referred to within the company as non-conforming black material and this is returned to the customer. If satisfactory, the products are referred to as conforming black material and this material is transported to the galvanising plant where it is hung on racks and then dipped into large baths of zinc. The racks are removed from the baths after a few minutes of treatment and then left to dry. An hour or so later the white material is checked and unsatisfactory (non-conforming) white material is sent to be regalvanised. Satisfactory (conforming) white material is then bundled back into batches, loaded onto trailers and eventually dispatched back to the customer.

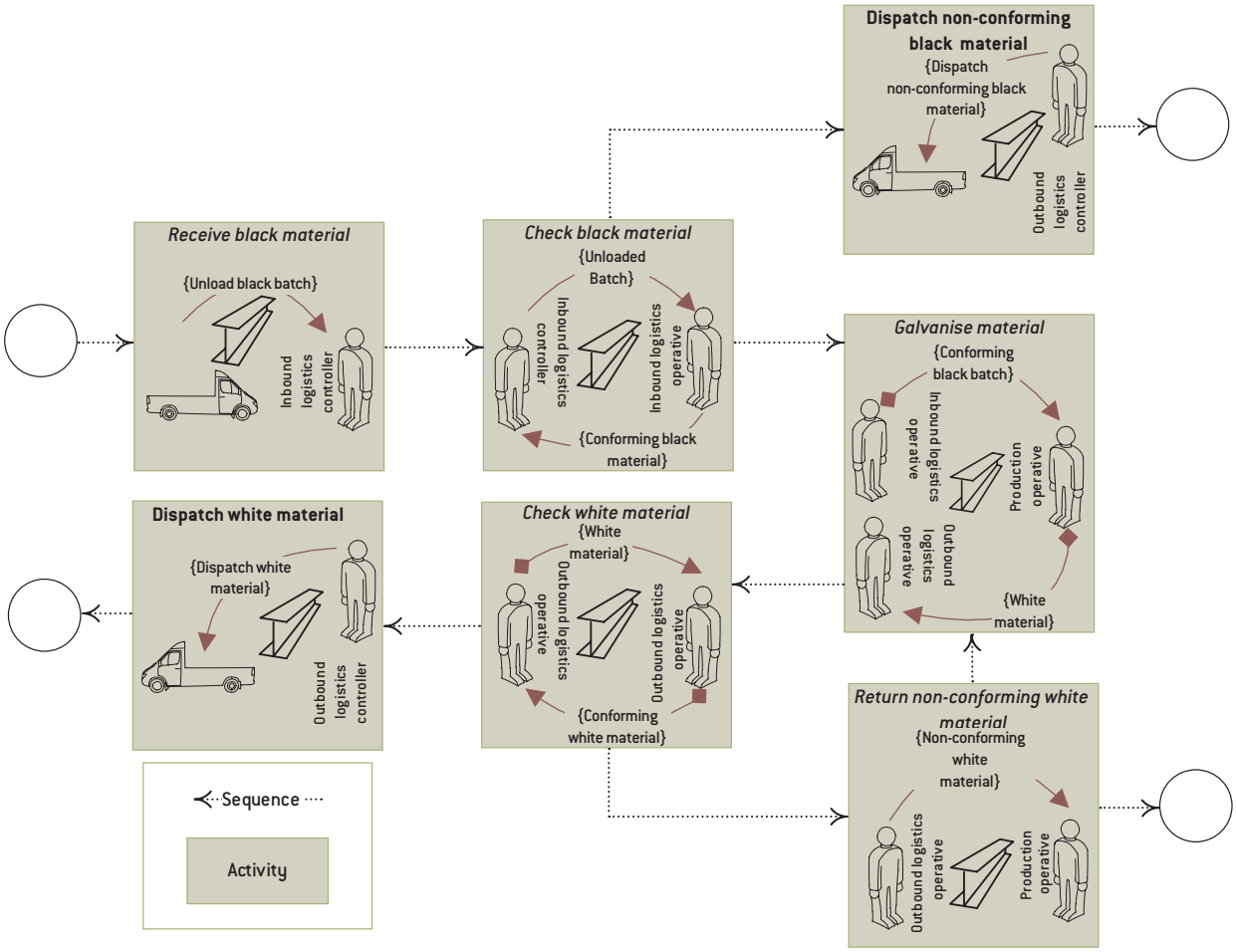


Figure 1.5 A visualisation of the activity system at Goronwy

CASE
continued…

In essence, any system or pattern of activity relates to the fundamental question of: What does an organisation such as Goronwy do? The response to such a question normally indicates the central activity of the organisation: in this case galvanisation. But galvanisation relies on one set of activities that handle raw material from the customer; and yet another set of activities that transport galvanised products back to the customer. Hence it is possible to think of the activities of Goronwy related by precedence. In other words, to perform one activity another activity needs to be performed first, and the performance of such activity will normally be a prerequisite for some other activity, and so on.

1.3 DATA

We want you to realise the important difference between data and information, and the consequences this distinction makes to understanding the benefits of the digital to organisation. To help coordinate activity, people and machines must communicate through the accomplishment of information. Communication occurs through data structures acting as messages or as records. These data structures are created,

updated, deleted and read within the data systems of organisations. Such data structures are then made sense of as information by people and machines within the information systems of organisation. Information as instrumental communication is very important to decision-making. It helps actors make decisions as to what activity to undertake next, and through this, serves to control the activity of some organisation.

1.3.1 Data structures at Goronwy

CASE

The data needed by people working within Goronwy originally consisted of three paper documents (see Figure 1.6) – a delivery advice, a job sheet and a dispatch advice. Each of these documents consist of a data structure – a structure for data.

The delivery advice details what batches have been delivered on a given truck to Goronwy. A trailer arriving from a customer might be loaded with several different types of steel product. These were divided into batches, and each batch was labelled with a unique order number. Each trailer was given a delivery advice note detailing all the associated batches on it.

A job sheet was produced for each unloaded batch to detail the conforming (for galvanising) and non-conforming (for return to the customer) material. On arrival at the galvanising plant the black material was unpacked by an inbound logistics operative and checked for discrepancies with the information on the delivery advice note. There are two major types of discrepancy: a count discrepancy, between the number of items delivered and the number indicated on the delivery advice note; a non-conforming black discrepancy arises when some of the material is unsuitable for galvanising. For instance, a steel lintel might be bent or the material might be of the wrong type. The operative would note both kinds, by making a comment in the appropriate box on the delivery advice note. When all the material had been checked, the delivery advice note was passed on to the production controller who, with the office clerk, copied by hand all the details on the delivery advice note, including any discrepancies, to a job sheet. A separate job sheet was filled in for each order line on the delivery advice note. The job sheet was passed down to the shop floor of the factory, where the shift foreman used it to record details of processing. Most jobs passed through the galvanising process smoothly. The steel items were placed on racks, dipped in the zinc bath and left to cool. The site foreman then checked each job. If all items had been galvanised properly, he put a Y for yes in the box on the job sheet and passed it back to the production controller. Occasionally, some of the items were not galvanised properly. They were classed as non-conforming white, and also noted on the job sheet (and typically scheduled for regalvanising).

A dispatch advice details the galvanised batches to be returned to customers. When the shop floor had treated a series of jobs, the production controller issued a dispatch advice note and sent it to the outbound logistics section. Workers in this section used it to stack the white material on trailers – one trailer to a dispatch advice note – ready to be returned to the manufacturer.

1.3.2 The data system at Goronwy

CASE

This description details a series of actions taken within the data system of Goronwy and as illustrated in Figure 1.7. Delivery notes, dispatch notes and job sheets are all data structures articulated by key actors within the data system at Goronwy. An ICT system is an instance of a data system. ICT consists of hardware (such as computers and display

Blackwalls steel products **Delivery advice**

Advice No.	Date	Customer name	Instructions
A 3137	20/01/1988	Goronwy Galvanising	Galvanise and return

Order No.	Description	Product code	Item length	Delivery Qty	Weight (Tonnes)
13/1193G	Lintels	UL 150	1500	20	145
44/2404G	Lintels	UL 1500	15000	20	1450
70/2517P	Lintels	UL 135	1350	20	130
23/2474P	Lintels	UL 120	1200	16	80

Haulier	Received in good order
International 5	√

Goronwy Galvanising **Dispatch advice**

Advice No.	Date	Customer name
101	22/01/1988	Blackwalls

Order No.	Description	Product code	Item length	Order Qty	Batch weight	Returned Qty	Returned weight
13/1193G	Lintels	UL 150	1500	20	145	20	150
44/2404G	Lintels	UL 1500	15000	20	1450	20	1460
70/2517P	Lintels	UL 135	1350	20	130	20	135
23/2474P	Lintels	UL 120	1200	16	80	14	82

Driver	Received by

Job sheet

Job No:	2046

Order no.	Description	Product code	Item Length	Order Qty	Batch weight
13/1193G	Lintels	L150	1500	200	145

Count discrepancy	Non-conforming black	Non-conforming white	Non-conforming no change

Galvanised	Dispatch no.	Dispatch date	Qty returned	Weight returned
Y				

Figure 1.6 Data structures at Goronwy

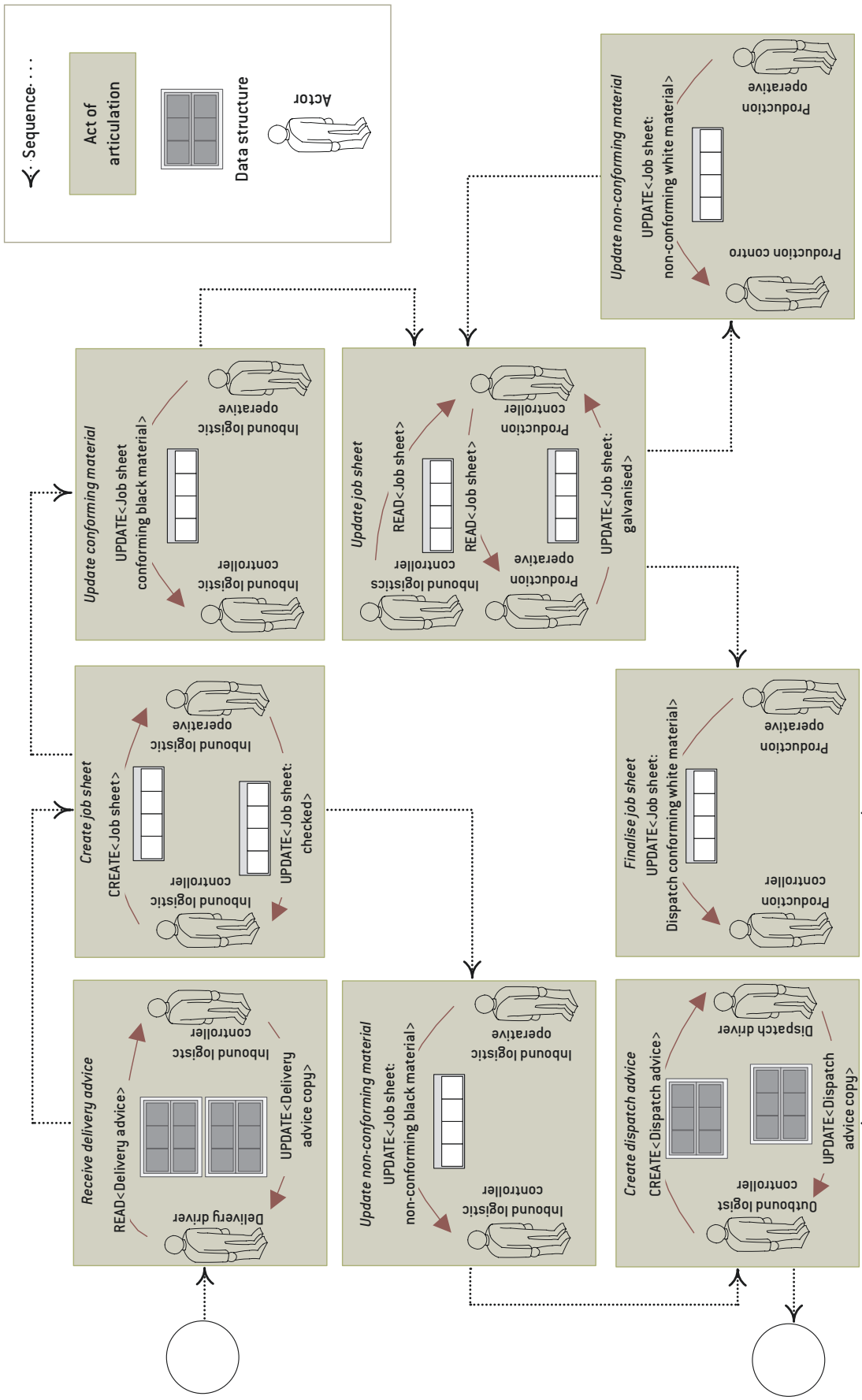


Figure 1.7 A visualisation of the data system at Goronwy

CASE
continued . . .

screens), software (such as operating systems and office products), data (such as databases) and communication technology (such as wireless networks) used to automate either the whole or part of some data system. Originally, the data system at Goronwy was paper-based, meaning that data structures were manipulated as physical pieces of paper. Eventually, Goronwy decided to automate this data system by applying ICT.

1.4 INFORMATION

Data is a plural term, whereas a datum is a unit of data. To form a datum we make certain differences in some substance and use such differences to code symbols. Symbols are of course things used to represent something else. Symbols are formed into larger entities as data structures and such data structures may be transmitted as messages or may be stored in a persistent manner as records. The differences made upon some data structure inform people about significant things of interest to them. Information is thus the differences made to some actor by their engagement with some data structure(s). This accomplishment of information through data enables them to coordinate their joint activity.

A delivery advice is a data structure important to Goronwy Galvanising. Marks made on the substance of paper constituted the differences used to code symbols such as UL150. When the ICT system was built for this company such differences were encoded as symbols onto magnetic disk. These symbols in combination are a component element of the larger data structure which comprises the delivery advice. The symbols on this data structure record important things of interest to the staff of Goronwy. When particular actors engage with the data structure of a delivery advice they are informed of things such as what material is being delivered to the company. This information enables them to make effective decisions about galvanisation activity.

1.4.1 Acts of communication

Information is accomplished in acts of communication – communicative acts. Communication is an act of sending and receiving a message. Any message has both content and intent. The content of a message refers to and describes the common things of interest between sender and receiver. The intent of a message establishes its purpose.

The messages within communicative acts tend to be sent with one of five intentions and such intentions are important to the coordination of activity. *Assertives* are communicative acts that explain how things are in a particular domain of organisation, such as reports of business activity. In the case of Goronwy, an inbound logistics operative might make an assertion to the plant manager that [*15% of all the black material we received over the last year was non-conforming*]. *Directives* are communicative acts that represent the senders' attempt to get the receiver of a message to perform or take an action, such as requests, questions, commands and advice. In the case of Goronwy, the plant manager might request of his production controller, [*Please ensure that all conforming black material is galvanised on its day of delivery*]. *Commissives* are communicative acts that commit a sender to some future course of action such as promises, oaths and threats. In the case of Goronwy, the manager might make the following commitment to its major customer, Blackwalls: [*We promise to turn around all products within a three-day period*]. *Expressives* are communicative acts that represent

the speakers' psychological state, feelings or emotions towards some aspect of the domain of organisation, such as apologies, criticisms and congratulations. In the case of Goronwy, the production controller might comment to his workers, [*I am pleased with our production over the last quarter*]. Finally, *declaratives* are communicative acts that aim to change some aspect of a domain through the communication itself. Within business settings declaratives are frequently used to represent that some state of performance has been achieved such as in the case of Goronwy, [*That batch Z has been galvanised*] or [*That batch Y has been dispatched back to customer X*].

1.4.2 The information system at Goronwy

CASE

Such acts of communication occur not in isolation but in patterns. Patterns of communication support patterns of coordinated activity. As such, an information system is a system of formal communication between people. Information systems are established and formalised systems of communication within organisations designed to get things done. Information systems support activity systems in the sense that the accomplishment of information is important for decision-making, and in turn for the coordination of activity to meet established goals. The information system important to the case of Goronwy Galvanising is visualised in Figure 1.8.

1.5 INFRASTRUCTURE

As we shall see, it is useful to think of organisation not as one system but as consisting of an infrastructure of systems. We can also think of vertical as well as horizontal infrastructure. Vertically, and as illustrated in Figure 1.9, we can think of systems of activity reliant upon systems of communication (information), which in turn are reliant upon systems of articulation (data). These three layers of infrastructure are critical to any organisation whether it be private sector, public sector or voluntary sector. Activity systems are supported by information systems which in turn are supported by data systems or ICT systems.

But usually in any reasonably sized organisation there are lots of different things going on which have to be in some way integrated together. This means that horizontally, and as illustrated in Figure 1.10, we can think of organisation as sets of interrelated activity systems, information systems and data (ICT) systems.

This idea of infrastructure allows us to understand why change to any domain of organisation cannot just involve changes to activity. Any change to a particular part of infrastructure is likely to impact upon other elements of infrastructure, both vertically and horizontally. This allows us to understand more clearly how change through ICT is not always as easy as it seems, and why changing what you do or communicate about inherently demands change to ICT.

1.5.1 Infrastructure at Goronwy

CASE

The three levels of activity, information and data make up the systems or patterns of action that constitute Goronwy as an organisation. Within Goronwy, people articulate data structures, primarily through the interface of a specially designed (bespoke) ICT system. The articulation communicates what has happened, what is happening and what should happen to important actors. The communication allows actors to make decisions as to what action to take next.

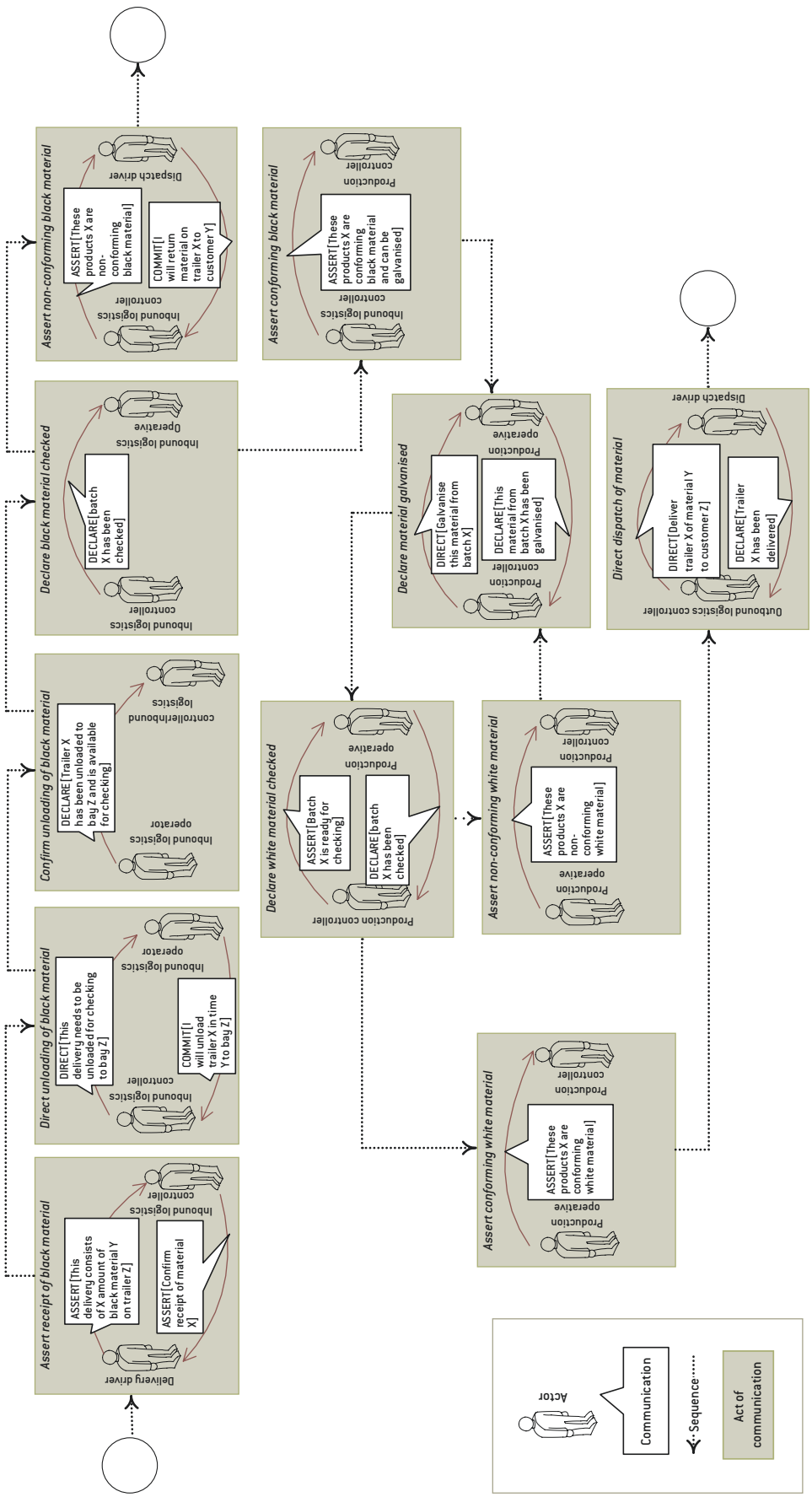


Figure 1.8 A visualisation of the information system at Goronwy

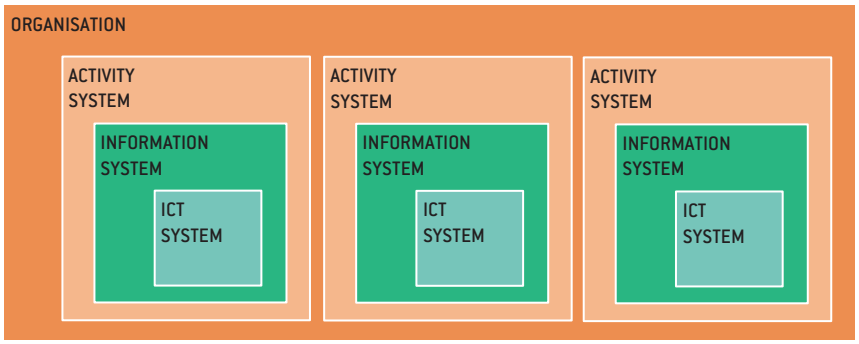


Figure 1.9 The vertical infrastructure of organisation

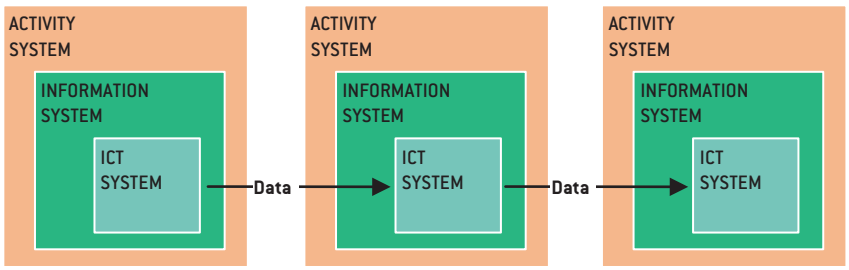


Figure 1.10 The horizontal infrastructure of organisation

CASE
continued…

In Figure 1.11, an electronic dispatch advice is created by a production clerk. This is a data structure. Data represented on this structure not only identifies and refers to things, it also informs somebody as to what to do next. The information communicated causes somebody to take action, namely, to load a particular truck with particular product.

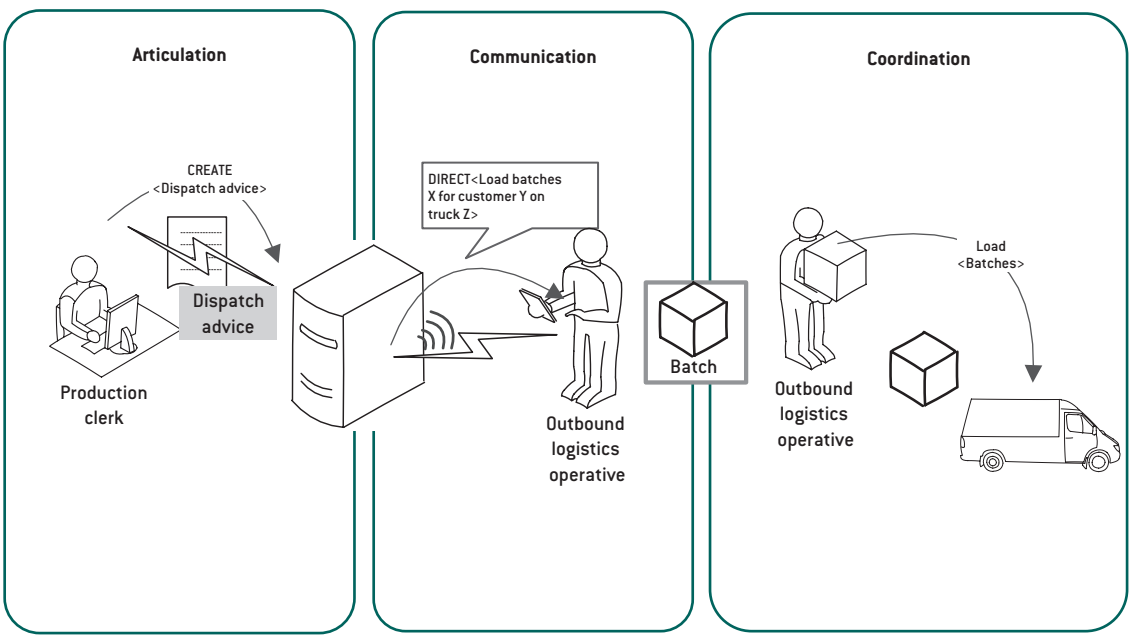


Figure 1.11 Articulation, communication and coordination

CASE
continued…

Activity systems are systems of coordination. They rely upon systems of communication – information systems. In turn, an information system relies upon a system for the articulation of data structures – a data system. Delivery notes, dispatch notes and job sheets are all data structures articulated by key actors within the data system at Goronwy. Such data structures communicate important things of interest to them and they use them to become sufficiently informed to make decisions: in Goronwy's case, for example, what material to galvanise. The actors then act on the basis of their decisions. If the data is incorrect, the wrong information is communicated and the wrong decisions will be made, causing activity to underperform.

1.5.2 Information systems infrastructure

Every organisation's information systems are necessarily different, but there are similarities, especially across organisations in the same business sector. So it is possible to develop generic descriptions or models of both back-end and front-end information systems infrastructure.

Key business back-end information systems include sales order processing, purchase order processing, inventory management, finance and payroll. The sales order processing information system records details of customer orders and supports activity systems such as sales and aftersales service. The inventory management information system maintains an inventory of raw material and finished goods. It is important for providing sales staff with accurate information on quantities and pricing of products. It also supports procurement activity. The purchase order processing information system records details of purchase orders and supports the procurement process. The financial information system records amounts owed by and to, and paid by and to, customers, suppliers and employees. It supports other infrastructure activities such as management and planning. The payroll information system records details of wages and payments made to employees and is a critical element of human resource management activity.

Front-end information systems interface directly with major internal and external actors: managers, employees, suppliers and customers. Management-facing information systems are built on the foundation of back-end information systems. Management information systems are used by operational management to monitor the state of the organisation. Decision support systems and executive information systems generally support longer-term, strategic and tactical decision-making. Typical customer-facing information systems include sales, customer relationship management, marketing and outbound logistics. Typical supplier-facing information systems include procurement, inbound logistics and supplier-relationship management systems. Typical employee-facing information systems include human resource management and production control systems.

1.6 ICT SYSTEMS INFRASTRUCTURE

As the Goronwy example has shown, information systems do not need to use modern ICT. But modern ICT makes systems work better and faster, and in today's complex global world, most information systems use it to at least some degree. We can see why by looking at some of the problems with the system Goronwy used in the 1980s:

- Data structures need to be shared among a number of people: for Goronwy, they include inbound logistics operatives, production controllers, shift foremen and

outbound logistics operatives. So copies of data are needed, and making manual copies is slow and therefore expensive.

- A lot of time was taken transferring data from one data structure to another: for instance, from delivery advice notes to job sheets.
- Every transfer stage is an opportunity for human error to creep in, and this can lead directly to data processing errors, which are costly and time-consuming to correct.
- It is difficult to analyse data held manually. Even if it works well for production purposes, it does not provide a good resource for managers who want to collate and analyse it to determine trends such as the throughput of the plant or the productivity of the workforce.

As a result, Goronwy and its parent company looked at moving to an ICT-based system for basic administrative functions. Let's consider what this means in practice.

We can think of an ICT system as consisting of three interdependent subsystems or layers – a data management layer, a business layer and an interface layer. Each of these layers of technology interacts to enable a data system that can be used to integrate and distribute data structures among multiple actors, working in different places, often at different times.

1.6.1 The data management layer

Since ICT systems are essentially systems for data articulation, they rely on a core repository: somewhere to keep the data used in the system. This repository is normally referred to as a database and is controlled by the data management layer of an ICT system. The design for the structure of the database at the heart of the ICT system is referred to as a data model. Essentially, this data model defines what data is stored within the system and in what form. For Goronwy, the structure of data might be defined as in Figure 1.12.

This model acts as a design shorthand for specifying data structures in this database, such as 'Customers' and 'Dispatches'. Each data structure is a collection of data elements, and each data element consists of a set of data items. A sample of the data that might be entered into 'Order lines' is shown in Figure 1.13. In this example, Order No and Delivery No are examples of data items. Each row of the table represents a data element. Each data element is identified by a key data item: in this example, the key is the value associated with an Order No, and such keys are underlined in the data structure definitions above.

Data systems are effectively systems for articulating data structures. Many, if not most ICT systems, are examples of data systems, reliant upon computing and communications technology. So ICT is effectively a way of throwing technology at

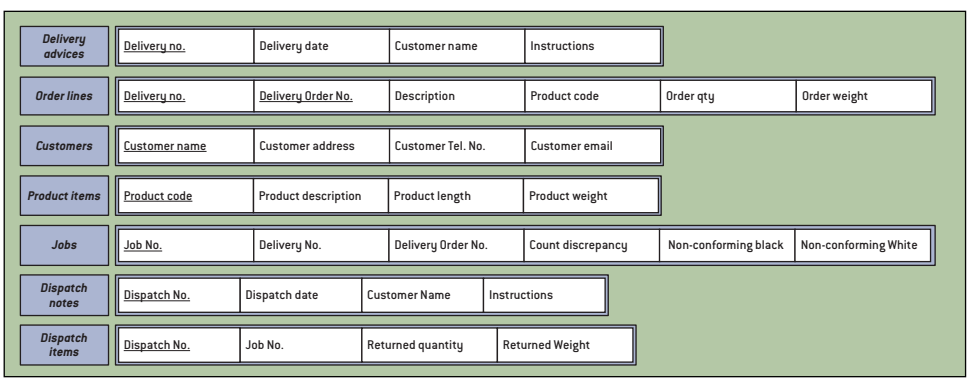


Figure 1.12 A model of the data management layer at Goronwy

Data structure

Order No.	Delivery No.	Product code	Order Qty	Order Weight
13/1193G	A3137	UL150	20	145
44/2404G	A3137	UL1500	20	1450
70/2517P	A3137	UL135	20	130
23/2474P	A3137	UL120	16	80

Data element

Data item

Figure 1.13 A table as a data structure

articulating data. The Goronwy ICT system allows data to be created quickly and distributed efficiently and effectively to many different people across the manufacturing plant. But ICT systems also interrelate horizontally within ICT infrastructure. Integration of data across the organisation is one key benefit of applying ICT. ICT infrastructure is critical to modern communication within organisations, but when it goes wrong things seriously happen within organisations.

1.6.2 Business layer

The business layer of a typical business ICT system consists of three interrelated elements: transactions, business rules and update functions.

A transaction changes a data structure from one state to another. There are four major types of transaction activities associated with a database, collectively referred to as CRUD:

- Create transactions create new data elements within the data structures of a database. For example, in Goronwy's new ICT system, a 'create' transaction might be used to enter a new order line against a designated delivery advice.
- Retrieval (or Read) transactions access data contained within the data structures of a database and are often called query transactions. In Goronwy's new ICT system a 'read' transaction might be used to assemble a list of the order lines appropriate to a particular delivery advice.
- Update transactions cause changes to values held within particular data items of data elements in a database. In Goronwy's new ICT system an 'update' transaction might be used to change the value Order Weight associated with a particular order line.
- Delete transactions erase particular data elements. In Goronwy's new ICT system, a 'delete' transaction might be used to remove a particular order line from the database.

A considerable amount of the functionality of an ICT system is taken up with business rules. These are found in both the business layer and the data management layer. They ensure that the data held in the data management layer remains an accurate reflection of the activity system it represents. In other words, the data held in an ICT system should display integrity; it should accurately reflect the state of its activity system. For instance, in the case of Goronwy, the data stored in the data structure *Jobs* should accurately represent batches of material that either have been successfully processed by the company in the past or are in the process of undergoing galvanisation. Likewise, in

a university, the data structure of a student record should store data about either existing students at the university or past students of the university.

Update functions represent units of functionality associated with an ICT system. They include both business rules and transaction types. Update functions are triggered by events, which are typically activated from the interface or from other update functions. When an update function is activated, transactions are fired at the data management layer of the ICT system and cause changes to the database.

Hence, in an ICT system at a university, a typical create function might be *create student* or *enrol student on module*. Alternatively, in the case of the Goronwy ICT system we might have a create function named *create order line*. When activated, this function would first check that a dispatch advice existed for the order line. Then it would check to see that the order line had not already been entered and that the data to be entered was in the correct format: for instance, that the order number is unique and a correct product code had been entered. If all these checks within business rules proved satisfactory, a transaction would be formed which would create a new row within the order lines table.

1.6.3 Interface layer

The interface layer is responsible for managing interaction with the human user, and is generally referred to as the user interface, or sometimes as the human-computer interface. ICT systems are significant actors within modern organisations and as such must be communicated with. Such communication is normally defined in terms of some interface or series of interfaces. Such a user interface defines how human actors can interact with and control the ICT system. It also includes the ways in which the ICT system communicates with humans.

In this sense, the user interface can be seen as a collection of dialogues: each dialogue being made up of a series of acts of communication between the human user and the ICT system. Business actors use the interface to input data into the system and to receive data output from the system. Decisions are made on the basis of information interpreted from the data supplied and action is taken within the encompassing activity system.

1.7 THE DIGITAL ENVIRONMENT

It is more than likely that the person reading this book is a *digital native*, meaning that you have not known of a time when ICT was not around. You have grown up with ICT and as such are likely to treat it as an accepted and mundane background to your everyday life. But this acceptance of the embeddedness of ICT comes at a cost – the basis of ICT as designed artefacts or designed infrastructure goes relatively unquestioned. Also, some of the changes being enacted in the economies, societies and polities of nation-states through digital infrastructure seem inevitable, rather than the result of choices made by both the producers and consumers of ICT.

The application of ICT is so embedded in modern life that it becomes appropriate to think of the digital society, digital economy and even the digital polity. It is becoming increasingly difficult to act as an individual in modern society without access to digital infrastructure. Increasingly, your activity as an economic actor is driven through ICT. Economic exchange worldwide relies upon ICT infrastructure. Organisations of all forms are increasingly dependent upon their ICT to produce value. What it means to be a citizen of a modern nation-state is increasingly reliant upon ICT infrastructure. As a citizen you are increasingly reliant upon ICT to pay your taxes, claim benefits and

gain advice on your rights. The way in which politics is conducted and policy enacted is increasingly reliant upon ICT infrastructure. Modern democracies owe much of their functioning to digital infrastructure.

1.7.1 Digital economy

The primary environment of any commercial organisation is the economy. Economies can be considered as systems for coordinating the production, distribution and consumption of value. Value is created. Value is passed from creator to user. Value is consumed in some way.

All economic activity relies upon the exchange of value. Somebody creates something of value to somebody else and exchanges this for something. But many aspects of economic exchange as an activity must be recorded, such as who is involved in the exchange, what is exchanged and how it is valued. So along with the flow of value between economic actors there is a corresponding flow of data.

1.7.2 Production and coordination costs

Any actor engaging with economic activity incurs two types of costs in any exchange: production costs and coordination costs. Production costs are the costs associated with creating, distributing and sometimes consuming some value. For instance, all the costs associated with galvanisation as a manufacturing process, as well as the costs of shipping finished material back to customers are production costs. Coordination costs are the costs associated with coordinating the action of multiple actors. Hence the costs associated with managing any exchange relationship are coordination costs. The costs Goronwy incurs in communicating with its customers and ensuring that products are processed as and when required are coordination costs. Goronwy will also incur such costs in managing its relationships of supply with Rito Metals. This distinction between production costs and coordination costs helps us understand why ICT is now so embedded within the global economic system. Because ICT can be used to help reduce coordination costs within economic markets, ICT can also help reduce certain production costs for certain types of value.

1.7.3 Value

Value traditionally comes in two forms, goods and services.

A good or product is some 'thing' created as the result of some activity. As such, goods are not dependent on any particular location or time for their existence. As outputs from some activity goods can be inspected, distributed and stored, hence the white material of Goronwy are classic goods. They are created by the production process of Goronwy and once created are independent of this production, meaning that they can be inspected and stored ready for eventual dispatch back to the customer.

A service is an activity performed by somebody or something on someone or something else. As an activity a service is time- and location-dependent – it takes place at some time and in some place. Likewise, as activities services cannot be distributed or stored: a medical operation is a classic service. It is conducted by some person or group of persons on some other person – a patient. As an activity it is always performed somewhere (typically within some operating theatre) and at some time (typically within some defined operating schedule).

1.7.4 Digital and non-digital value

The nature of value has been impacted by the increasing application of ICT in many areas. A useful distinction is between goods and services that either are or can be digital and those which are non-digital.

Certain goods and services are not amenable to digitisation, to being turned into data, and some are never likely to be so. Hence a steel galvanised product is a non-digital good and is likely to always remain so. Similarly, a medical operation is a physical or non-digital service that is never likely to be digitised.

In the case of activity systems which create non-digital goods or services ICT is primarily used to reduce coordination costs. It does this primarily by efficiently managing the flow of data necessary for the proper coordination of activity, such as transactions associated with exchange.

Certain other goods and services are amenable to digitisation, to being turned into data or to being conducted at a distance using communication channels. For instance, music and movies can still be experienced as a non-digital good and even a non-digital service. You can still buy a CD or a DVD as a commoditised good and you can still attend a music concert or a cinema presentation of a movie. But we know as 'content' both movies and music are effectively data and can be created, distributed and consumed as such through services such as music and movie streaming.

In the case of digital goods then, ICT can be used not only to reduce coordination costs but also to reduce production costs. For example, once a piece of music is digitised then the cost of distributing the music track to the consumer via a streaming service is close to zero.

1.7.5 Value chain

The primary goal of most organisations is to produce or create some form of value. For commercial organisations such value will typically constitute goods. For public sector organisations value will typically consist of the services such organisations provide. Therefore, organisations are value-creating or value-producing systems. Organisations can be thought of as chains of interrelated activity systems associated with the production and dissemination of value. Michael Porter (1985) has proposed a template for the activity systems of the typical business, known as the internal value chain and consisting of a defined set of primary and secondary activities.

1.7.6 Value network

Organisations consist of a series of interdependent chains made up of related activity systems that deliver value. Organisations, as systems, also exist within a wider value network consisting of chains of value between the organisation and external actors. Types of such external business actors include customers, suppliers and partners. This means that five value chains are significant for most businesses:

- The **internal value chain** consisting of a series of activity systems by which the organisation creates value.
- The **supply chain** consisting of those activity systems by which an organisation obtains goods and services from other organisations.
- The **customer chain** consisting of those activity systems by which an organisation delivers value to its customers.

- The **community chain** consisting of those social networks surrounding the business that support value generation between individuals and groups.
- The **partner chain** consisting of those activity systems that support coordinated or collaborative value creation by two or more organisations to the same set of customers.

Consider the value network of Tesco plc, a major supermarket chain. The internal value chain of Tesco involves all those activities that contribute to the retail of foodstuffs to its customers. The customer chain involves activities devoted not only to the operation of its supermarket stores but also to its operation of online grocery. As a food retailer Tesco has a large and complex chain of activities devoted to getting foodstuffs from its suppliers to its stores and warehouses. Tesco operates a loyalty scheme as part of its community chain as a means to retain its customers. Finally, Tesco is in partnership with a range of other companies such as in areas like insurance and Internet service provision.

1.7.7 Commerce

Commerce consists of the exchange of products and services between businesses, groups and individuals. Therefore commerce or trade can be seen as one of the essential activities of any business. Commerce of whatever nature can be considered as an activity system of exchange between economic or business actors with the following generic activities: pre-sale activities occurring before a sale occurs; sale execution comprising activities involved with the actual sale of a product or service between economic actors; sale settlement involving those activities which complete the sale of a product or service; and, after sale, consisting of those activities which take place after the buyer has received the product or service from the seller.

1.8 DIGITAL BUSINESS

Traditionally, ICT has been used to improve the operation of the activity systems making up the internal value chain of the organisation. More recently, ICT has also been used to improve activity systems between the organisation and its wider value network.

The application of digital computing and communications technology to organisational issues in the private sector is sometimes known as digital business. We use this term to encompass two other related terms, electronic business (eBusiness) or electronic commerce (eCommerce). The two are not the same. eCommerce refers to the use of ICT to enable activities within the wider value network. We use eBusiness as a term for the use of ICT to enable both internal and external activities. In Figure 1.14, to represent the electronic exchange of data structures upon which eCommerce relies, we have a communication symbol connecting the ICT system of the external actor with the ICT system of the organisation.

1.8.1 eBusiness

An electronic business (eBusiness) is a business in which the use of ICT is critical to supporting both its internal value chain and its external value network. The internal value chain consists of the series of activity systems by which the organisation delivers a product or service to its customers. The external value network consists of the activities, relationships and flows of value between the organisation and actors in its external environment.

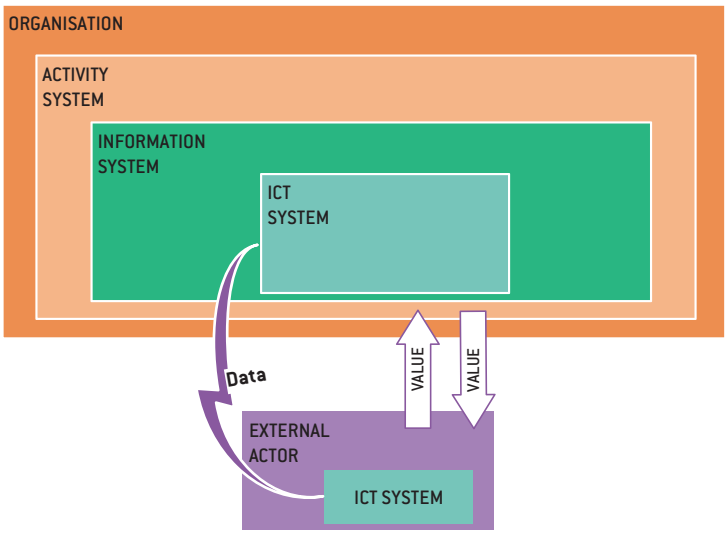


Figure 1.14 Digital business

1.8.2 eCommerce

Generally, we may distinguish between four distinct forms of eCommerce corresponding to the application of ICT transformation to major aspects of the value network: to the customer chain (B2C eCommerce), to the supply chain (B2B eCommerce), to the community chain (C2C eCommerce) and to the partnership chain (P2P eCommerce). It is also possible to discuss micro-strategies associated with particular aspects of the customer chain and the supply chain respectively. In this light we consider the importance of eMarketing and eProcurement to modern business.

Business-to-consumer eCommerce is sometimes called sell-side eCommerce and concerns the enablement and transformation of the customer chain with ICT. Customers or consumers will typically be individuals, sometimes other organisations.

Business-to-business eCommerce is sometimes called buy-side eCommerce and involves supporting and transforming the supply chain with ICT. B2B commerce is clearly between organisational actors – public and/or private sector organisations.

Consumer-to-consumer eCommerce concerns the enablement of the community chain with ICT. Partner-to-partner eCommerce concerns the enablement of the partnership chain with ICT. Business organisations now engage in networks of collaboration as well as networks of competition. This means offering a range of different products or services from a number of different businesses at the same time to the same customer through the same access channel.

1.8.3 Electronic marketing and electronic procurement

Two key aspects of B2C and B2B eCommerce respectively are important because of their contemporary significance as key digital strategies for improving organisational performance: eMarketing and eProcurement. The Internet and Web offer innovative ways of engaging in pre-sale activity with the customer. One of the most significant of such innovations over the last decade has been the growth in the electronic marketing (eMarketing) of goods and services. As part of B2C eCommerce, eMarketing is an important way of impacting upon the efficiency and effectiveness of the customer chain. eMarketing not only involves the use of electronic channels for the delivery of promotional

material; it also involves the conception and pricing of products and services. In the case of B2B eCommerce, engaging in electronic procurement (eProcurement) is an important way to improve the efficiency and effectiveness of an organisation's supply chain. The pre-sale activity of search, negotiate and order in the supply chain is frequently referred to under the umbrella term of procurement. Sometimes the term procurement is used to refer to all the activities involved in the supply chain.

1.8.4 Digital business at Goronwy

CASE

For Goronwy, it is possible to show how the introduction of the new ICT system led to the establishment of its parent company, Rito Metals, as an eBusiness. Goronwy's new ICT system continued in operation for a couple of years, then Rito Metals carried out an evaluation. It concluded that the system had improved the plant's performance in a number of ways, as we have seen. Executives at headquarters made a strategic decision to roll out the ICT system to all 10 galvanising plants in the group. As well as wanting to improve the information handling at the plants, they wanted to see them using standard activity systems.

This rollout took a further two years to complete, as some plants found it difficult to adapt. When it was complete it became possible to create a management information system (MIS) at headquarters, fed with data from the individual plant ICT systems. To enable this, a dedicated wide area communication network was created, linking each plant with headquarters.

Now Rito Metals could carry out more effective strategic management of its galvanising plants, because it was able to obtain an accurate and up-to-date picture of operations and problems at particular plants, making them easier to identify and rectify. In this sense, the MIS enabled more effective control of the separate business units.

In developing an integrated ICT and information systems infrastructure, Rito Metals moved in the direction of becoming an eBusiness, because the use of ICT became critical to supporting its internal value chain. Goronwy itself also went down this route in the mid-1990s. It started by introducing handheld devices for inbound and outbound logistics operatives, linked via a plant wireless communication network. The workers could use these devices to access data from the central system, and update it with data about the receipt and dispatch of goods.

1.9 SOCIAL MEDIA

Digital infrastructure within and between organisations continues to evolve, sometimes in directions which it is quite difficult to predict, such as in the case of social media. It is actually difficult to pinpoint precisely what is meant by this term. The term social media is often used to refer generally to any means for creating and sharing of digital content, such as written material, photographs, video and audio material. But the term social media is also associated with the sharing of such content via online social networks. Certain characteristics of social networks, such as the network effect, strong and weak links, and social capital make social media particularly attractive to business.

1.10 MOBILE COMMERCE

Another key change to digital infrastructure that has occurred over the last decade is the movement towards mobile commerce. Mobile commerce can be considered a subset of electronic commerce, and in particular of B2C eCommerce. It relies upon a number of aspects of technological infrastructure. Various mobile access devices may be used by the consumer, such as smartphones or tablets. Such devices use positioning

systems which typically exploit features of the cellular phone network to engage with location-based services. The interface to the ICT system normally runs as an app on the mobile device. Requests to the ICT system travel as IP messages over the cellular telephone network. Most of the ICT system itself runs within a cloud data centre, which services the requests made by the customer. The ICT system may enact further requests to other cloud services, such as electronic payments.

1.11 DESIGNING DIGITAL ORGANISATION

As we have seen, within this book organisation is considered a complex adaptive system. The institution of organisation emerges from patterns of action that serve to constitute organisation. Organisations as systems can achieve their goals or purposes in a multitude of different ways. This means that there are likely to be different patterns of organisation that meet the same defined objectives or goals. The consequence of this way of thinking is that we should approach all forms of organisation in terms of a design orientation. In other words, we should be able to *design* different patterns of organisation and then evaluate which is the most appropriate pattern for resolving aspects of some problem situation.

There are a lot of different ways of thinking about design as an activity. Many divide the activity of design in two ways, such as problem-setting and problem-solving. Problem-setting means establishing the problem to be engaged with. This is often the most difficult part of design because it typically involves determining not only the boundaries of the problem to be solved but the purpose to be served by any solution. This demands that the problem situation is investigated or analysed using participation, conversation, observation and/or documentation. It also means determining the motivation for making changes to existing problem situations.

Problem-solving involves specifying changes to patterns of action, particularly by visualising how the new proposed system of organisation will pan out as a narrative or story. This means suggesting what happens, when and where things happen, who makes things happen, and how and finally why things happen.

1.12 DIGITAL INNOVATION AND DIGITAL STRATEGY

The notion of the organisation as a complex and adaptive system is inherently one which accommodates change. Organising is a continuous accomplishment performed by actors which continually produces and reproduces organisation. This book is all about change through innovation and, in particular, digital innovation – innovating with or through ICT (Figure 1.15).

Strategy and innovation are clearly related. Strategy is about deciding what change is necessary and what steps will be taken to achieve such change. Change is normally conducted in order to innovate – to make a difference. This helps us relate together issues of both digital innovation and digital strategy through the mediating concept of a digital business model.

1.12.1 Business models

The concept of a business model has been much considered in the wider literature, particularly in terms of much recent management writing which attempts to make sense of strategy in times of rapid technological change. Not surprisingly, business models have been particularly used as a way of understanding the impact of innovation with ICT upon business practices – an area referred to traditionally as electronic business and electronic commerce but more recently as digital business.

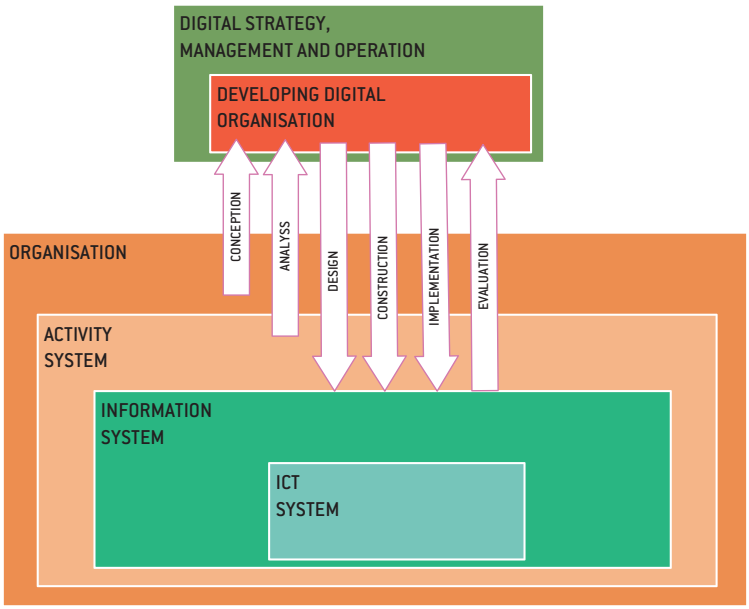


Figure 1.15 Digital innovation

These features closely align to our notion of organisation as a system and also to elements of design thinking. A business model is a way of expressing the core design for some value-creating system. This design must outline the system of action necessary for the achievement of the goals of organisation. We have seen that there are three layers of action that make up organisation as a system, and serve interdependently to create value, the central goal of organisation.

As a system, organisation consists of three interrelated patterns of action which can be described as narratives or stories of ways of organising. An activity pattern consists of sequences of coordinated, instrumental activity. A communication (information) pattern consists of sequences of communicative acts. An articulation (data) pattern consists of sequences of manipulating data structures. All three patterns or subsystems are needed to express a business model, as well as some notion of how these patterns interrelate.

1.12.2 Strategy and motivation

We can analyse some existing domain of organisation and build a business model which expresses how things work currently – an *as-is* business model. We can also express a business model as a design: as how we would like things to be – as an *as-if* model. Because of the nature of organisation as a system there is potentially a large range of as-if business models for any one as-is business model. Each of these as-if models may be able to achieve the same purpose, but clearly in different ways. Clearly, to enact change, one of these as-if models must be chosen as a *to-be* model. This then becomes a design for a new domain of organisation that will hopefully be implemented in practice.

The concept of a business model also allows us to distinguish between business motivation and business strategy. Business motivation involves the need to document explicit reasons for changing an existing (as-is) business model, such as enhancing revenue or better adapting to market changes. The nature of organisations as open systems means that more than one envisaged (as-if) business model may fulfil one or more aspects of expressed motivation. Business strategy involves optimising the selection among as-if models and specifying courses of action to implement a new (to-be) business model for the chosen domain (Figure 1.16).

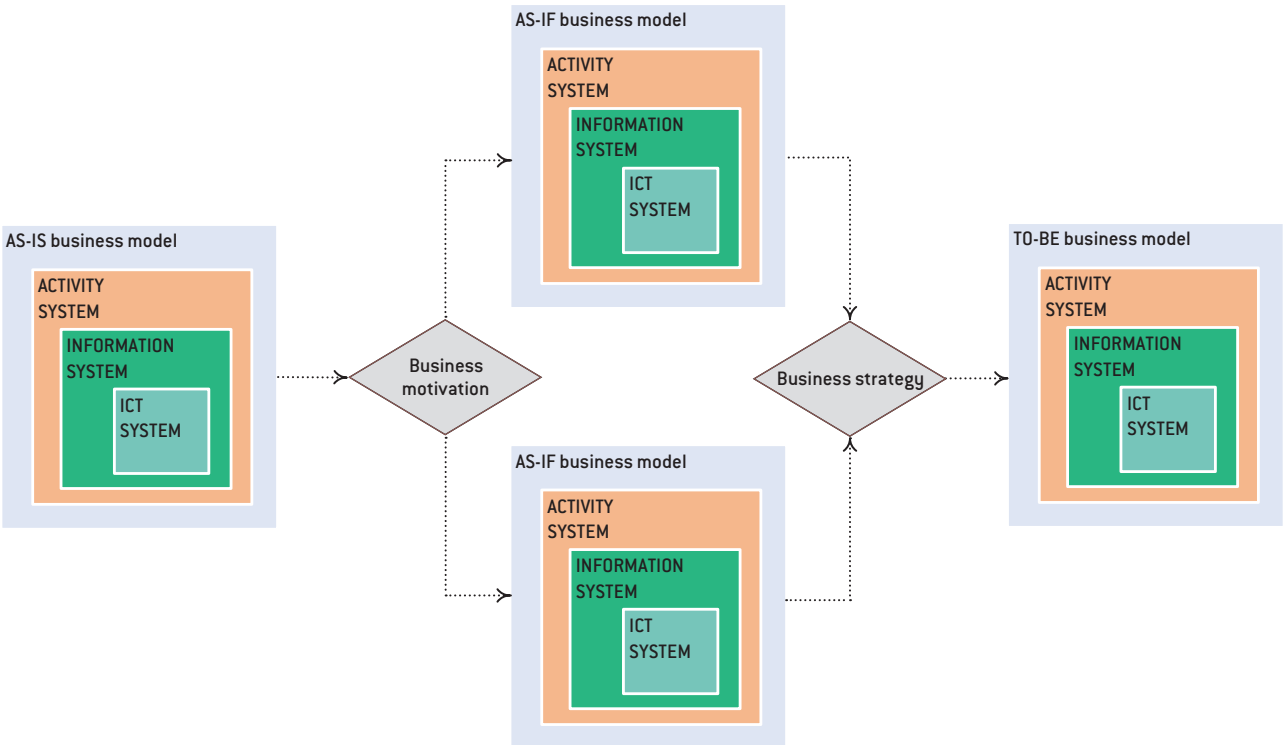


Figure 1.16 Business models, motivation and strategy

1.12.3 Digital innovation

Much modern innovation is clearly digital innovation – innovation with and through ICT. ICT has been applied in various domains of organisation to do things differently, and as such these examples of innovation are prime instances of disruptive innovation or creative destruction. However, to innovate successfully with ICT we have to look rather differently at ICT; we have to challenge conventional ways of thinking about ICT.

Traditionally, technology (such as ICT) is seen as something separate from business activity, but which supports such activity. This viewpoint suggests that to undertake digital innovation you should design changes to activity first and then design ICT systems to support activity change. Throughout this book we have suggested thinking differently about ICT as a participant actor within contemporary ways of organising, alongside humans.

1.12.4 Goronwy digital innovation

CASE

Goronwy initially invested in a limited corporate website which merely promoted its services and provided contact details. It then created a companion website specifically for repeat customers such as Blackwalls, so they could enter details of orders and track their progress from receipt through galvanisation to dispatch.

To enable fully transactional websites, organisations need to update the data dynamically from back-end databases, and to ensure that data entered by stakeholders update the company information systems effectively. So, when a customer inputs delivery details, this information needs to be available to all the other systems that need it. This

CASE
continued…

demands integration and interoperability of front-end and back-end systems within the ICT infrastructure. For Goronwy, the back-end ICT infrastructure managed the data structures we described above as well as the business rules, update functions and transactions critical to what we referred to as the business layer.

After 10 years of operation, Goronwy decided to upgrade its ICT system onto a new hardware and software base, to make it easier to develop web interfaces and integrate them with a central corporate database system. The system was redesigned and rewritten, and the company also invested to ensure the privacy of electronic data held in the system, and the security of transactions travelling both within Goronwy and between Goronwy and the central ICT systems at Rito Metals. This continual investment in the ICT infrastructure is evidence of its growing value to the performance of the business.

1.12.5 Business evaluation

One key lesson is that it is important for organisations to evaluate their ICT systems and their impact on activity systems. Strategic evaluation involves assessing the system's potential for delivering benefit against estimated costs. Formative evaluation involves assessing the shape of an information system during the development process. Summative evaluation involves returning to the costs and benefits established in strategic evaluation after a period of use. A variant of this is post-mortem analysis, summative evaluation of a failed information system project to determine lessons for organisational practice.

1.13 CONCLUSION

This chapter is meant as a high-level summary of the topic areas covered in the rest of the book. So here is how we intend to consider the domain of business information systems.

We start by looking at what organisation means in systems terms. This leads us to identify the coordination of activity as a key problem that all organisation faces (Chapter 2). Effective coordination relies upon effective communication, so we consider what information means in terms of communication. To communicate about some thing we must make differences within some substance – this is the essence of data (Chapter 3).

Information systems have been around for many thousands of years. ICT has only been around for some 50 years or more and applied to information systems. The place of ICT can only be understood in terms of wider infrastructure of organisation (Chapter 4). Data (ICT), information and activity systems may be coupled vertically as well as horizontally to form such infrastructure.

Modern organisation relies heavily on effective ICT infrastructure. This book considers such infrastructure in terms of access devices and channels, communication networks, front-end and back-end ICT systems, and data management (Chapter 5).

Organisations are not isolated entities, they are open systems. This means that the success of any organisation will depend on how well it integrates with aspects of its environment. This book focuses primarily on the economic environment of the organisation and describes ways in which organisations can be considered as systems producing value that travels within and between them (Chapter 6). But ICT is critically embedded not only within the modern economy but also within society and polity.

We use the term digital business to refer to any ICT application within business. As such it encompasses two older terms, electronic business and electronic commerce.

In this chapter we focus upon electronic business and electronic commerce. Electronic business (eBusiness) involves any ICT-enablement of an organisation's internal value chain, as well as its external value network. In contrast, electronic commerce is a subset of eBusiness, and refers to ICT-enablement solely of aspects of the external value network of some organisation (Chapter 7).

As more interaction with organisations occurs online, more and more potential exists for use of electronic channels for marketing purposes. Electronic procurement as a form of digital innovation is seen as a means of reducing major supply chain costs to companies and to public sector organisations (Chapter 8).

We also consider some of the more recent digital innovations that have or are impacting upon organisations of many different forms. We have a look not only at some more established areas, such as mobile commerce and social media as key examples of digital business, but also some innovations that are likely to impact upon organisation in the near future (Chapter 9).

The design orientation gives us a useful way of approaching the design of digital organisation. As we shall see, this fits well with the systemic and action-oriented view of organisation promoted in this book (Chapter 10).

This book is all about innovation and, in particular, digital innovation – introducing change with or through ICT. Crucial to managing change and innovation is the concept of a business model. The notion of a digital business model allows us to relate the motivation for innovation as well as the strategy for change (Chapter 11).

Since ICT is embedded in modern organisational life as well as in the wider environment, not surprisingly ICT is a vast industry of both producers and consumers. In consuming organisations there is normally a function charged with developing, maintaining and operating the ICT infrastructure in support of information systems, which we shall refer to for convenience as the ICT service (Chapter 12).

In the final chapter we provide an overview of certain aspects of ICT change that are likely to affect the nature of digital infrastructure over the next decade or so – such as ubiquitous computing, artificial intelligence and new architectures for computation. We can better make sense of the changes to digital infrastructure if we apply coherent theory. This is why we bring together elements of a theory of information systems in this final chapter. This summarises our perspective on what information and information systems are, and also helps us not only better understand the potential digital future but also presents us with better ways of approaching the design of such future (Chapter 13).

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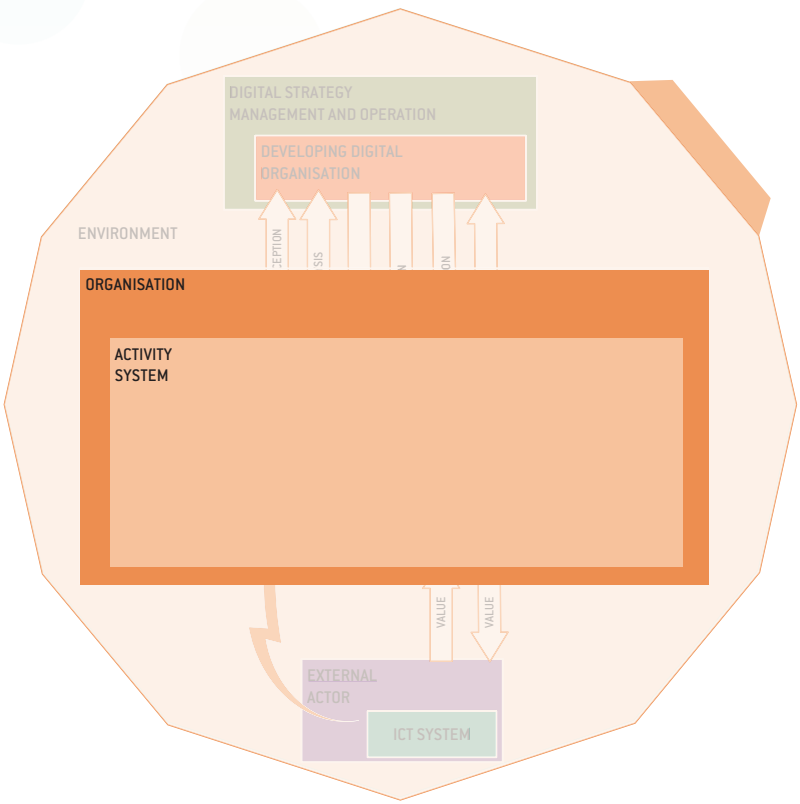
2 SYSTEMS OF ORGANISATION

'Observe how system into system runs, what other planets circle other suns.'
– Alexander Pope (1688–1744) *An Essay on Man* (1733) Epistle 1

LEARNING OUTCOMES	PRINCIPLES
Understand the fundamental elements of all systems.	The concept of system is fundamental to the three types of system considered in the book: activity systems, information systems and data systems (ICT systems).
Explain the idea of organisation as a value-creating system.	An organisation can be considered an open system interacting with a wider value network.
Discuss the place of control in the regulation and adaptation of systems.	Control is essential both to the internal regulation of systems such as organisations and to the ways in which organisations adapt to their external environment.
Explain the importance of modelling to understanding, explaining and designing organisation.	Modelling is important to help managers both to understand their organisations and to provide tools for intervening in organisation.

CHAPTER OUTLINE

2.1 Introduction
2.2 The nature of organisation
2.3 Organisation as a system
2.4 Patterns of organisation
2.5 What is organisation for?
2.6 Control
2.7 Modelling activity
2.8 Conclusion
2.9 Review test
2.10 Exercises
2.11 Projects
2.12 Further reading
2.13 Bibliography



2.1 INTRODUCTION

Consider the following question. How much of your life is spent either working within organisations or interacting with organisations of various forms? When given time to reflect, most people would probably answer: a lot of time. People worldwide spend a substantial proportion of their lives either working in or interacting with organisations. Much of modern-day life is therefore organisational life. This explains why we are interested in this book in the ways in which information and communication technology (ICT) is used to accomplish information and through this to coordinate the activity of actors working within and between organisations.

In this chapter we shall examine the nature of organisation itself. We shall also explain how ways of organising things can be best understood as patterns of action. This book promotes a systems view of organisation, because this perspective enables us to better understand the place of information and information systems within any notion of organisation. It also allows us to see the role that ICT plays within contemporary organisation globally.

The word 'organisation' derives from the Greek word *organon*, meaning a tool. This is useful because it suggests the value of treating domains of organisation as tools for action. The major part of this chapter explains certain core concepts underlying systems thinking, or systemics. We show how these concepts allow us to relate to each other many of the issues critical to management in the modern organisation, including strategy, control, performance and change, which we shall revisit within later chapters. A systems view of organisations is also important because it suggests practical ways of analysing the dynamics of existing organisations, and of designing new organisational forms. This is also a topic we consider later.

2.2 THE NATURE OF ORGANISATION

Organisation
The patterned order evident in some domain of action. A complex, adaptive system consisting of activity, communication and representation.

As a term, **organisation** is used in two major ways. It is used as a *noun* (a referring word) or it is used as a *verb* (an action word).

As a noun, organisation is used as a term to refer to an institution – a social structure. The institutional perspective views organisations as entities which exist independently of the humans belonging to them. Human actions are directed or constrained by such larger social structures. Institutions have a life over and above the life of their members. In this sense we speak of Tesco, the National Health Service (NHS), Cardiff University or Alibaba as an organisation.

Cardiff University, for instance, was established in 1883. Since that time many academics have worked for it and many students have passed through its doors. The actions of both academics and students have been informed and governed by the expectations of this institution over time. The NHS was founded in 1948 and is the largest employer in Western Europe, having nearly 1.5 million people delivering healthcare to the UK population of various kinds. Such people working for the NHS must follow the policies and practices established within this institution. Alibaba, a group of Chinese multinational digital businesses, was founded in 1999 and currently manages much of the online activity of China's 1.4 billion citizens.

Organisation can also be treated as a verb (as a doing word) – to organise or as organising. In this action perspective an organisation is continually produced or recreated through the continuing actions of its members. The interest here is in how humans coordinate their actions in the achievement of joint goals. This means that organisations do not exist independently of the humans belonging to them and the actions they take. The organisation is produced and reproduced through such actions.

Cardiff University is continually reproduced by lecturers delivering lectures to students, lecturers setting assessments for students, students submitting assessments … among a vast range of other actions. The NHS involves numerous healthcare workers performing many different types of healthcare action daily for patients. Such actions include diagnosing illnesses, transporting people to hospital and entering patient records into ICT systems.

For much of its history the theory of organisation has tended to portray the institutional and action perspectives on organisation as mutually exclusive. In practice, of course, each is a legitimate or valid position. We all act and interact with fellow human beings within organisations and appreciate the fluidity of organisational life. We all also experience the monolithic nature of organisations and the constraints placed upon our actions by these institutional structures.

Emergence
Most systems display emergent properties – properties that emerge from the operation of the system and which is not present in any of the parts of the system.

Within this book we resolve the puzzle of organisation through the idea of **emergence** – which is a systems concept. An organisation is best seen as a system in which structure emerges from action. Consider the analogy of a river to help understand the concept of emergence. More than 2,000 years ago the ancient Greek philosopher Heraclitus argued that '*change is the only constant*' in the universe and he used the statement '*you can never step in the same river twice*' to help explain this. A river might be considered a physical structure with certain persistent features such as the course it takes through a landscape. But the constituent element of a river is of course water, which is continually flowing. Hence the structure of the river emerges through the flow of water.

In a similar way an organisation as a structure can be said to emerge from the continuing patterns of action performed by its members. Cardiff University is a system in which people enact roles such as lecturer and student … such roles are part of the wider social structure of this organisation. In playing these roles various actors perform continuous action which creates the structure of the university. Their action reproduces the roles they enact … and through this the structure of the organisation itself.

Therefore, rather than using a noun (organisation) it is perhaps better in system's terms to focus on the verb (organising), and also to acknowledge that structure continuously emerges from patterns of organising (see Figure 2.1). In this book we think of organisation as a set of interrelated and interdependent patterns of organising coordinated action in the achievement of collective goals.

REFLECT

How many organisations have you been a part of in your life so far? How have these organisations constrained or determined the actions you have taken? How have your actions helped reproduce the organisation in any small way?

RECAP

There are two major perspectives on organisational life – the institutional perspective and the action perspective. The institutional perspective considers organisations as units which constrain or structure people's behaviour. The action perspective considers organisations as arising out of human interaction. We use the systems viewpoint to unify these two positions. An organisation is best seen as a system in which structure emerges from action.

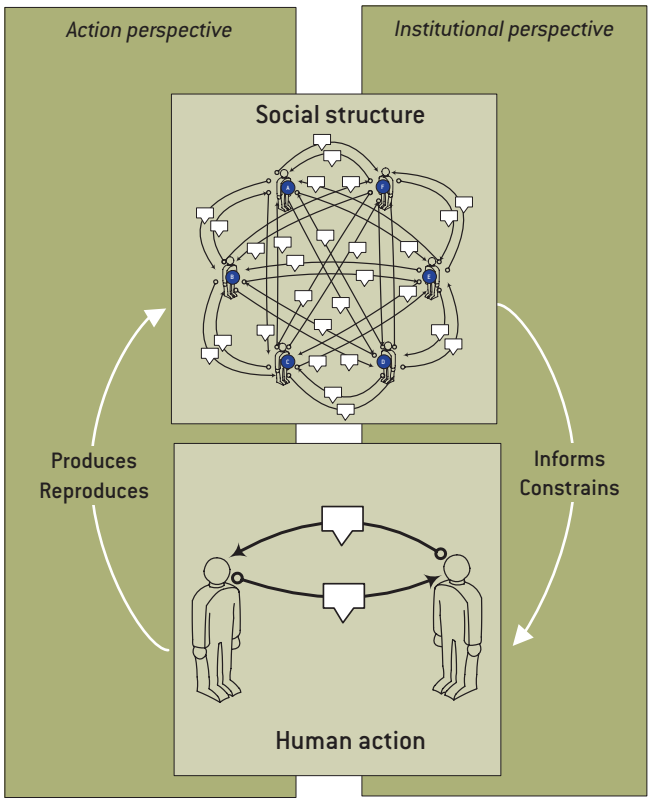


Figure 2.1 Organisation as a cycle of emergence

2.2.1 Meals on wheels as an example of organisation

CASE

Let us consider a very simple case of organisation to help introduce the idea of organisation as a system consisting of various interrelated patterns of action.

Many elderly and disabled people are unable to shop for foodstuffs on a regular basis and are physically incapable of preparing a hot meal for themselves. However, many such persons want to continue to live independently in their own homes. To help enable this, some Local Authorities in the UK provide a service called 'meals on wheels' to the elderly in their immediate area. However, many other areas of the country are not served by such a public sector service, but rely instead upon charitable activity. This is the case in the local area in which our group of volunteers live; they decide to set up a meals on wheels service (a voluntary sector service or social enterprise) for their area themselves. The key question here is: How should they organise themselves to achieve the collective goal of delivering this service?

There are clearly several activities that must be performed on a regular basis by various different people to achieve the goal of delivering hot meals to the elderly and disabled. First, they need to continuously determine who among the elderly and disabled population in their area would like a hot meal every day and be willing and able to pay a small fee for this. Then somebody must source foodstuffs from suppliers. Someone else will have to prepare the foodstuffs, to cook the meals and to package them ready to be delivered. Other people will have to deliver meals to people who subscribe to the service. And all these activities, performed by many different people, will have to be coordinated effectively to ensure that the elderly and disabled people who want a hot meal get it on time and of a requisite quality.

CASE
continued…

Initially, they recruit some 20 people to the scheme and decide only to try to provide a hot meal to these persons three days a week for a small weekly charge. Several volunteers allocate themselves to the task of purchasing foodstuffs and preparing meals at a local community kitchen that they are able to rent for this purpose. A group of other volunteers indicate that they are prepared to deliver the hot meals in reusable, insulated containers to subscribers of the scheme in their own vehicles. The cooks indicate to the delivery people what they have prepared on any designated day and the delivery people indicate to subscribers what they can expect each day the scheme operates.

This way of working is successful for several months. However, the success of the scheme passes by word of mouth throughout the community and within a short period the number of subscribers to the service trebles. Consequently, the quantity of foodstuffs needed to be sourced from suppliers rises considerably and the established way of purchasing from high-street supermarkets is no longer viable. Also, a growing range of volunteers is needed to cover gaps in the workforce caused by illness and other circumstances. This makes the task of determining who is doing or should be doing what and when much more difficult.

This means that the group of volunteers must decide to *organise* themselves more appropriately. They start making records of things such as: members' details including their addresses and dietary requirements; volunteer details including contact details and times when they are able to contribute; a rotating monthly menu with a detailed breakdown of foodstuffs required; details of foodstuff suppliers; financial details such as what money has been collected from which members and how much has been expended on foodstuffs, rent of the kitchen and fuel in deliveries.

Such records communicate to volunteers what has happened, what is happening and what should happen, among other things. This increased level of formal communication allows volunteers to better coordinate their activities. The rotating menu, for instance, is used by many different volunteers to make decisions about their own appropriate activity. Volunteers that deal with suppliers use the menu to determine what foodstuffs to buy and when. Volunteers that cook the meals use the menu as a guide to food preparation and volunteers that deliver hot meals use the menu to guide subscribers as to what to expect.

In this simple example we have all the component elements making up organisation and which we shall consider in some depth in this chapter. The volunteers are best described as *actors* in the sense that they act: they perform on a repeating basis a set of activities such as cooking meals and delivering these meals to subscribers of the service. Each volunteer needs to coordinate his or her activities with those of other actors: other volunteers. As a group they also need to coordinate their collective activity with that of further actors such as foodstuff suppliers and of course the subscribers to the scheme themselves. For such coordination, communication is needed.

Communication relies upon some mutually agreed system of signs between coordinating actors. Statements in spoken language are clearly acts of communication between two or more actors which rely on such a common sign-system. But statements in spoken language do not persist beyond the communication in which they take place. Hence groups of actors that wish to coordinate their performance across time and possibly space need to create records. In other words, records ensure that multiple actors are informed of the actions of others some period after such actions have been completed. Records can also be accessed in a different place from that in which the actions took place. Such records are thus by their very nature used to do different things such as to make persistent certain assertions about the current state of some organisation or to direct future actions of group members. In this sense, records are particularly important for making decisions about future courses of action.

So, from an institutional perspective, this meals on wheels service exists as an entity greater than any particular individual that participates in the organisation. From an action perspective the organisation is constituted from the actions of the individuals which make up the organisation.

REFLECT

Try reflecting on the nature of organisation in simple settings known to you. For instance, when you go into a coffee shop you probably participate in a pattern of activity. You are an actor within this setting – a consumer – and you interact with another actor within this setting – a barista. How would you describe this as a typical pattern of performance? What pattern of communication normally accompanies such performance? In other words, what communication normally occurs between yourself and the barista? Is there any pattern of articulation evident in support of the pattern of communication? By this we mean, are there any records involved in supporting this business interaction?

Try broadening this idea out from face-to-face interaction to one involving human and machine. What sort of patterns of action support the ordering of goods online via a website?

2.3 ORGANISATION AS A SYSTEM

System
An organised set of interdependent elements that exists for some purpose, has some stability and can be usefully viewed as a whole.

Within this book we shall think of organisation in terms of **systems**. The concept of *system* is central to thinking in numerous fields. For instance, in medicine it is seen as important to consider our bodies as being made up of various systems such as a digestive system and a central nervous system. In terms of astronomy we live on a planet that is part of the solar system. From the perspective of the social sciences we engage with people in groups that form social, political and economic systems. In mathematics we are educated in the use of number systems. Modern organisations are systems of activity that would collapse without effective information systems and are reliant on efficient data systems.

At first sight these varied systems appear to have little in common. However, on closer examination we see that all these examples represent what we might describe as a patterning or ordering of things. Systems theory, systems thinking or as we prefer to call it, *systemics*, is the attempt to study the generic features of such patterning.

Systemics
The study of systems.

The discipline devoted to the study of the general nature of systems is often referred to as systems thinking or systems theory. We prefer to refer to it as **systemics** because it has become popular in numerous aspects of life to refer to certain difficult problems as systemic. But what actually underlies a systemic approach to things? A system very broadly is an organised set of interdependent elements that exists for some purpose, has some stability and can be usefully viewed as a whole. Five key principles are significant within this definition: that of holism, identity, organisation, purpose and emergence.

First, one of the fundamental principles of systemics is summed up in the ancient Greek philosopher Aristotle's dictum that '*the whole is more than the sum of its parts*'. This suggests that when we attempt to investigate and understand complex phenomena, such as how businesses work, we should attempt to do so holistically – in terms of the whole phenomena rather than parts of the phenomena. Second, a system has an *identity*. By this we mean it can be clearly distinguished from other phenomena. We can draw a boundary around what is inside the system and what is outside the system. We also can see a system as persisting through time. Third, systems display *organisation*. Systems are different from aggregates or collections of things because in a system we observe the continuous patterning of some phenomena. Fourth, to say a system displays organisation implies that a system is organised to do something: it has some explicit or implicit *purpose*. This means that systems are normally seen as organised to achieve some goals. Fifth and finally, a consequence of a system having identity, displaying organisation and achieving purpose is that systems accomplish *emergence*. A system is a complex entity that has properties that do not belong to any of its constituent parts. Instead, they emerge from the relationships or interaction of its constituent parts. This is really what is meant by '*the whole is more than the sum of its parts*'.

Consider a simple example of a physical system. A road network can be viewed as a system. It is made up of component parts such as roads, road intersections and vehicles which travel along this network. The purpose of some road network is likely to be to transport people and goods between points within some geographical space. In a road network a bottleneck experienced at some road intersection is the result of the interactions of a large body of components or parts (vehicles) coming together in particular ways. A bottleneck is not a property of any one component of a system such as a vehicle; it is only a property of the system as a whole; it is an emergent effect of the operation or the action of this system.

2.3.1 Hard and soft systems

Hard system
Systems in which the goals of the system are relatively unproblematic. Many technological systems are hard systems.

Soft system
A social system that is designed to meet certain objectives. The objectives of a soft system may be problematic or open to interpretation.

As we shall see, systemics has been applied to both 'hard' systems, such as road infrastructure, and 'soft' systems, such as organisations. **Hard systems** are not 'hard' in the sense of being any more complex than **soft systems**. Instead, they are 'hard' in the physical or technical sense. In such situations it is possible to use system concepts as a means of investigating complex situations and taking rational action with the objective of achieving what are seen to be defined, unquestioned and frequently unproblematic goals. For instance, large integrated manufacturing plants such as petro-chemical plants can be treated as hard systems in the sense that the design of such plants to achieve production goals is relatively unproblematic. Most technological systems, including, as we shall see, ICT systems, can be considered as 'hard' systems in a similar manner.

In contrast, most human systems are 'soft' systems because they are social in nature. They are collections of people undertaking activities to achieve some purpose. However, within human systems the boundaries or scope of the system may be fluid and the purpose of the system may be problematic and certainly open to interpretation from many different viewpoints. Hence the purpose or purposes of a private, public or voluntary sector organisation may be open to different interpretations depending upon the viewpoints of particular actors that not only are members but also observers of the system. A university, for instance, might be considered a system for educating students, for conducting research, for engaging with industry or for contributing to the wider community.

DID YOU KNOW?

Elementary systems thinking emerged in the work of the Gestalt psychologists, a collection of psychologists who emphasised the study of the mind as a whole unit, rather than as a collection of psychological parts. This approach they described as holistic thinking. The idea of using the concept of a system to understand phenomena is normally attributed to work in the 1930s conducted by Ludwig von Bertalanffy (1951), a German biologist. He gave the name general systems theory to a discipline devoted to formulating principles that apply to all systems. Following Bertalanffy's pioneering work systems thinking began to be applied to numerous fields, leading eventually to the creation of the Society for General Systems Research, a group including Bertalanffy, Rapaport, Boulding and Gerard. Boulding's (1956) work highlighted certain phenomena as being present in many disciplines such as populations, individuals in environments, growth, information and communication. This established some of the fundamental principles of general systems theory. Systems ideas have had their greatest impact in the field of organisational/management science. It is from the adaptation of the systems idea within thinking about organisations that much of the thrust for contemporary information systems can be seen to derive.

The systems perspective has had a significant influence on areas such as ecology. Some have even proposed considering the entire earth as a complex ecological system and even given such a system a name: Gaia. Changes to any part of Gaia, such as deforestation of the Amazon basin, are likely to have knock-on effects on many other parts of the system, such as changes to climate. This, in turn, is likely to influence melting of the polar ice caps, which is likely to further exacerbate changes to climate.

2.3.2 Complex, open systems

Complex adaptive system
A system of organised complexity which continuously has to adapt to its environment.

The term *system* has a Greek origin, derived from *syn* meaning together and *histemi* meaning to set. In very broad terms, and from a static point of view, a system can be seen to consist of a collection of objects that are related or set together. Objects that are set together also lead to systems that are dynamic in the sense that the objects potentially influence each other.

The meals on wheels service described in section 2.2.1 can clearly be regarded as a system. This service has a clear identity in that we can draw a boundary around what forms activity in this area. The activity which accomplishes this service is continuously reproduced in a patterned way and it is through such patterning that this organisation persists through time. The purpose of this organisation is to provide regular hot meals to the elderly. Such purpose is achieved or emerges from the complex coordination of the activities of a multitude of different actors.

Open system
A type of system that interacts with its environment.

Variety
A measure of the complexity of a system; the number of states a system can assume.

Organisations are **open systems** in the sense that they interact with actors in their environment. Organisations are also complex systems that, as we shall see, need to regulate themselves and adapt to changes in their environment. Two other constructs are useful for specifying and managing the complexity inherent in systems such as organisations: that of **variety** and the associated idea of a subsystem.

The complexity of any system can be defined in terms of the notion of state, which is defined by values appropriate to the attributes of some system. At any point in time, a value can be assigned to each of these attributes. The set of all values assumed by the attributes of a system defines a systems' state. Variety may be defined as the number of possible states of a system. For many systems, particularly those involving human action, the variety of the system may be quite large in the sense that the number of possible states may not be precisely countable. Variety is therefore useful as a measure of the complexity of a system.

We can illustrate this idea using a simple example. Consider a collection of human actors, each of which we represent as a node labelled A–F in the diagram illustrated in Figure 2.2. We assume that each actor within this system can theoretically communicate with each other actor in the group. We draw arrows between actors to represent such communication and draw these arrows in both directions between any two actors to indicate that, for instance, relation A → B is different from B → A. In other words, actor A can make an utterance to actor B and actor B can make an utterance to actor A; each is a separate speech or communicative act. In this sense, each relation or communication channel in this system is effectively a 'switch' that may be turned on or off, perhaps indicating the effect of one actor in the network on another through communication. Here we have a simple system in which a collection of things now interacts; it operates or behaves.

Hence we could consider this as a simple model of a human communication network in which, perhaps, we wish to study the movement of communication around the network; perhaps the way in which some business communication travels among group members. In this system, one state of the system is when one communicative act such as A → B takes place. Another state is when B → C as an act of communication takes place, and so on.

As we have seen, using the idea of a system's states, variety may be defined as the number of possible states of a system. Hence, since there are two possible communication relations between each of the six actors in the network, there are n(n-1) or six times five possible relations between actors, which is 30 possible relations. If we regard a state of the system as being a certain configuration of active and inactive relations of communication, then there are over 2^{30} (1,073,741,824) possible states for the entire system. This is a measure of the variety inherent in this comparatively simple system. Hence, for many actual social systems in which there are many more actors and relationships than in our example, the variety or complexity of such systems may be incomprehensibly large.

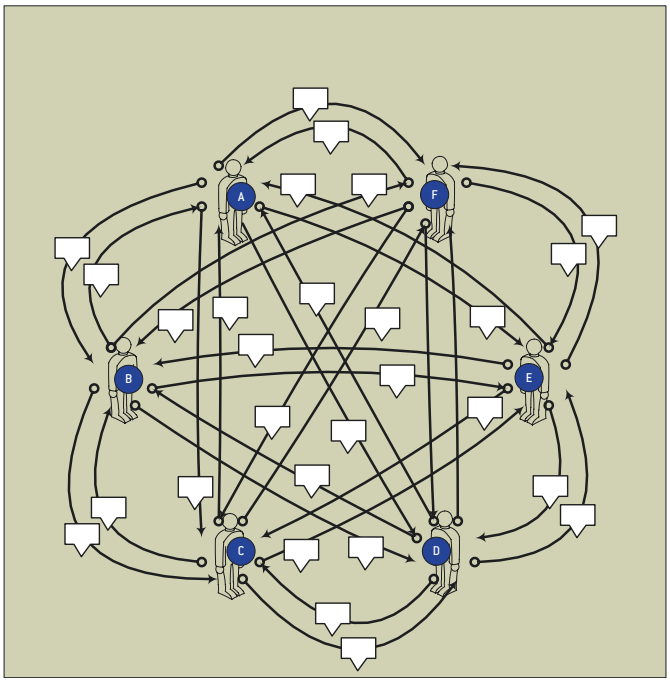


Figure 2.2 The variety of a simple human communication system

At first glance, we might conclude that the consequence of this is that it is impossible to understand and describe the workings of any reasonable complex system such as an organisation. But one way of handling the complexity of systems is to apply the notion of hierarchy to understanding and representing them. In this way, systems can be seen as being composed of various levels, each level of which can be conceptualised in terms of a system. Hence the environment of a system may be viewed as a system in its own right. And an activity which is part of one system may be treated as a system in turn. In this way we can build a hierarchy of system, **subsystem**, sub-subsystem and so on.

Subsystem
A coherent part of a system that can be treated as a system itself.

For example, within the meals on wheels case we can identify a number of subsystems of activity. These include ordering foodstuffs, preparing foodstuffs, cooking meals, packaging meals, delivering meals to subscribers, collecting subscriptions, washing containers and so on. Each of these subsystems can be seen to consist of certain interrelated activities. Each activity, in turn, can be considered a system in itself.

RECAP

A system is a set of interdependent elements that exists for some purpose, has some stability and can be usefully viewed as a whole. Organisations are open systems in that they interact with their environment. Organisations are also complex systems. We can manage the complexity of systems through hierarchy.

2.4 PATTERNS OF ORGANISATION

Pattern
Elements which repeat across situations.

In the previous section we hinted at the idea of thinking of a system as a set of interrelated **patterns**. A *pattern* is anything which repeats across situations. A pattern consists of a set of elements that repeat in a predictable manner. Inherent in the idea of a pattern is that it is reproduced across more than one situation. This idea of a pattern has had much influence in other disciplines. For instance, the American architect Christopher

Alexander (1964) proposed that architectural design is based on a number of archetypal patterns. These patterns define certain fundamental principles of building design. Within software engineering design patterns are proposed as general solutions to programming problems.

What repeats within systems of organisation are actors taking repetitive action at different times (across time) and in different places (across space). Any pattern of organising therefore consists of the following elements: actors, action, sequence (time) and location (space). We use the term 'actor' for anything that can act. Action is not only taken or enacted by humans, but also by 'machines' (such as ICT systems) and somewhat by other artefacts (such as data structures). We experience organisation as patterns of action, in fact three interrelated and interdependent types of action – coordination, communication and articulation. Finally, action takes place as sequences or cycles of events, and these events occur at specific times and are located somewhere.

Let us look at these elements of a pattern of organisation in more detail.

REFLECT

You may have heard of a piece of music called Pachelbel's *Canon* (try to search for an audio recording of this piece). All music such as this piece consists of patterns. What are the component elements of such patterns and what repeats in such patterns? A canon is a particularly important pattern in classical music. Try to find out how this pattern in music is organised.

DID YOU KNOW?

Organisation in nature is never static – it is a continual accomplishment. The two illustrations in Figure 2.3 provide evidence of such organisation. The left-most illustration displays the idea of fractal order or organisation – how a tree grows by reproducing patterns: fractals. This representation of a tree as organisation is accomplished by repeated application of a certain shape. What is this shape? The right-most illustration presents the shell of the nautilus, a large sea creature, as a pattern of organisation produced by something known as the golden ratio. The golden ratio is expressed in mathematics as: two quantities are in the golden ratio if the ratio of the sum of quantities to the larger quantity is equal to the ratio of the larger quantity to the smaller one. In other words a + b is to a as a is to b. This ratio expressed in decimal notation is the constant 1.6108. The golden ratio also underlies many of the principles of architectural design, such as that used in the proportions of the Parthenon in Athens. For Leonardo Da Vinci, the golden ratio was a significant proportion found in the dimensions of the human body.

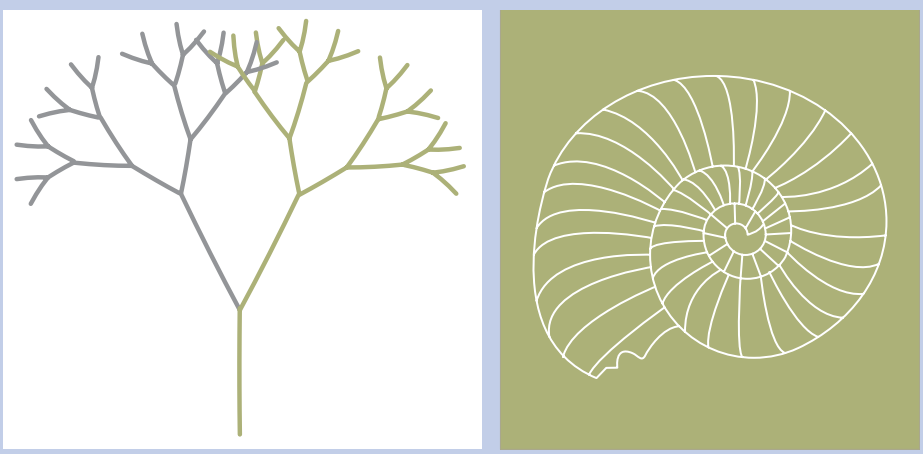


Figure 2.3 Two patterns of organisation found in nature

2.4.1 Actors

Actor
Any human, animal or machine that can act.

Within modern-day organisation work is rarely done by humans alone. Work is accomplished by humans with 'machines' or entirely by 'machines'. In the past, for instance, animals such as pit ponies were significant **actors** within industry. Nowadays, machines, such as vans, cranes and even ICT systems, as we shall see, are significant actors within most organisations. For example, most office work is now performed by humans working in interaction with ICT systems. But some action is performed independently and autonomously by ICT systems, such as in the case of automated security trading.

But we also believe that it is useful to think of data structures (see Chapter 3) as key actors in organisations, such as student records or records of patient admissions. So how can a student record be said to act? Well, having a student record serves to designate you as a student of a further or higher education institution. Having a student record prescribes that you do certain things in terms of this organisation … such as taking modules, producing assessments and receiving grades. Not having a student record proscribes (prohibits) you from doing these things. Data structures act because they prescribe or proscribe things and prescription and proscription are both related to action.

2.4.2 Action

Articulation
The action associated with the manipulation of data structures.

Communication
The process of enacting communicative acts. The accomplishment of meaning between actors.

Coordination
The achievement of joint activity by a group of actors.

There are three distinct but interrelated types of action important to any patterns of organising: **articulation**, **communication** and **coordination** (see Figure 2.4). Consider medical emergency response as a system of organisation. This system consists of three interrelated patterns: actors articulate data structures; such data structures communicate various things to other actors; such communication helps a multitude of different actors coordinate their joint actions in the achievement of collective goals. In terms of articulation, people such as call-takers and dispatchers make records of things such as incident locations and patient details. In terms of communication, records and other forms of communication, such as radio messages, ensure that ambulances get to incidents quickly. In terms of coordination, people such as paramedics and ambulance drivers take coordinated action to provided appropriate healthcare at the location of some incident.

When someone is described as articulate then that someone is judged to be good with expressing what they mean through speech or in writing. We shall see in Chapter 3 that both the spoken and written word can be best thought of as data and we use the term 'articulation' for any transformation of such data. Articulation stands for the various ways in which pretty much any substance is given form, for the purpose of informing actors. For instance, within the meals on wheels case volunteers create many data structures to identify and describe things important to them. A volunteer rota identifies and describes volunteers and activities; a delivery schedule identifies and describes scheme subscribers and meals; a food order identifies and describes quantities of foodstuffs and possibly payments made.

Communication is concerned with information. It stands for the various ways in which actors inform themselves and others, for the purpose of coordinating activity. Hence, within the meals on wheels case, data structures inform volunteers not only what has happened (such as what foodstuffs are on order) or is happening (such as what deliveries are being made today) but also what should happen (such as detailing what volunteer is undertaking cooking on Tuesday next week).

Coordination is concerned with instrumental activity. It stands for the various ways in which informed actors achieve coordinated performance in the achievement of

collective goals. For example, within the meals on wheels case, communication enables different volunteers to take joint action (such as recruiting members, sourcing foodstuffs, preparing foodstuffs, cooking meals, packing meals and delivering meals) in achieving the goal of delivering meals on a daily basis to their subscribers.

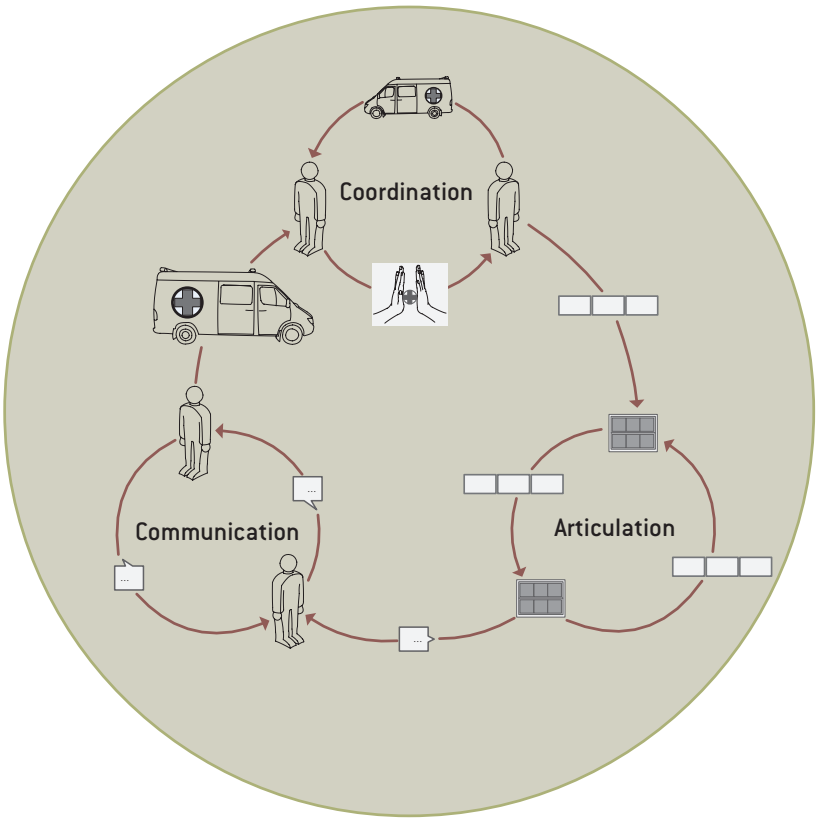


Figure 2.4 Three types of interrelated action

Lewis Carroll has one of his characters utter in *Through the Looking Glass*, *'It takes all the running you can do, to keep in the same place'*. This aptly explains why we have illustrated organisation as a continuous cycle of action in Figure 2.4. In Chapter 9 we shall make the case that organisation is a continual accomplishment of action in the face of disorder. Without the continual cycling of action, the organisation will cease to exist. In this sense, systems of organisation are sometimes seen as 'islands' of patterned order (what physicists call negentropy) in a universe of disorder (entropy). Just to stay still and accomplish its goals an organisation must continually expend energy through action.

2.4.3 Time and space

Action is undertaken within some spatial and temporal (time-related) order. Action always takes place at a certain time and at a certain place. Actions occur as events which take place before and after other events. In Figure 2.5 a pattern of events is illustrated with which you should be familiar. Actions such as a student receiving a coursework brief, completing coursework and submitting it must always appear in this sequence. You cannot submit coursework until you have completed it and you cannot complete coursework until you know what it is about. Likewise, events always happen somewhere – a student will submit coursework at some place (perhaps in the student's residence), a lecturer will mark it at some other place (perhaps in the lecturer's office)

and the student will receive her grade at probably yet some other place (perhaps at the university's undergraduate or postgraduate hub).

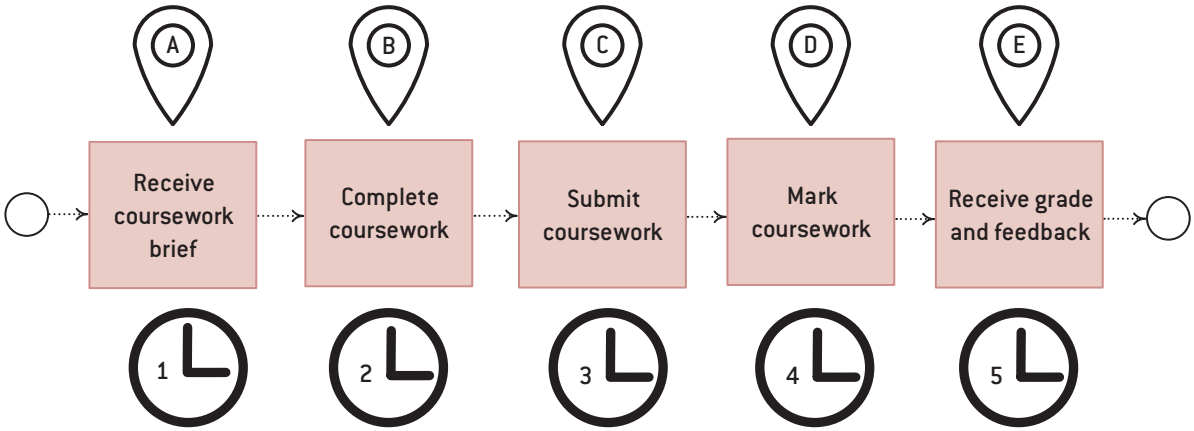


Figure 2.5 Actions in time and space

2.4.4 Benefits of a systems view of organisation

This way of thinking about organisation as systems or patterns of action not only allows us to better understand some classic management concepts such as the nature of management, performance, strategy and change; it also allows us to think about how to design and innovate ways of organising things through ICT (see Chapters 10 and 11).

A systemic conception of organisations is useful because it has clear ways of addressing some classic concerns of organisation theory such as decision-making, coordinated action and the place of information. The conceptual tools of systemics also offer managers practical ways of engaging with or intervening in organisations for which they are responsible, not only so they can ensure operational effectiveness, but also to understand environmental uncertainty, plan strategy and manage change.

RECAP

Organisation emerges from action. Organisation comprises systems or patterns of action. Any pattern of organisation consists of various actors taking action within some temporal and spatial order. Action may comprise articulation, communication and coordination. Action takes place in sequences or cycles across time and in given locations.

2.5 WHAT IS ORGANISATION FOR?

A system's view of organisation allows us to directly answer this question of: What is organisation for? Any system is teleological, meaning that it exists for some purpose or purposes. The notion of a goal is clearly tied to the purpose of some system. For certain classes of system, such as technical systems, then the goal or purpose of the system is relatively clear-cut (this is why they are referred to as hard systems). For instance, the purpose or goal of a thermostat is clearly to regulate room temperature.

For systems of human activity the goal or purpose of the systems may be less clear-cut, and frequently will depend upon who you ask (this is why they are referred to as soft systems). For example, what is the purpose of a university? Some would say it is to

deliver education in the form of teaching. Others would say it is to produce new knowledge through research. Yet others would say it is, as a business, to make a sufficient profit such that monies can be reinvested in staff, estate or equipment. The direct consequence of this is that establishing the goal or goals of some system of action is the first step in designing any system of organisation.

REFLECT

What is the purpose of Goronwy Galvanising? What is the purpose of the meals on wheels service?

2.5.1 Value and value-creating systems

Value
A general term used to describe the worth of something such as the output from some system of organisation.

Value-creating system
Organisations are best seen as systems directed at the creation of value.

The goal of most systems of action involves the creation of **value**, because organisations are best seen as **value-creating systems**. This begs the question: What is value? At its most basic, value is anything considered to be of worth to somebody. Typically organisations provide or create two types of value – goods (products) and services.

The concept of value is at the heart of much business literature which considers strategy, innovation and change. Michael Porter thinks of organisations as value chains (see Section 6.3) and believes that competition among business organisations is all about the attempt to deliver better value to customers. Lean thinking focuses upon improving manufacturing by designing what it refers to as the value stream to eliminate 'waste' – non-value-adding activities. Alex Osterwalder conceives of strategy-making and digital innovation in terms of developing the value proposition of some business.

Establishing the goal or goals of some system of action is the first step in designing organisation. Peter Checkland thinks of the goal of some system of activity in terms of its central transformation. The central transformation establishes the purpose of some system of activity. It expresses the key value transformed by this system of activity. Consider medical emergency response again. For an emergency ambulance or response service the key value here is the service of providing emergency healthcare at point of incident. This is the central transformation for this system of activity.

2.5.2 Coordination problems

Coordination problem
The problem of achieving joint action among a multitude of actors in fulfilment of a goal in common.

Accomplishing the goal of some activity system involves multiple actors performing multiple actions, time and time again, sometimes in different places. Therefore, any system of activity designed to create value in some way is subject to coordination problems. The philosopher David Lewis (2002) argues that a **coordination problem** exists when two or more actors have a goal in common and have to take independent but interrelated action to achieve this goal. Coordination problems are resolved through conventions of action. A convention is an arbitrary expectation as to how actors should act in particular circumstances.

Consider this example. Driving along a road network is a system of activity. Drivers of automobiles have a common goal which is to get between their point of departure and their destination using this road network and without colliding with fellow actors (other drivers and vehicles) using this network. This means that anyone attempting to drive along a road network experiences a series of coordination problems. Such coordination problems are resolved through adopting one or more conventions of

driving. Within a country such as the UK such conventions are documented in the *Highway Code*. Hence, to drive safely on the road networks of the UK, we follow conventions of driving documented in the *Highway Code*.

Consider one coordination problem and some conventions that resolve this coordination problem. At a traffic roundabout multiple drivers have the common goal of negotiating their entry onto the roundabout and their exit onto some road. At a roundabout in the UK, drivers follow conventions such as driving on the left and giving way to traffic on the right. In most other countries of the world you would adopt the convention of driving on the right and giving way to traffic on your left. This demonstrates the arbitrary nature of convention. These conventions of driving are not fixed. The effective coordination of multiple actors depends upon all actors knowing the appropriate way of doing things (conventions) in certain situations, and of course adopting them appropriately within action.

REFLECT

What coordination problems do you think people working for the meals on wheels service face?
Can you think of one coordination problem faced in undertaking teaching at a university?
Where do issues of coordination arise in the case of Goronwy Galvanising?

2.5.3 Equifinality and design

Equifinality
The idea that a system can be designed to fulfil its purpose in a number of different ways.

Ways of organising can be designed because systems of action are open systems and all open systems are subject to a property known as **equifinality**. Equifinality means that the goal or outcome of some system of action can be achieved in a number of different ways. This implies that we can design different systems or patterns of action to achieve the same goal; that we can implement different conventions of action to achieve the same outcome, of creating value.

So business activity is instrumental action, meaning it is directed towards achieving some goal. Business activity involves the transformation of value – producing, distributing and consuming value. In the early twentieth century Frederick Taylor proposed that management should closely study the way in which business activity is performed, with the aim of redesigning activity to better achieve established goals. One of his studies was of workers shovelling raw materials (such as iron ore) within US steelworks. The transformation here is the movement of some volume of raw material from one place to another. Taylor prototyped a number of different ways of shovelling raw material and implemented a number of changes to this activity based on an evaluation of the performance of each different convention of action. Such changes involved training workers in the use of different shovels for different material and introducing regular rest breaks for workers.

2.5.4 Performance and performance management

To design any system of action we not only need to know or establish the goals for the system, we also need to establish the performance of the system. So, what is performance?

Efficacy
A measure of the extent to which a system achieves its intended transformation.

In terms of activity, performance is some assessment or evaluation of whether you are doing the right thing (**efficacy**), doing something with the minimum resource (**efficiency**) or doing something that contributes to the goals of some higher-level system of action (**effectiveness**). Therefore there is a clear relationship between performing some business activity and measuring performance.

Efficiency
A measure of the extent to which a system achieves its intended transformation with the minimum use of resources.

Effectiveness
A measure of the extent to which the system contributes to the purposes of some higher-level system.

Take the activity of driving an emergency ambulance to an incident. The transformation here involves moving paramedics and specialist medical equipment to the location of some medical emergency. The performance of this activity might be measured in a number of different ways. One of the ways this activity is measured in practice is in terms of response time – how long it takes an ambulance to get to an incident. Since delivering medical treatment quickly at point of incident is a key goal for this activity system, this is best seen as a measure of the efficacy of this system – how well it is doing what it is designed to do.

So what is measurement and why do we measure performance? And how does performance measurement relate to performance management? All measurement for us is a form of communication. To measure something we choose particular signs (see Section 3.4.4) to stand for certain things in which we are interested. We then use these signs in the evaluation of the worth of some system or pattern of activity.

For instance, our measurement of time employs a set of signs and these signs correspond to a set of arbitrary conventions for communication. Our division of time into seconds, minutes, hours, days, weeks, months and years is a set of useful but arbitrary conventions. We have also devoted much effort to devising technology (clocks) that can accurately signify such conventions.

Having established certain signs for measurement we can use such signs to stand for certain features of some activity or a series of activities. We might use our measures of time to indicate precisely when some activity happened, as in the case of making some booking or receiving some delivery. Or we might use such measures to indicate the duration of some activity or set of activities, such as the time taken to shovel a given volume (another measure) of iron ore or the time taken to respond to an emergency incident.

REFLECT

What signs do we use to locate things and events and how do we use these signs for measurement?
It is sometimes difficult to specify precise performance measures for an activity system. What difficulties might be experienced in attempting to specify efficacy, efficiency and effectiveness measures for a business?
What sort of performance measures might be set for a voluntary sector organisation such as the meals on wheels service?

RECAP

Performance management is the use of certain defined performance measures to control activity. Such measures may communicate the efficacy of some system (how well the system achieves its purpose), how efficient the system is (how it uses resource) or how the system contributes to some higher-level system (effectiveness).

2.6 CONTROL

Control is effectively the way in which the order or patterning evident within some system is sustained. We know that something is systemic if it is ordered or organised; if we see evidence of patterning. In other words, we observe a common pattern across situations. Hence a common pattern of activities is evident in situations such as the meals on wheels, or the Goronwy Galvanising, or the medical emergency response examples. These patterns consist of routines through which organisational actors perform work.

Control
The process that implements regulation and adaptation within systems.

Control is the way in which such patterning of order is created and maintained across situations. We recognise something as having a distinct identity – as being a system – through some patterning in the world. Control is the process by which a system ensures continuity through time. It is thus the means by which system identity is sustained. Control is also the way in which the system maintains its viability in terms of changes in its environment. Control is the means by which the action of some system is reproduced. Control produces the patterning evident in systems of activity, communication and representation among groups of actors.

Regulation
The process of ensuring that a system remains viable.

Hence control can be conceived both as a process of **regulation** and a process of adaptation applicable to systems. The typical meanings associated with the term *control* are stability and conservation. This side of control is frequently referred to as regulation and is typically concerned with the internal operations of some system. In terms of regulation, control ensures that a system will recover some stability after a period of disturbance and maintain its viability over time. For instance, if we were to observe the work of a particular organisation such as the meals on wheels service in close detail for a number of weeks we would see clear evidence of such patterns. Different actors within such settings will reproduce similar modes of activity, communication and record-keeping, time and again.

Adaptation
The process of ensuring that a system continues to sustain itself in the face of environmental change.

However, there are alternative meanings associated with the process of organising. This side of control is frequently referred to as **adaptation**. Adaptation is the evolutionary side of control and is concerned with the external relationships between the system and its environment. Systems generally exhibit some form of control that enables the system to adapt to changes in its environment; changing its ways of organising to ensure a degree of 'fitness' between system and environment.

Hence, if we consider a manufacturing organisation such as Goronwy as a system, then the internal activities of this organisation must be regulated to ensure that it performs efficaciously, efficiently and effectively. But such an organisation also has to adapt to its competitive environment; it must ensure that it produces things demanded by its customers at appropriate prices.

DID YOU KNOW?

Much of the literature on organisational adaptation makes an analogy between organisations and biological organisms. In this sense, organisational adaptation is seen as similar to the process of natural selection. Animals evolve to fit their ecological environment. Organisations that survive 'evolve' to fit their economic environment. Organisations that do not evolve fast enough to fit with changes to their environment go out of existence.

Control is typically exercised through some form of performance management activity which monitors some operating activity and reacts to certain changes measured in the operating activity. In Figure 2.6 certain measures are established for some operating activity – setting certain targets to be met. These are sometimes referred to as control inputs. Measurement is then taken of the operating activity itself and communicated to the control activity in terms of the established measures. If there is substantial variance between the actual measures of performance and the targeted measures of performance then certain changes must be communicated to the operating activity.

Consider control in relation to the emergency ambulance case. A target is typically set for an ambulance trust in the UK of a response time of 8 minutes for life-threatening incidents. To control this activity, actual response times of ambulances to incidents need to be measured. These actual response times are then compared against the target set for the response time. If for a large proportion of incident patterns actual response times are substantially greater than the target set, then changes need to be made to such systems of activity.

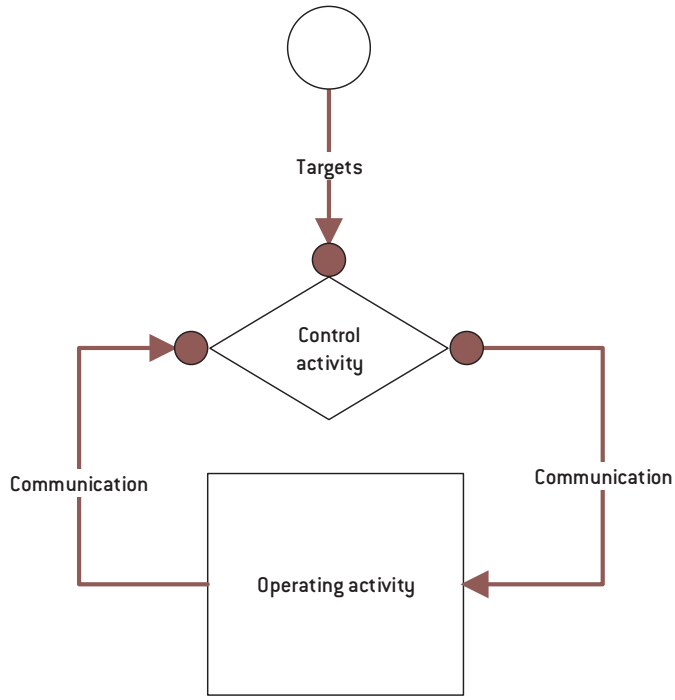


Figure 2.6 The exercise of control

2.6.1 Feedback

Feedback
The way in which a control process adjusts the state of some system being monitored to keep it within defined limits.

The loop of communication and control evident in Figure 2.6 is sometimes referred to as *feedback*. In fact the type of feedback evident in the emergency response example is an example of negative feedback. Sometimes known as a balancing loop or damping feedback, it involves control activity monitoring what is being communicated from the operational process about its performance. The control activity detects variations from defined levels of performance provided by targets set. If communicated performance varies from established levels, then the control activity initiates some actions that *reduce* or decrease the variation by communicating changes to operating activity.

Consider another example of negative feedback. In the case of Goronwy Galvanising a number of operatives were employed to check incoming steel batches. They effectively acted within a pattern of control activity and used a set of rules to determine whether a batch was conforming or non-conforming. If a batch was conforming, then the material was passed to further operators who moved the batch through the galvanisation process. If the batch was non-conforming, then it was dispatched back to the customer.

2.6.2 Decision strategies

Decision strategy
A set of rules that implement control inputs.

As is evident in the Goronwy example, control activity is normally implemented or realised as either an explicit or implicit **decision strategy**, in which a decision strategy can be considered a set of decision rules.

In a heating system, thermostats normally act as control subsystems. A thermostat is set at a desired temperature (the target). It then monitors the temperature of its environment, and when this reaches the set level, it activates to switch off the heating components (such as radiators). Once the temperature in the environment drops back below a defined range, the thermostat activates again, to switch the heating components back on.

A decision strategy such as this can be thought of as a series of IF THEN statements or decision rules. For example, these are the decision rules for the decision strategy embedded in a thermostat:

- IF sensed temperature < desired temperature THEN open heating valve to increase flow of heat.
- IF sensed temperature > desired temperature THEN shut heating valve to reduce flow of heat.

REFLECT

What sort of decision strategies might be set for a voluntary sector organisation, such as the meals on wheels service?

2.6.3 Performance measurement

Performance measurement
The establishment of performance targets and the process of monitoring the achievement of such targets.

Control typically relies upon performance management through target setting. Targets can be seen as a way of instituting goals within activities. But managers need to be careful in the design of **performance measures** as targets. Because, as the business guru Digby Jones says: '*What gets measured gets done*'. In other words, performance measures act as a focus for action. Actors within activity systems will always work towards targets because they know this is the basis on which their performance is measured. So managers must make sure that the targets they set for some systems or patterns of activity are closely aligned with the goals they wish to establish for the activity system. Managers need to ask themselves continuously: are the targets I set getting you to do the right thing?

Consider what happens when targets are misaligned with the potential goals of certain activity systems. UK secondary (high) schools have been ranked by the exam results that their pupils achieve for many years. Not surprisingly, teachers tend to teach to exams and pupils tend to work in relation to the learning outcomes set for exams within a national syllabus. The key question here is: Are secondary schools organisations for education or for the achievement of satisfactory exam results? Likewise, healthcare trusts (units of the NHS) within the UK are typically measured on the size and length of their waiting lists for operations. As a result, many trusts, to remain within target, pay for expensive operations in the private sector as a means of offloading patients from their waiting lists. *Is this an effective use of health service money?* In 2012, analysts claimed that Microsoft lost market share because of its bad performance management practices at the time. This system, known as stack-ranking, forced each of its business areas to rank a certain percentage of its employees as top, good, average or poor in their performance. This meant that even if the business area was performing well a certain quota of employees were rated poor. Not surprisingly this appears to have interfered with some important goals for any software development, namely, to foster high levels of cooperation and teamwork.

REFLECT

Business strategy can be considered as a form of control used in organisations. Such business strategy might be expressed in a mission statement (see Section 11.4.3). Can a mission statement be considered as a set of targets, and if so, how is it used to regulate or adapt organisational action?

RECAP

Control is the activity which ensures that operational activity is both regulated and sustained. Control is normally exercised through the establishment of certain measures as targets. Operational activity is then compared with these measures and appropriate action taken to ensure that activity stays within the measures set. This loop of feedback relates communication with control.

2.7 MODELLING ACTIVITY

Business analysis
The analysis of systems of business (organisation more generally).

Business design
The design of systems of business (organisation more generally).

To understand business organisation and determine how it should change to adapt to its environment we engage in systems analysis and design. Because systemics is most often applied to business, the terms systems analysis and systems design tend now to be replaced by the terms **business analysis** and **business design**.

There is now a professional association of business analysts (International Institute of Business Analysis) which has produced a handbook documenting what it refers to as a 'body of knowledge'; this it uses to accredit business analysis professionals. The British Computer Society (BCS) defines business analysis as '*The methodical investigation, analysis, review and documentation of all or part of a business in terms of business functions and processes and the information they use*'. The definition of what business analysis means is therefore undergoing something of a change: from a narrow focus on gathering and documenting requirements for ICT systems to a more general approach for solving business problems in a methodical manner. Such method usually means applying the lens of certain perspectives – such as that provided by systemics – broadly. Business analysis involves taking a system perspective on organisations and building models of such systems to better understand how things are. Business design uses models to better understand how we would like things to be within business.

2.7.1 Models

We therefore undertake business modelling for several reasons:

- It allows the modeller to abstract certain features of some situation or phenomenon, and in this sense, simplify a business situation.
- It enables the modeller to represent these key features in an agreed way.
- The model helps people communicate and share a set of common understandings about a phenomenon.

Model
An abstraction of some domain

A good example of a **model** is a tube or metro map. The first map of the London Underground was designed by Harry Beck in 1933. Beck was an employee of the London Underground who realised that the exact physical locations of stations were irrelevant to travellers who just wanted to know how to get from one station to another. They were interested in the topology of this system; in other words, how the stations are connected. So he drew up a map which was effectively a model of the actual underground railway network. It highlights or abstracts key features and represents them as a series of circles (for stations) and coloured line segments (for tube lines). It does not show in proportion the distances between stations, but it does show the features that many users want.

Ontology
That branch of philosophy concerned with theories of reality. Also used to describe a systematic model of some area of existence.

Business analysis and design use the language of systems to build what artificial intelligence (AI) (see Chapter 13) researchers and software engineers call ontologies. An **ontology** is a term borrowed from philosophy: it means a systematic account or model of an area of existence. This is also often called a universe of discourse or domain of discourse, meaning the things that a group of actors commonly refer to or describe.

But we should also include within an ontology the things that actors do. This explains why we refer to the ontology of some business or domain of organisation as a business model (see Chapter 11).

Models make explicit the assumptions underlying the performance in some domain that are normally implicit. Organisational models are useful for management in a number of ways. They help managers better understand the organisation they are responsible for, they aid decision-making and they are useful for managers in learning the effect of their decisions.

However, managers should not make the mistake of assuming that the model is the system. The model is always an approximation, abstraction or representation of the system of organisation. Generally, it will have much less variety or complexity than the system itself. The art of management frequently consists of trying to draw out sufficient essential details of the operation of the system for the purpose of effective control.

In this chapter we consider models of activity. In Chapters 3 and 10 we consider other models of importance to organisation such as models of communication and models of articulation.

Models of activity systems require some representation of patterns of activities undertaken by actors or roles across time and space.

2.7.2 Activities

Activity
An activity is some transformation of the world performed by some actor or actors.

An **activity** is some transformation of the world performed by some actor or actors. This is why we typically describe some activity using an action word (verb) to indicate the transformation undertaken. This action word is then followed by some referring word (noun) to indicate the thing transformed. Hence in the private sector we might define activities such as *manufacturing a table*, *growing foodstuffs*, *transporting passengers* or *retailing clothing*. In the public sector we might define activities such as *caring for the elderly*, *educating children*, *paying benefits* or *collecting household waste*.

2.7.3 Roles

Role
A package of expected (conventional) actions assigned to actors in certain social situations. A resource used by actors to guide action.

To adequately get a handle upon some activity we also need to describe the actors, or more likely the **roles**, involved in each activity. The analogy here is between organisational life and drama. In Shakespeare's play *As You Like It* he gives a character the following line: '*All the world's a stage, and all the men and women merely players; they have their exits and their entrances, and one man in his time plays many parts*'.

A role is a convenient label (a sign) for a package of expected (conventional) actions. Roles, when assigned to actors, are resources which people utilise to guide their action. Hence, Jane Bloggs is a name (a sign) used to identify a particular actor. When we say that 'Jane Bloggs is a Production Clerk' we define a particular 'hat' that this particular person is expected to 'wear'. It defines the role assigned to this person and helps us understand the likely activity she will be expected to undertake or enact.

2.7.4 Patterns of activity

Organisational activity occurs in patterns. By this we mean that we can observe repeated sequences of instrumental activity designed to achieve some goal or goals. Hence there is a common pattern of activity undertaken by multiple actors within the organisation domain of medical emergency response. Here is a 'recipe' for putting together a model of some pattern of activity.

Start with the goal or central transformation of the pattern such as indicated in Figure 2.7. Here, the transformation is the provision of emergency healthcare at point of incident.

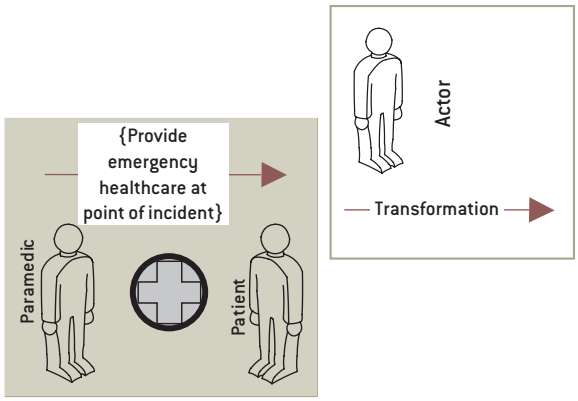


Figure 2.7 The central transformation

Then think of the activities that must be undertaken to achieve this central transformation such as those indicated in Figure 2.8. Hence to provide emergency healthcare we first have to deploy our resources such as ambulances and their crews strategically around some geographical area. We then have to get designated resources to incidents.

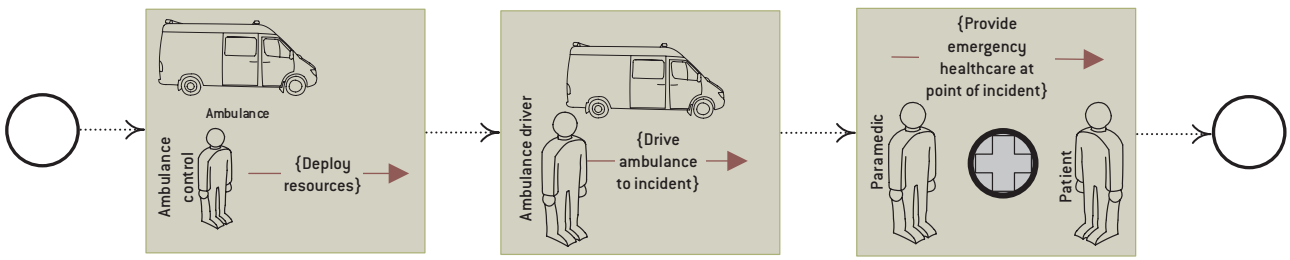


Figure 2.8 Input activities

Then think of activities that must be completed after the central transformation is undertaken, such as those indicated in Figure 2.9. Therefore, after we deliver healthcare, an assessment is normally made as to whether the patient demands further treatment. In such a case the patient must be transported to the nearest general hospital. After delivery and handover of the patient into the care of other healthcare professionals the ambulance resource can be released back into the system of action.

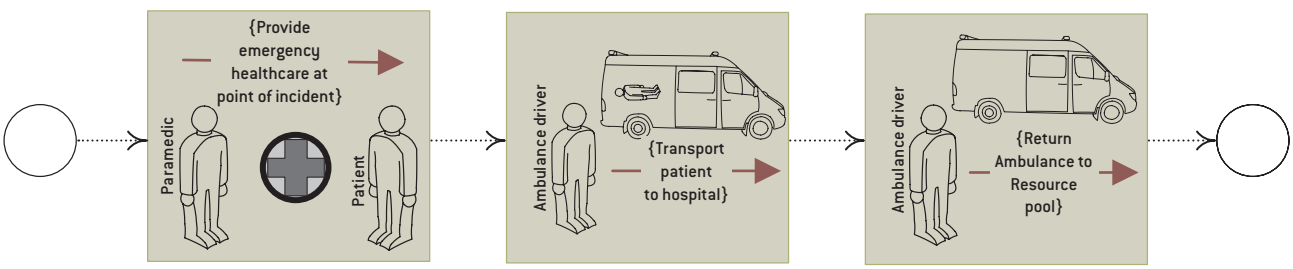


Figure 2.9 Output activities

This basic 'recipe' can then be the starting point for elaborating upon the pattern of activity in more detail, such as that provided in Figure 2.10.

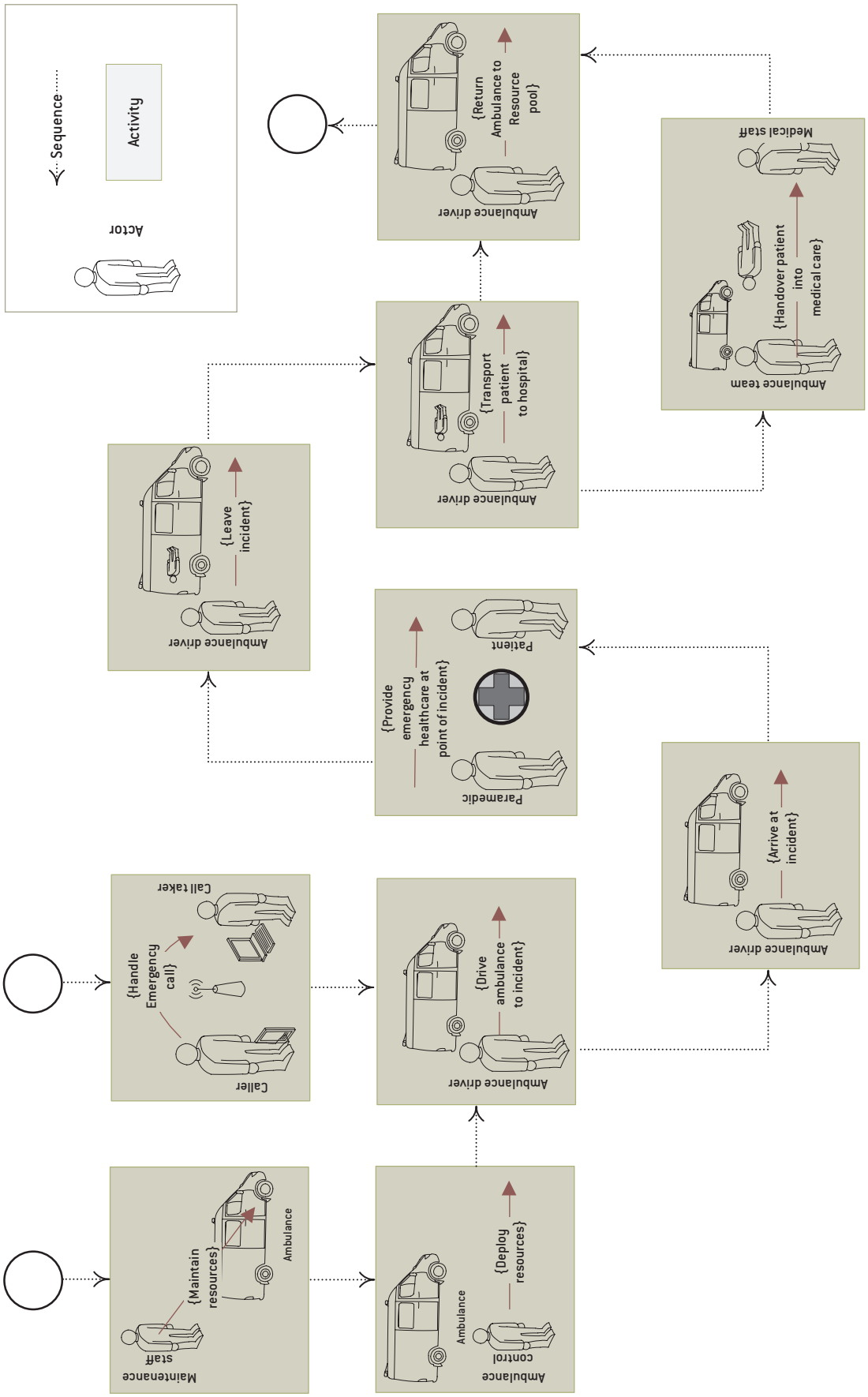


Figure 2.10 A complete pattern of activity

Activity system
A coherent collection of interrelated and coordinated activities performed by some group of people.

In Figure 2.10 the start of the **activity system** is indicated by an open circle with a dotted arrow emerging from it. The end point of the activity system is indicated by an open circle with a dotted arrow entering it. Each activity is represented by a box and the sequence of activities is indicated by dotted arrows. Within each box actors or roles are represented as mannequins and labelled with an appropriate role name. The activity itself is represented by a labelled arrow. Additional icons are added to help improve understanding where needed such as ambulances and prone patients.

REFLECT

How important is modelling to the effective management of organisations? Suggest some ways in which having a good model of some aspect of an organisation helps managers make better decisions.

2.7.5 Visualising systems of activity, information and data

Visualisation
The process of building a visual representation of something.

As we shall see in Chapter 10, designers concerned with the proper application of ICT to issues of organisation generally use **visualisation** a lot in their modelling. Following this accepted practice, we use many examples of visualisation, such as Figure 2.10, to illustrate the ways in which designers understand the complexities of the various types of system making up some domain of organisation. At this point it is therefore appropriate to provide a key or a legend to some of the features of visualisation that you will see in our diagrams of activity systems. We shall explain further aspects of this visual notation applicable to data and information systems in further chapters and we shall refer to such visualisations later as pattern comics, because they attempt to represent the patterns making up the various systems of organisation. The elements we utilise in the diagrams of activity systems are represented and described in Figure 2.11. We shall consider in more detail how each of these elements may be used within analysis and design work in Chapter 10.

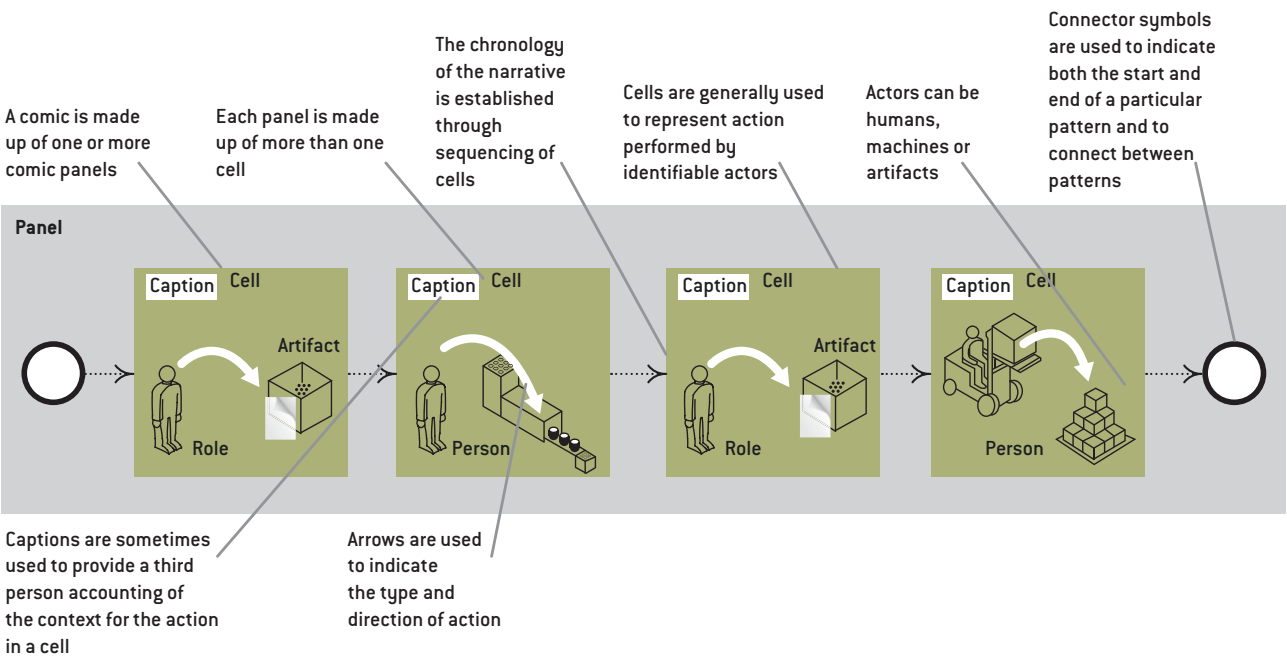


Figure 2.11 Elements of an activity system visualisation

2.7.6 Business processes and activity systems

The idea of activities occurring in patterns is fundamental to many approaches which attempt to understand (analyse) and design ways of organising. Within Operations Management lean production is viewed as a stream of transformative activity. Within Organisational Behaviour habitual action is typically framed as organisational routines. As we have seen, within soft systems work patterns of activity are thought of as activity systems. And within ICT systems office work is frequently formalised in terms of workflow. There are also many business design techniques based upon the idea of modelling activity patterns such as process modelling, narrative explanation, value stream mapping and service blueprinting.

Business process
A term which tends to be used in various ways, sometimes to refer to an activity system.

The idea of **business processes** and the modelling of such processes is one which is particularly well used within the ICT industry. It is tempting to say that the term 'business process' is another term for an 'activity system', but that is not strictly true. Both the idea of a business process and that of an activity system clearly rely upon a systemic view of organisation, and as such both think of organisation or ways of organising as a series of transformative actions which relate together in the achievement of some goal. However, the idea of a business process and the associated modelling of such processes tend to relate together the coordination of activity with the articulation of data in one overall representation. Process models also tend to leave out the consideration of the accomplishment of information through communication which we feel is particularly important for understanding information systems. For this reason we adopt a form of modelling through visualisation which can be seen to reflect core elements of process modelling as adopted in approaches such as Business Process Modelling Notation (BPMN), but which highlight important features of the theory imparted in this book.

2.8 CONCLUSION

This chapter considered the important context for any information systems, that of organisation. It began by considering some classic viewpoints of the organisation, and distinguished between the institutional perspective and the action perspective. It then showed how both viewpoints are compatible by considering organisations as complex, adaptive systems. This unifying perspective allows us to see an organisation as both an institution and a collection of actors coordinating their activity to achieve a common purpose.

The concept of a system has had a profound influence on the area considered in this book. This is seen, for instance, in the label 'information system', the primary bridge between human activity and ICT. The system concept is applied both to technology such as hardware and software ('hard' systems) and to human activity ('soft' systems). Information systems today (as we shall see in Chapter 4) are key examples of hybrid or sociotechnical systems.

Systems concepts have heavily influenced the design of modern computer technology. Systems thinking also influenced the creation of the communications revolution that underpins the Internet and the World Wide Web (see Chapter 5).

Systemic thinking underlies much contemporary thinking and work on business organisations, because it offers practical ways of engaging with organisational life. Most organisations can be modelled or analysed in systems terms. The aim of this is to identify deficiencies in current systems, then design new systems that can improve organisational performance. From this perspective, both information systems and ICT are key enablers for organisational change, as well as key agents of strategy.

In Chapter 3 we consider another foundation concept, that of information. We relate this concept to a number of issues arising from our treatment of organisations: the relationship of information to data, the role of information in decision-making and activity, and the relationship of management to all these issues.

2.9 REVIEW TEST

2.1 Equifinality means that a system can achieve its purpose in more than one way.

True or false? (Select only one by placing an X in the box)

- [ ] True
- [ ] False

1 mark

2.2 There are two major perspectives on organisation.

Select the two most appropriate terms from those below by placing an X in the box.

- [ ] Institutional perspective
- [ ] Bureaucratic perspective
- [ ] Action perspective
- [ ] Social perspective

2 marks

2.3 Three types of interrelated business systems typically build organisation.

Select three types by placing an X in the box.

- [ ] Information system
- [ ] Data system
- [ ] Accounting system
- [ ] Activity system

3 marks

2.4 Variety refers to how flexible a system is.

True or false? (Select only one by placing an X in the box)

- [ ] True
- [ ] False

1 mark

2.5 A coordination problem exists when two or more actors have a goal in common which they must achieve through joint action.

True or false? (Select only one by placing an X in the box)

- [ ] True
- [ ] False

1 mark

2.6 A _____ is a label for a package of expected actions.

Fill in the blank term below.

1 mark

2.7 Any pattern of organisation consists of the following elements.

Select all that apply by placing an X in the box.

- [ ] Actions
- [ ] Actors
- [ ] Machines
- [ ] Sequence
- [ ] Location

4 marks

2.8 An activity system supports an information system.

True or false? (Select only one answer by placing an X in the box)

- [ ] True
- [ ] False

1 mark

2.10 EXERCISES

- Consider an organisation known to you. Describe it first as an institution and then try to describe it as a series of actions.
- There are various ways of classifying systems besides open or closed. Try to identify a number of other system types and give examples of each type.
- Identify one activity system known to you. Who or what are the key actors involved in this activity system?
- Investigate the notion of control in relation to one activity system in an organisation such as a university. How does the control ensure regulation of activity?
- Investigate one activity system of interest to a university such as the enrolment of students. Develop a simple visualisation of this activity system.
- Consider university teaching as an activity system and suggest some appropriate performance measures for it.
- Control through feedback is frequently used to maintain the homeostasis of a system. Investigate the term homeostasis in greater detail and report on your findings.

2.11 PROJECTS

- Examine the literature on business information systems. Determine which of the two perspectives on organisation is most used in this literature.
- Attempt to apply some aspect of systems thinking to a non-trivial problem in business or commerce. For instance, consider the problem organisations such as Tesco have in managing their supplies and suppliers. Attempt to model this supply chain as an activity system and consider the usefulness of applying a systems approach to this area.
- The systems approach has been criticised by a range of authors in the areas of organisation theory and organisation behaviour. Investigate this literature and use it to critically determine the degree to which it is appropriate to use a systems model for describing and understanding organisations.
- The whole is greater than the sum of its parts or the system is greater than the sum of its subsystems. What do you think is meant by this in terms of the three levels of business systems (activity systems, information systems and ICT (data) systems) examined in this book? Provide some examples of the way in which these principles reflect organisational life.
- Attempt a small project in designing some activity system for an organisation known to you. For instance, consider admissions activity at a university. How could this activity system be improved, and how important is ICT to your redesign?
- There are a number of different graphical notations for specifying models of activity systems. Investigate two distinct notations for specifying activity system models. Develop some criteria of comparison (such as number of constructs or ease of drawing) and analyse each approach using these criteria.
- Models are useful as a means of joint understanding not only within a particular organisation but also between organisations. Some have proposed the development of high-level or generic models that may be applicable across organisations within the same industrial sector. Suggest some of the benefits and problems of this proposal. Determine to what degree it is possible for organisations to reuse existing generic models to help in organisational analysis and design.

2.12 FURTHER READING

There are many books on organisational theory and organisational behaviour. Bratton et al. (2010) provide a comprehensive review of the field. Morgan (1986) provides a number of different perspectives on organisation. This chapter has provided an overview of systems theory as applied to organisations, which is particularly designed to act as foundation to our consideration of informatics. Checkland (1999) provides the definitive account of soft systems work upon which the approach to activity systems described in this chapter is built. Jackson (2003) provides a more general but comprehensive overview of the range of systems thinking applied to management practice. The theory behind the distinction between activity, information and data systems is explored in my own book (Beynon-Davies, 2011).

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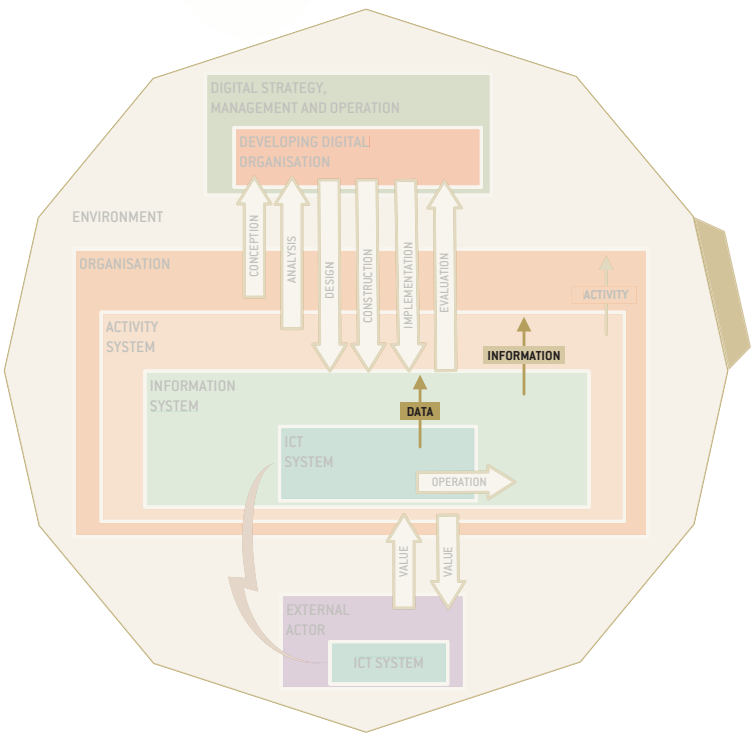
3 DATA AND INFORMATION

'Take care of the sense, and the sounds will take care of themselves.'
– Lewis Carroll (1832–1898) *Alice's Adventures in Wonderland* (1865), Chapter 9

LEARNING OUTCOMES	PRINCIPLES
Understand the nature of data and how it is different from but related to information.	Data are differences made in some substance. Certain differences are used to code symbols. Symbols are formed into larger entities as data structures, which may be transmitted as a message or stored in a persistent manner as records.
Explain the nature of information and its basis in purposive communication.	Information is accomplished by actors in acts of communication – sending and receiving messages. Any message has both content and intent. The content of a message refers to and describes the common things of interest between sender and receiver. The intent of a message establishes its purpose.
Describe the ways in which data systems relate to information systems and how systems of coordinated activity rely upon information systems.	Organisational and individual action is reliant upon data structures articulated within data systems. Acts of communication occur in patterns. Patterns of communication support patterns of coordinated activity through decision-making.

CHAPTER OUTLINE

3.1 Introduction
3.2 Data
3.3 Data systems
3.4 Information
3.5 Conversations for action
3.6 Conclusion
3.7 Review test
3.8 Exercises
3.9 Projects
3.10 Further reading
3.11 Bibliography



3.1 INTRODUCTION

Soon after the Norman Conquest, William the First sought to consolidate his power by conducting a survey of his new kingdom. This 'Great description of England' was published in a book which the common people referred to as the *Domesday* (pronounced Doomsday) *Book*, because Domesday referred to the day of judgement. The book appears to have had several purposes. First, it served to document the liability of estates in terms of the Kings Geld – an annual tax levied by the Anglo-Saxon kings and adopted by the Norman conquerors. Second, it served to document the resources of the newly established feudal order in England. Third, and perhaps most importantly, it served to legalise changes made to the kingdom by Norman possession. All these purposes were served by what was effectively a set of records or data structures – one example of which is presented below.

> *LAND OF THE BISHOP OF WORCESTER IN PATHLOW HUNDRED.. in Loxley. 1 hide. Land for 3 ploughs. In Lordship 1; 4 villagers with 1 plough Value before 1066 and later 20s; now 25s.*

Information and data are normally seen to be the fundamental 'stuff' of ICT. However, one key problem is that these terms are used interchangeably among a great deal of literature on the subject, and also are used in very loose ways within such literature. For example, the entries in the *Domesday Book* have been described both as data and as information.

In this chapter we shall examine the nature of data and information. But we want to be more precise about what these terms mean, and also how they relate. This greater precision will enable us to explain why data systems are different from but related to information systems (see Chapter 4) and how information systems differ from and relate to activity systems within organisations of all forms. Hence on one level the *Domesday Book* is a classic example of a data system for us – it was a data system used for articulating a complex set of data structures. The data structures were used to communicate different things to different people. Various people in the elite of society at the time were informed as to who owned which parcel of land or which item of property. This communication function is the essence of an information system. Finally, the *Domesday Book* was used to get things done. On the basis of what it communicated to the king's bureaucracy about relationships of property and land ownership, various taxes were levied on the population then under the control of the Normans.

In Chapter 2 we saw how the term organisation can be treated either as a noun (an institution) or as a verb (a continuous system of action). We also saw how these two views of organisation are in fact complementary. It is possible to see organisational structure as emergent from organisational action; indeed, from three interrelated types of action – coordination, communication and articulation. These three forms of action, as we shall see, are linked together through the concept of a *sign*.

This chapter considers the nature of signs as units of significance and demonstrates how they are crucial building blocks in understanding the role of ICT and information systems in organisations. The concept of a sign helps us relate notions of data, information, decision-making and activity in organisations and connect them to the three types of business system we introduced in the previous chapter: activity systems, information systems and data (ICT) systems.

3.2 DATA

During the early years of the industrial revolution most business organisations were relatively small, family affairs. To administer and control the performance of activity in such organisations informal communications were generally sufficient. Verbal and non-verbal communication was used for immediate purposes and written letters were used for communications that had to travel some distance or were about events in the future.

By the 1840s in Great Britain large-scale administrative offices had developed to handle the increasing complexity and size of business operations. A new philosophy of management arose around the same time which emphasised the use of standard and formal communications ('forms') for numerous purposes such as the issuing of managerial orders, tracking of worker activity and the production of summary reporting. We tend to forget that the use of the 'form', consisting of a set of defined and named areas for representing things upon paper, is a comparatively recent invention dating back less than 200 years.

Much communication in modern-day organisations still occurs through use of informal, spoken messages. However, formal communications represented in forms are now part of the essence of what we mean by organisation, even in the modern-day digital business. Organisations still create such forms on paper but increasingly produce and transfer such documentation as electronic messages or store the data on electronic records.

But why do we represent things in such manner? The main reasons lie in the limitations of human cognition. Human memory, for instance, is sufficient to support cooperative and simple activities between individuals in small groups. As groups grow, activities, particularly those reliant on economic exchange, need to take place between strangers and generally are more complex in nature, reliant typically on some division of activities among a multitude of different actors.

At some point in human development symbols started to be used to make persistent records of things. The key purpose of such records is to extend and compensate for the limitations of human memory. Records of economic transactions, for instance, institutionalise memory of past economic exchanges and the obligations placed upon individuals engaged in such exchange. Accurate record-keeping is also critical in establishing and sustaining trust between strangers engaging in economic exchange. Economic records not only account for the types and quantities of commodities exchanged, but are also important for supporting social relationships of ownership and debt.

3.2.1 The nature of data

Data
Symbols used to represent something.

So, what is **data**? Consider a couple of strange examples that illustrate the nature of data. For decades an organisation known as the Search for Extra-Terrestrial Intelligence (SETI) has been monitoring electromagnetic radiation emanating from outer space. It has not yet found a coherent radio signal among this traffic, suggesting any alien civilisation is attempting to communicate with us. However, animal scientists are convinced that the squeaks and whistles emitted by dolphins are a form of communication.

So what do these two examples have in common? The answer lies in differences. Data are differences made in a substance by an actor that makes a difference, in the sense of informing an actor of something of significance.

DID YOU KNOW?

Note that the word data is plural. You normally need a set of differences to make data. A single unit of data is sometimes called a datum.

Here is how scientists suspect that dolphins can communicate with each other and that aliens are not communicating with us. Consider the graph in Figure 3.1. If you plot the differences made in something like spoken English against the occurrence of such differences in actual speech, you get something approaching a 45-degree slope. This slope indicates that there is variation in human speech – that differences are being made with some substance (namely air) to make sound, and that certain sounds appear more frequently than others in a sampling of this sign-system.

If there is no variation then no differences are being made and nothing can be communicated, as in the case of the electromagnetic radiation monitored by SETI and emanating from outer space. Interestingly, the slope of the differences made by dolphin squeaks and whistles approaches that of human speech, providing strong evidence that these mammals are communicating, but we do not yet know what.

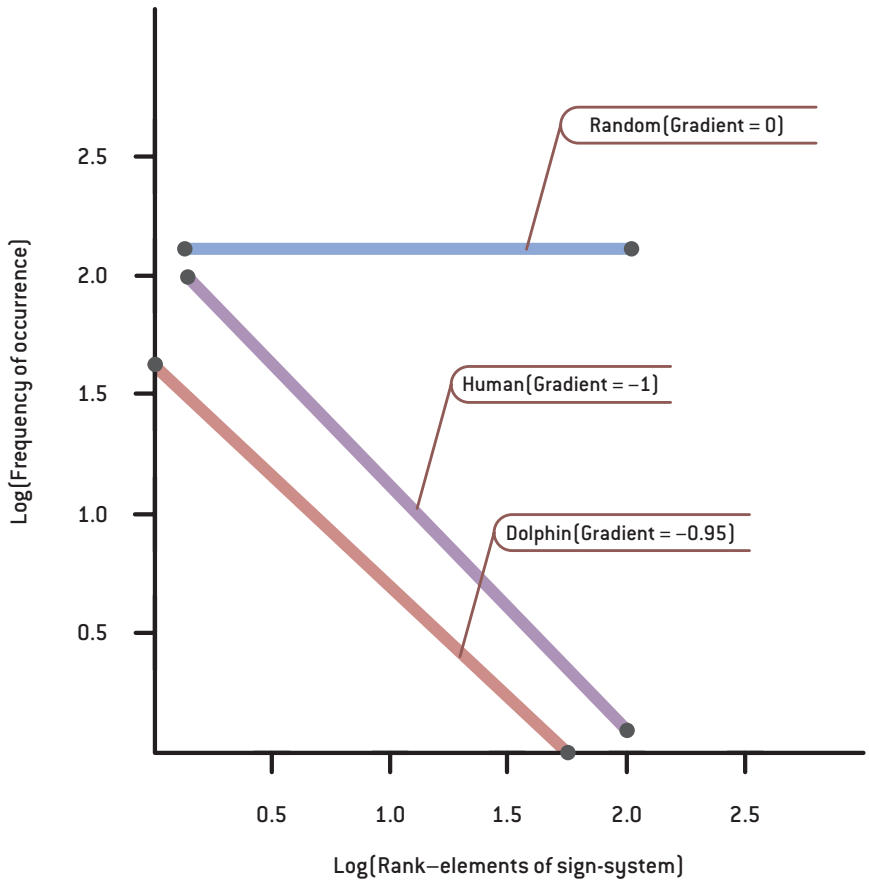


Figure 3.1 Differences evident in various sign-systems

DID YOU KNOW?

The graph illustrated in Figure 3.1 is an example of Zipf analysis. George Kingsley Zipf, an American linguist and philologist, studied statistical occurrences in different languages. He noticed that a small collection of elements (such as letters and words) in natural languages are used very frequently, but the vast majority of elements are used infrequently. This insight hints at an appropriate method for determining whether a signal consists of a code based on a language (rather than, say, a series of numbers, or a random succession of states). If you count the number of times certain letters appear in written extracts of English, you get a graph with a –1 (negative) slope. The same is also true of most other human written languages. A random string of letters (not conveying any meaning) appears as a flat slope on the graph.

REFLECT

In terms of written rather than spoken English, what is the most common letter that appears in written text and what is the least common?

3.2.2 Modulation and coding

Modulation
The process of introducing variety (differences) into a physical pattern such as a signal.

What is actually being plotted upon the graph in Figure 3.1 is the degree of modulation in some signal, such as human or dolphin 'speech'. In these cases, modulation consists of the pattern of differences made with the substances of air and water. Speech as a waveform would look something like that in Figure 3.2. Speech as sound is a pressure wave which travels through a solid, liquid or gas. In this form differences correspond to the peaks and troughs of the sound wave, and this variation corresponds to the modulation of the signal.

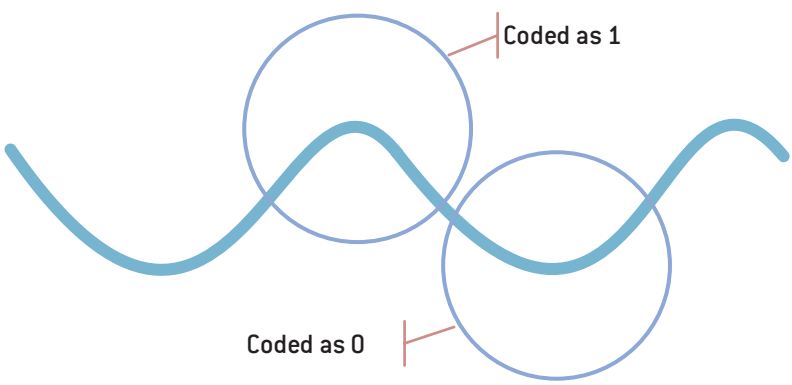


Figure 3.2 A waveform

Coding
The translation of a signal from one medium into the same pattern expressed differently in some other communication medium.

Certain differences made in some substance can be coded to form symbols. A waveform is an analogue signal in the sense that the differences are expressed over a continuous range. A digital signal has a small number of possible values, two for a binary digital signal. In a digital signal we might code a peak in the waveform as a 1 and a trough as a 0. This turns an analogue signal into a binary digital signal.

So data is formed from differences made within potentially any substance. Symbols are coded from such differences and formed into larger entities known as data structures – structures for data. Such data structures may act as messages conveyed as signals, and/or such data structures may be stored in some way within certain substances to record things – to build a collective memory of some things.

RECAP

Data are differences made in a substance. Certain differences made in a substance can be used to code symbols using modulation.

3.2.3 Data structures as messages

Bit
An abbreviation of binary digit – one of the two digits (0 and 1) used in binary notation.

The fundamental difference you can make with any substance is a binary difference. The essence of making a difference is being able to 'draw' a boundary around something. In doing so, an actor distinguishes that which is inside the boundary and hence part of the thing from that which is outside the boundary and not part of the thing. This is a binary distinction and explains why the most basic unit of discrimination, and hence the most basic way of coding data, is in terms of binary digits, otherwise known as **bits**. It can also be shown as a consequence of this that all other forms of coding can be collapsed into this basic form of coding in bits. That is why bits are the most fundamental way in which symbols are formed as data.

A basic difference between something and something else is typically coded as a binary digit, a 0 or a 1. We can see the power of bits by considering an example from the period of the Napoleonic War. At this time, the Royal Navy used sequences of flags to code certain messages sent between ships of the line, such as the famous message sent prior to the Battle of Trafalgar from Nelson's flagship HMS *Victory*: '*England expects every man to do his duty*'.

Let us abstract from this example and assume that some sailor needs to signal as a message a number between 0 and 127, using flags. Using a single, distinct flag to code each number he needs 128 flags to achieve this. If he decides to code the number in the message as a decimal number then he needs 21 flags – 10 for the units, 10 for the tens and 1 for the hundreds. Using a binary code he requires just 14 flags, consisting of 7 ones and 7 zeros. This is why the capacity of a communication (signalling) channel – how much data it can normally carry – is measured in terms of bits per second.

3.2.4 The Inka khipu

CASE

The strange case of the khipu demonstrates how data structures formed in pretty much any substance can be used as messages and to form records.

During the period AD 1200–1475 the Inka created a large empire stretching along the high Andes in South America. The empire was administered by a bureaucracy that made records using assemblages of knotted cord constructed from llama and alpaca wool and cotton (Figure 3.3). Khipu means to knot in the language of the Inka, and these artefacts were created and used by specialist keepers of the knots – the khipucamayuq. Lots of differences can be made with cords made from llama/alpaca wool and cotton. For instance, you can tie knots in various ways on these cords and position the knots at different places along the cords. We know something of how certain symbols were coded by using differences made in the construction of a khipu.

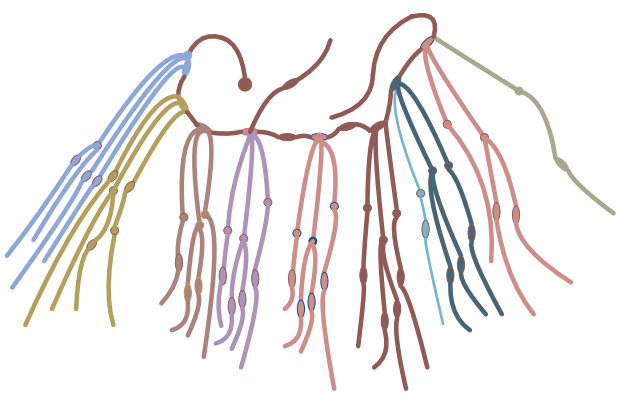


Figure 3.3 An illustration of a khipu

CASE
continued…

For example, we know that among certain khipu knots tied upon so-called pendant cords were used to code digits in decimal. A figure of eight knot was always used to code 1 as a digit and loop knots were used to code numbers between 2 and 9. Loop knots were created by tying a basic knot in a cord with a specified number of loops. The number of loops coded the digit. The position of a loop knot upon a pendant cord indicated whether the knot coded units, tens, hundreds, and so on. A gap in any position along the pendant cord where a knot would normally be expected coded a zero.

A pendant cord formed in this manner could be used to refer to a number or to symbolise some other thing, such as an identifier. Hence the digit 50 could symbolise a quantity such as the number of vessels of grain stored in a storehouse, or it could be used to code the storehouse itself – storehouse 50 (Figure 3.4).

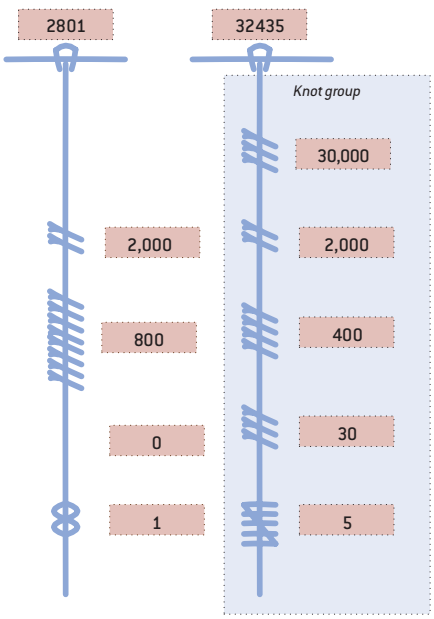


Figure 3.4 Coding pendant cords

3.2.5 The medium of representation

Theoretically, any form of matter, whether it be solid, gas or liquid, can be used to form data. Likewise, any form of chemical or physical energy can be used to provide a signal for communication. For instance, as we have seen, human speech travels as a signal consisting of a pattern of sound waves (acoustic energy through air), while hand gestures and facial expressions rely upon the reflectance and transmission of light (optical, reflected, physical energy). In contrast, honeybees communicate through the transmission of certain odours (gases diffusing through air) and through vibrating honeycomb within the hive (manipulation of a solid).

The medium or substance in which differences are made has an important bearing on the way in which data structures are used. Embodied data such as human speech or human facial expressions are fleeting – they disappear shortly after the differences have been made. This helps explain how data structures as signals differ from data structures as records. **Data structures** can be formed in non-persistent substances such as air waves, but in such circumstances can only be used as transient messages. Among the Inka a khipu was formed in a persistent substance, namely camelid wool or cotton twisted into cord. The differences formed in this substance persist long after the act of creating this data structure.

Data structure
A collection of data elements.

Forming data with a persistent substance has the important advantage of being able to act as a collective rather than an individual memory of something. Persistent data can be used by many different actors across different times and at different locations in space. So we know that khipu could act as records because they were rolled into balls, placed within the pouches of specialist runners known as chaski and transported to different people situated in different places within the Inka empire.

3.2.6 The ubiquity of data structures

As records, data structures come in a vast variety of different forms and may be used for a multitude of different purposes. Data structures may be paper forms, letters, documents and memos. They may be electronic tables in a database or electronic documents held on some data server or even emails, texts or social media messages.

Data element
A collection of data items.

Data item
A physical structure which can store some value.

All data structures can be seen to consist of a set of data elements, which in turn are formed of data items. So, an entire khipu would be the data structure, a group of pendant cords would be a **data element** and an individual pendant cord a **data item**. Or in a physical filing cabinet a drawer of the cabinet might form the data structure, while a hanging section placed in the drawer might be the data element, and an individual paper form placed in a section might be the data item. Or in an electronic database a table would be the data structure while a row of the table would be a data element and an individual attribute of a row would comprise a data item (see Figure 3.5).

Data structure

Order No.	Delivery No.	Product code	Order Qty	Order Weight
13/1193G	A3137	UL150	20	145
44/2404G	A3137	UL1500	20	1450
70/2517P	A3137	UL135	20	130
23/2474P	A3137	UL120	16	80

Data element

Data item

Figure 3.5 An electronic table as a data structure

REFLECT

Consider an everyday data structure that you come into contact with on a regular basis, such as a supermarket till receipt or a utility bill. In what way could these be considered as representative of a data structure?

3.2.7 The continued growth and importance of data

We have become a global society of record-keepers and hence our capacity to store data is increasingly important to organisation. The capacity of some data storage is not typically measured in bits but in bytes. A byte stands for by-eight and consists of a collection of eight bits. The amount of data created and stored in data structures of various forms by both organisations and individuals is growing astronomically (Figure 3.6). A kilo-byte amounts to 10^3 bytes (10 with 3 zeros following it), a mega-byte

10^6 bytes, a giga-byte 10^9 bytes, a tera-byte 10^{12} bytes, a peta-byte 10^{15} bytes, an exa-byte 10^{18} bytes and a zeta-byte 10^{21} bytes. We are generating more data now than at any time in human history. It is claimed that between 10,000 BC and AD 2003 we as a species created 5 exa-bytes of data, which is equivalent to the estimated amount of data in all the physical books held in the US Library of Congress – the largest physical library in the world. We now are estimated to create 5 exa-bytes of data every two days!

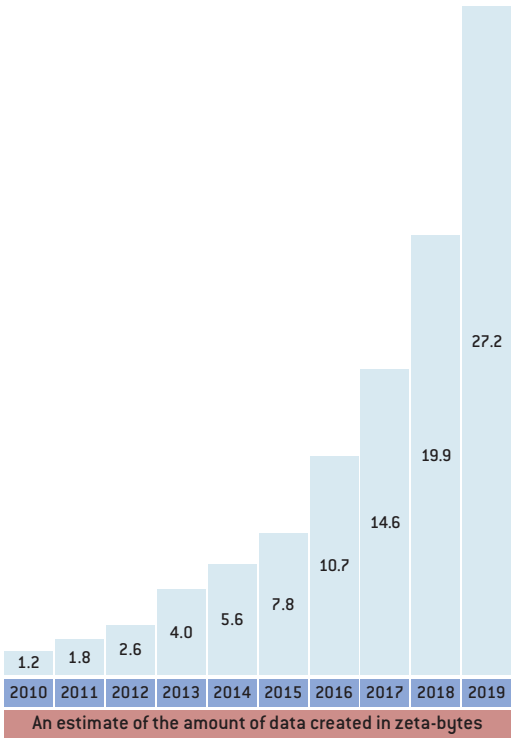


Figure 3.6 The growth in data

3.2.8 Coding schemes for binary data

To form symbols, strings of binary digits have to be coded up into larger structures. For instance, the American Standard Coding Scheme for Information Interchange (ASCII) defines a set of ways for representing alphabetic characters as binary strings, among other things. 10100001 stands for the capital letter 'A' coded in ASCII.

Data items within some data structure are normally declared to be of a given standard data type or format. A data type such as a character string, and an integer or a date, declares not only how data should be coded as a binary string but what operations can be performed on this data. Hence you can add two integers together but not two characters.

REFLECT

What sorts of operations can you perform on or with dates? For instance, can you add two dates together?

More complex data types or formats for data are needed for images, video and audio. For instance a colour image is built from a grid of pixels in which each cell within the grid is coded with a particular colour.

3.2.9 The importance of data structures

Records or data structures more generally are not really thought about much. But data formed in structures are critically important both to organisations and to individuals, in the sense that much organisational and individual action is reliant upon data structures.

As a citizen of a modern nation-state your biography is not only recorded but lived through data structures. Your birth is marked with a birth certificate, which enrols you as a citizen of the state. You pass various education exams and are issued with certificates which qualify you to do certain things. You undertake gainful employment and get recorded in employment, national insurance and taxation records, which require you to do certain things like pay income tax. You perhaps get married and are issued with a marriage certificate and may have children issued with their own birth certificates. All these data structures change your institutional status, and in turn your rights and responsibilities. You may at some point fall seriously ill and need to access data structures such as your NHS record or national insurance record to access healthcare and welfare benefits. Finally, your death triggers a death certificate, which is used by your descendants to resolve issues of probate (inheritance).

REFLECT

Think about all the data created about you as an individual throughout your life. Which is the most critical data structure in terms of enabling you to get certain things done?

3.2.10 Herman Hollerith and the electronic tabulator

CASE

The founding fathers of the United States of America wrote into the constitution that a census of the population should be conducted every 10 years. The US Census Bureau was established for this purpose and can be considered as a major governmental activity system that has been emulated worldwide. The first US census was undertaken in 1790. The census was funded by Congress and conducted by assistant federal marshals from 1790 to 1890. During this century all data processing was conducted by hand. Figure 3.7 illustrates the major activities undertaken within the system of census-taking as evident in the 1890 US census.

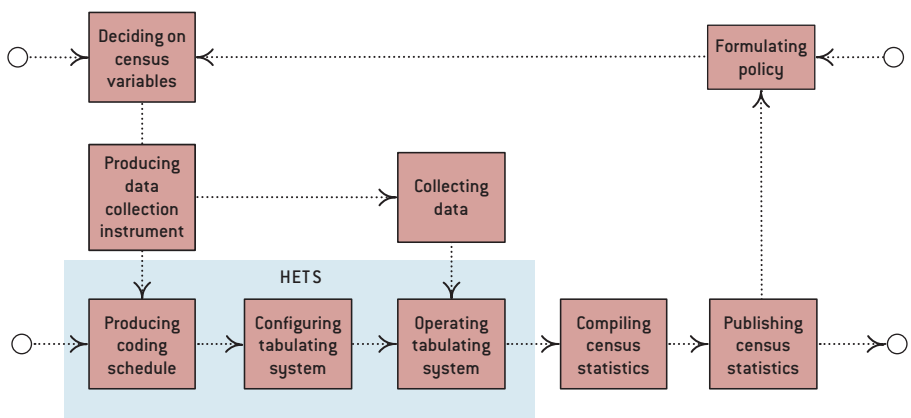


Figure 3.7 The place of the Hollerith Electric Tabulating System (HETS)

CASE
continued…

For the 1880 census the Census Office received an increase in funding and was able to employ its own enumerators (a person employed to work on the census of the population). Also, formal enumeration districts were defined for the first time. Over time, an increasing range of data items about the US population were collected (age, sex, race, place of birth, occupation, etc.). Not surprisingly, it took almost 10 years to complete the data processing by hand for the 1880 census. With increasing population size it was feared that the completion of the next census would overlap with the start of that immediately following.

Technological innovation supplied the solution to this problem of organisation. In 1890 the first automated census was conducted successfully due to an invention introduced by Herman Hollerith, known as the Hollerith Electric Tabulating System (HETS) (Figure 3.7). Central to this system was a scheme for coding census data onto punched cards. Each card was made up of 24 columns and 12 rows, allowing 288 distinct holes to be punched. As can be seen from Figure 3.8 a number of irregularly shaped regions or 'fields' were used to code facets of an individual upon this substance.

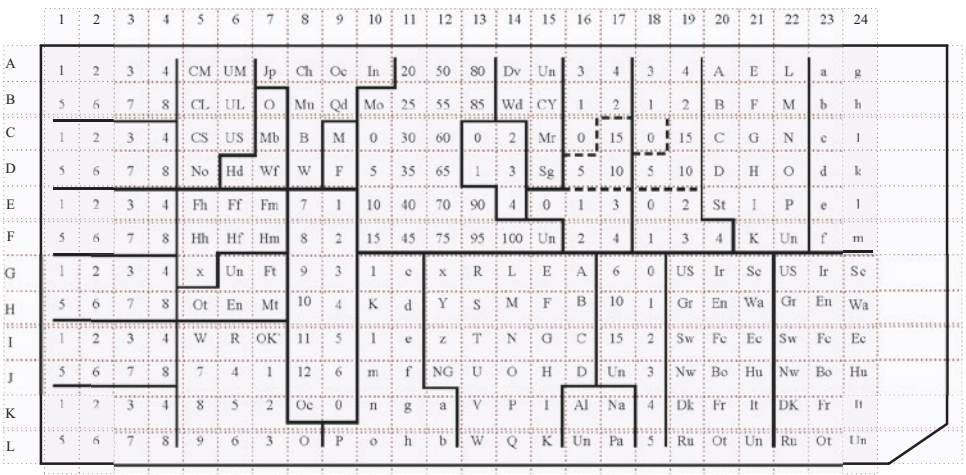


Figure 3.8 A punched card with its associated fields

Holes were punched onto cards to correspond to data gathered about each US citizen on an interview schedule. A sorting box was then used to automatically order cards by chosen characteristics such as gender, marital status and age. The sorted cards were then passed through a circuit press, one at a time. Pins were passed through holes in the card to complete an electronic circuit. A completed circuit caused one or more dials on a tabulator to increment, thus assembling totals for each census characteristic tabulated.

Within this case we begin to see a necessary separation being established between the representation of data and the processing or articulation of data, which still underlies modern business computing applications. The use of HETS for the 1890 census brought the timescale for the analysis of data down to two and a half years, saving US taxpayers five million US dollars. Tabulating machines and their associated equipment were soon being sold around the world for use not only by governments but by businesses as well. Hollerith sold on his invention to a company which would later become International Business Machines (IBM) – which continued to produce electronic tabulators into the 1950s.

Early computing machines based on Hollerith's design were used by Hitler's Nazi administration to compile two censuses of the German population in 1933 and 1939. These tabulating machines allowed the Nazi regime to identify Jews and other nominated groups in the population for eventual transmission to the death camps. Tabulating machines were even used in the death camps themselves to process data about the 'performance' of the extermination effort.

DID YOU KNOW?

Punched cards were used as the dominant input for computing devices up until the late 1970s.

REFLECT

A list is a data structure, frequently produced as a result of articulating data structures, such as that undertaken in the US census or during the Holocaust. Several lists were produced of Jews assigned to work in the factories of Oskar Schindler. An entry on such lists prescribed or proscribed certain actions taken in relation to persons. If you were on such a list, then you were transferred to work in the factories of Schindler. If you were on such a list, then you deferred being sent to the death camps.

Think of some other lists used in modern societies and how they are important to the actions taken about or with people.

RECAP

Symbols are formed into larger entities as data structures. Data structures may be transmitted as messages or may be stored in a consistent manner as records. All forms of coding data can ultimately be translated into binary differences as bits. The volume of data is measured in bytes.

3.3 DATA SYSTEMS

Data system
A system in which data structures are articulated.

Data structures are not static things which stay unchanged once created. As records, data structures are articulated within **data systems**. Data structures usually have a 'birth' – they are created by some actor. To help people communicate about and coordinate their activity many updates are likely to be made to data structures throughout their life. Data structures are read lots of times by many different actors, sometimes in many different places, because these artefacts communicate things of importance to actors. At some point a decision will be made either to archive a data structure or to delete a data structure. Forgetting about something in terms of some data structure is as important as remembering something through a data structure.

The life of a data structure can therefore be thought of as a pattern of articulation – a series of events involved with manipulating data structures. By articulation we typically mean four main types of action that can be undertaken on a data structure by an actor.

- **Create** involves encoding symbols in some new data structure, element or item.
- **Update** involves changing certain symbols in some existing data structure, element or item.
- **Delete** involves removing some existing data structure, element or item.
- **Read** involves decoding the symbols of some existing data structure element or item.

Figure 3.9 illustrates a typical high-level pattern of articulation which expresses the life of a data structure.

REFLECT

In terms of some data structure known to you think about how it is created, updated, read and deleted in terms of the articulation pattern illustrated in Figure 3.9. What is the key difference between deleting a data structure and archiving a data structure?

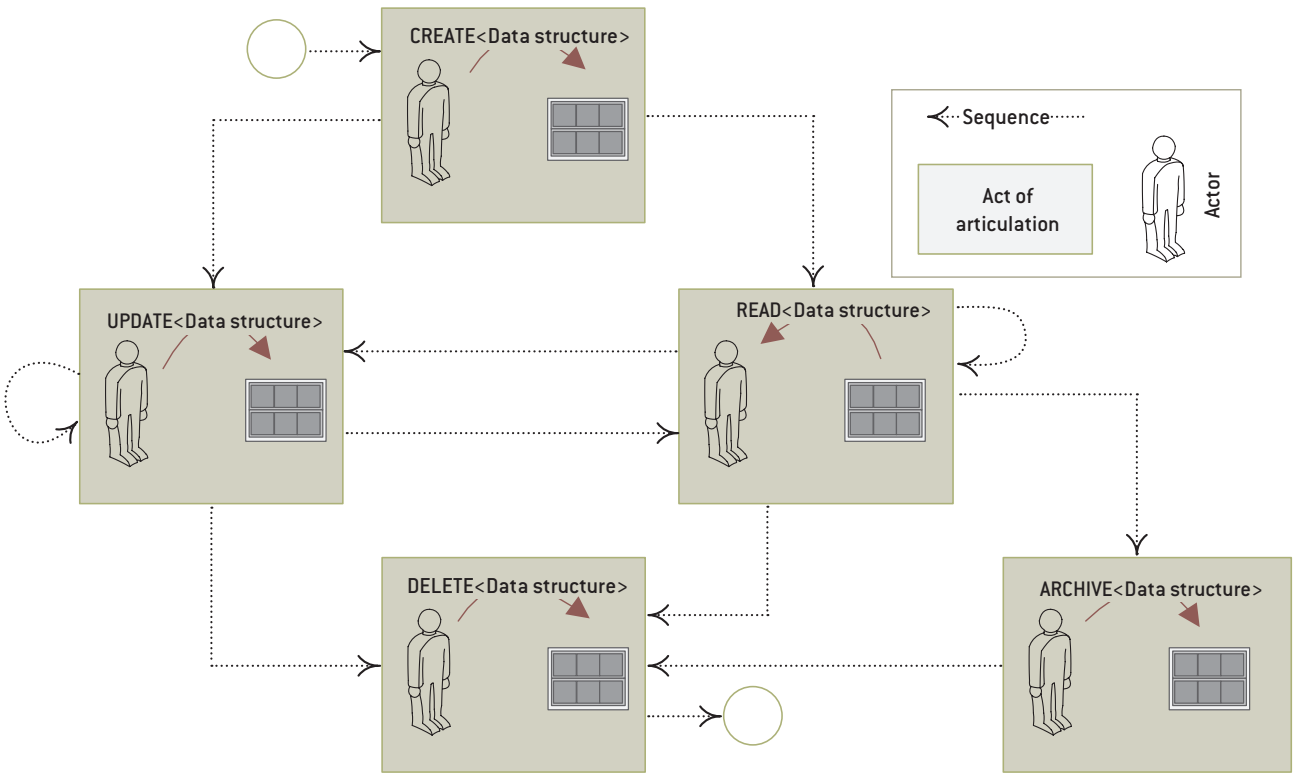


Figure 3.9 A typical pattern of articulation

3.3.1 The data system at USC

CASE

Back in the 1980s a UK university decided to offer a series of short courses to industry. At the time it was particularly interested in offering courses in ICT of some 3 to 4 days' duration. For this purpose, it decided to set up a commercial arm – USC (University Short Courses) – to develop, market and administer such courses.

Each short course offered by the company was created and maintained by one member of university staff, known as the course manager. However, depending upon the popularity of the course, a course might be presented by several different lecturers in addition to the course manager.

USC presented such courses both at a specially prepared site on the university campus and at commercial and industrial sites throughout the UK. The former type of course was described within the company as a scheduled presentation, while the latter were described as on-site presentations. Students on scheduled courses generally came from a number of different industrial organisations, while students attending on-site courses typically came from the same organisation. On-site courses gradually became a lucrative part of the business of USC as a number of companies began to use USC courses as part of their in-house training schedule for new employees.

CASE
continued …

A number of administrative activities were eventually established to manage the growing portfolio of courses and clientele. During the first couple of years of its establishment USC administrators created and maintained physical files containing paper records of courses, lecturers, presentations and attendance. The administration of financial transactions between organisations, individuals and USC was initially handled by the university's finance department, and hence no records were held by USC itself on financial matters.

During this period bookings were taken over the telephone for courses. When a person telephoned to register for a particular presentation of a course, USC staff needed to check the number of persons already registered. Each presentation was set a course limit, meaning that staff had to ensure that the number of people registered for a presentation was not greater than the course limit. This meant that staff needed to access records about how many people had already booked for a particular presentation.

Periodically staff had to also access their files to check that particular presentations were viable to run. Eventually it was decided that four students was a break-even point for costing a presentation. On a regular basis USC staff needed to search for those presentations that had fewer than four students registered for them. If fewer than four persons were registered one month before the scheduled presentation, then the presentation was postponed and scheduled for a later date.

Two weeks before a presentation staff telephoned each booked student to confirm attendance. One week before each presentation, staff needed to check that the presentation fee had been paid. Assuming a viable presentation, an attendance list was then produced. USC also needed to keep track of which lecturers were qualified to teach which courses. Using such records lecturers had to be assigned to scheduled courses at least six months ahead of a given course presentation.

After each course presentation, evaluation forms were handed out to attendees. On this basis data was gathered on the performance of lecturers and of courses. This data was used in decisions about revisions to the course portfolio, which took place at a special meeting held every six months.

As we have seen, whenever a group of people get together and attempt to engage in collective activity the issue of coordination arises. Some way must be found of answering the question, how do I coordinate my activities with others in pursuit of common goals? At USC the activities of lecturers and students needed to be coordinated. A particular lecturer needed to appear at a particular site at a particular time to deliver a particular course. Likewise, the employees of certain companies needed to know where to go and at what time and date to receive instruction.

To enable coordination of activities enacted by particular business actors, then communication is needed. At USC administrators needed to communicate to lecturers when and what they were expected to teach, and students needed to be informed of what instruction they could expect to receive and when. This could of course have been communicated through verbal messages perhaps over the telephone. But, as the number of students and lecturers increase then relying upon verbal communication and individual memory is likely to prove difficult and be error-prone. Hence most organisations keep records of things of interest or significance to them.

Records are data structures and the structure of the data important to the USC case is illustrated in Figure 3.10. Actors within the domain of organisation need to record data about courses, lecturers, students, presentations and so on. Each data structure in this specification is made up of a number of data elements. Hence, courses' records consisted of an identifier for each course (course No), the name of the course appearing in the course portfolio (course Name), the identifier of the lecturer responsible for creating and maintaining the course materials (course Manager) and the number of days specified for the training (course Duration). A representation such as that in Figure 3.10 is sometimes referred to as a data model because it provides a model of the structure of data articulated within a nominated data system.

Courses	Course no.	Course name	Course manager	Course duration		
Lecturers	Lecturer code	Lecturer name	Home address	Work address	Home tel no.	Work tel no.
Students	Student no.	Student name	Student address	Student Tel. No.		
Presentations	Presentation no.	Course No.	Presentation date	Presentation site	Lecturer code	
		Lecturer Evaluation	Course Evaluation			
Bookings	Student no.	Presentation no.	Date of booking			
Payments	Student no.	Presentation no.	Deposit paid	Balance paid		
Attendance	Student no.	Presentation no.	Grade			
Qualifications	Lecturer code	Course no.				
Venues	Venue code	Venue name	Venue facilities			

Figure 3.10 Data structures at USC

CASE
continued …

Data systems are 'hard', technical systems and include not only modern ICT systems but also traditional, manual record-keeping systems, such as the one originally used by USC. Such a data system can be visualised, as in Figure 3.11, as a pattern of acts of articulation performed with data structures.

RECAP

Data structures consist of data elements which in turn consist of data items. Organisational and individual action is reliant upon data structures articulated in data systems. Articulation involves the creation, update, deletion and reading of data structures.

3.3.2 Visualising data systems

The specific elements of notation which we add to our visualisations to illustrate the articulation of data structures within some data system are represented in Figure 3.12.

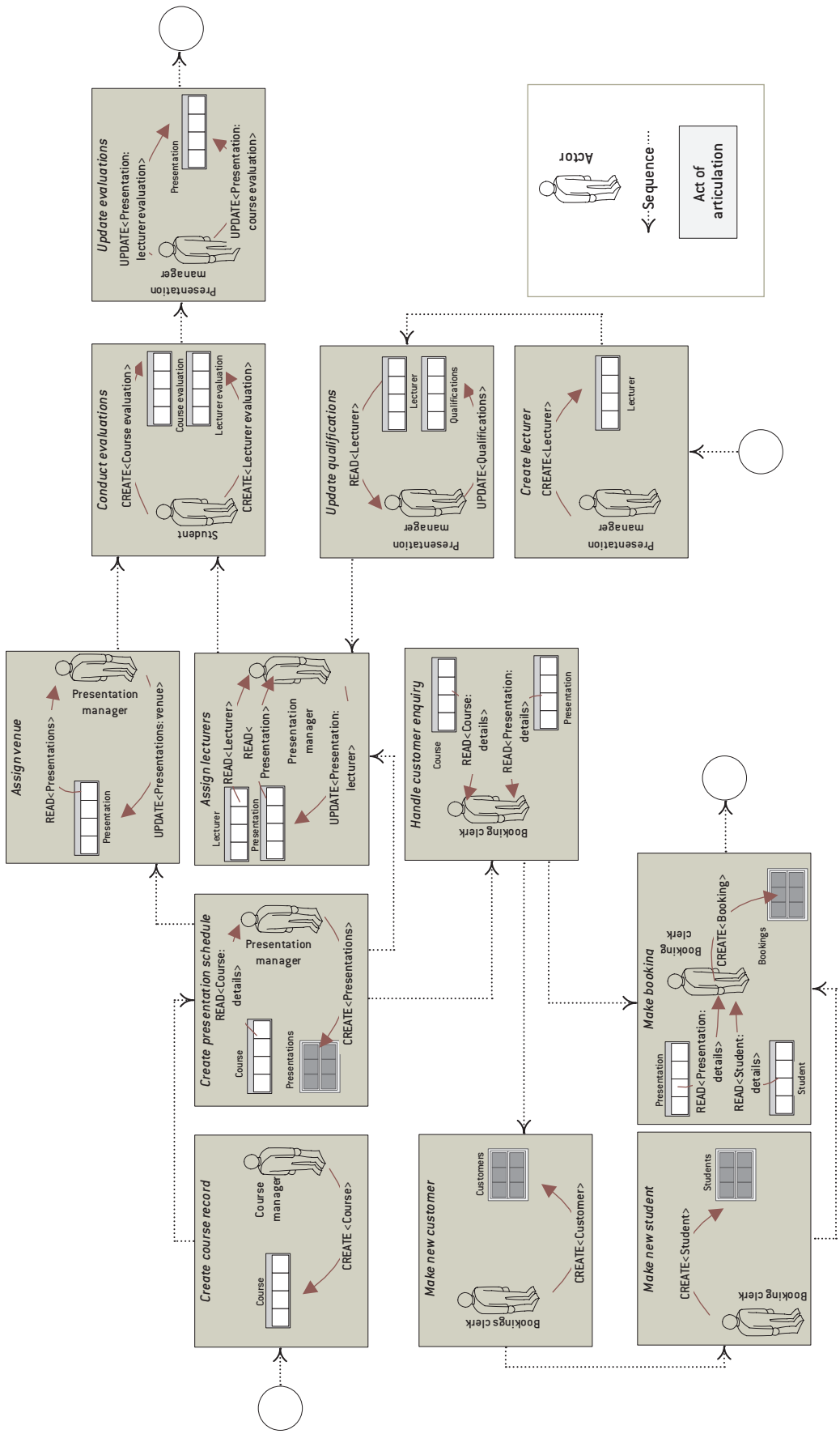


Figure 3.11 The data system at USC

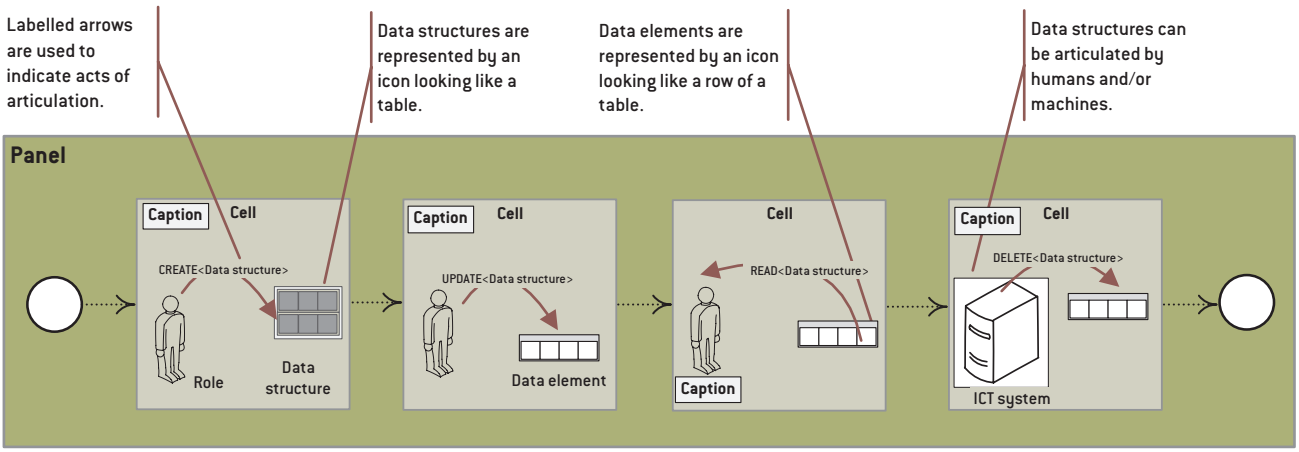


Figure 3.12 Elements of a data system visualisation

3.4 INFORMATION

Information
The accomplishment of meaning by some actor with data.

In the first half of this chapter we established how data are any set of differences formed in some substance. The eminent biologist Gregory Bateson (1972) usefully defined information as a direct extension of data: '*information is any difference that makes a difference*'. **Information**, as we shall see, is the difference or set of differences that an encounter with data makes to an actor. Information is an accomplishment made by an actor or actors and is very much bound up, as we shall see, with instrumental and formal communication.

Consider this simple example, which has all the elements of an information situation and which we shall elaborate upon later. Person A looks across at Person B, who is at the opposite end of a room. She holds up a hand and points a finger upwards, clenching her other fingers in a fist. What will B take this to mean? Will he take it perhaps as an insult, a command to provide one of something, or a message that there is something stuck on the ceiling?

In forming the shape of the pointing finger Person A is making a set of differences with a certain substance, namely a certain part of her body. Person B encounters this data structure but must make a decision as to what he thinks is the most appropriate meaning to assign to this act performed by Person A. When this decision is made then it makes a difference to Person B in the sense that their future action will depend upon this accomplishment.

3.4.1 Communication

Communication
The process of enacting communicative acts. The accomplishment of meaning between actors.

Information emerges in the accomplishment of certain forms of **communication**. So, what is communication?

Consider a simple model of communication as illustrated in Figure 3.13. A certain actor, which we shall call the sender, has something that he, she or it wishes to express. The actor encodes this as a message using some agreed symbols. The message is emitted by the sender and travels as a signal along some communication channel. The signal/message is decoded into its constituent symbols by another actor – a receiver. He, she or it interprets what is expressed by the sender from this message.

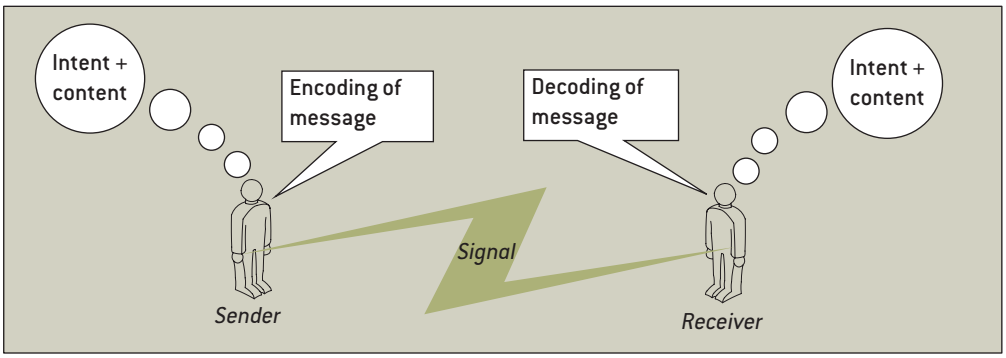


Figure 3.13 A simple model of communication

3.4.2 The ubiquity of communication

DID YOU KNOW?

The Austrian animal behaviourist Karl von Frisch came to the conclusion after much research that there is clear evidence of complex communication among European honeybees. When a honeybee scout discovers a useful source of nectar it flies back to its hive and then performs a 'waggle' dance on the floor of the hive (see Figure 3.14). This dance communicates a number of things to other bees observing it, including the distance and direction of the food source. In this example the honeybee scout is the sender of the message and the observing bees are the receivers of this message. Elements of the 'waggle' dance itself encode symbols within the message which is decoded by its receivers. Interestingly, the signal is carried here not as light because the floor of the hive is pitch-black. Instead, receiving bees observe differences in the dance as vibration made on the hive floor by the scout bee.

Figure 3.14 The 'waggle' dance of the European honeybee

There are different types of human-to-human communication. For instance, humans not only communicate through the spoken word but also a great deal through bodily expression. Changing the configuration of the human face by moving certain muscles is a very important form of human communication.

CASE

During his voyage in the HMS *Beagle* Charles Darwin pondered on how strange it was that he had no difficulty in understanding the facial expressions of the many people he met, even though he could not understand any of their spoken words. Hence, some 20 years after publication of his ground-breaking work, *The Origin of the Species*, Darwin published another book of which he was equally proud, *The Expression of the Emotions in Man and Animals*, in which he described his pioneering investigation of emotive facial expressions in humans and their closest evolutionary relatives, the great apes. His key conclusion was that '*the young and the old of widely different races, both with man and animals, express the same state of mind by the same movements*'. Up to the mid-twentieth century most anthropologists believed that all facial expressions were entirely learned and should therefore differ among cultures. Pioneering work by the anthropologist Paul Ekman and others eventually supported Charles Darwin's original contention that certain emotive facial expressions, such as those for happiness, anger and sadness, are inherited and thus universal across human cultures.

REFLECT

Here are the so-called universal facial expressions, described originally by Darwin. What does each expression communicate to you?

And we should not ignore the fact that much business communication is now conducted between human and 'machine' or solely between 'machines' (see Figure 3.15). The interface between human and ICT system can be seen as a dialogue (a two-way sequence of communication) between human and machine.

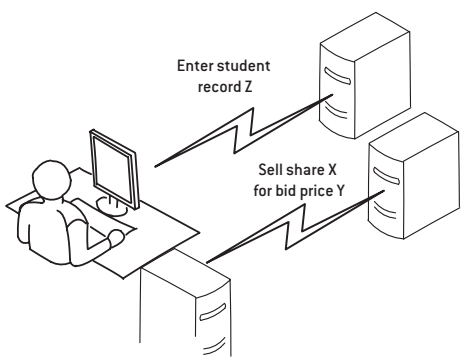


Figure 3.15 Human-to-computer and computer-to-computer communication

3.4.3 Communicative acts

Communicative act
An act in which a message is sent between sender and receiver with a particular intent and content.

Intent
The intent of a communicative act refers to its purpose. There are five major types of intent.

Content
A term now used to refer to any media stored in digital form. Can also be used to refer to the symbols within some message that identify or describe things of interest.

Communication involves the transmission of messages between sending and receiving actors. As such communication is action and can be thought of as consisting of communicative acts taking place between one actor and another. Any communicative act must therefore have a sending actor, a receiving actor and some message.

Any message used in a **communicative act** has two aspects – **intent** and **content**. The content of a message consists of the things identified and described by the symbols making up the message. The intent of a message establishes its purpose – what an actor (normally the sender of the message) is trying to achieve through the communication.

Consider a communicative act from the domain of emergency response as illustrated in Figure 3.16. Within the emergency ambulance service actors enact roles such as dispatcher and ambulance driver. Many communicative acts involve messages being sent between actors playing these roles. One such common message is illustrated here as a speech bubble. The direction of the arrow indicates the direction of transmission of the message. Hence the dispatcher is the sender of this message and the ambulance driver the receiver of this message. The elements within the square brackets consist of things identified or described – in this case an incident and where it is located. The keyword DIRECT refers to the intent or purpose of the message. In this case, the dispatcher is directing that the ambulance driver do something indicated by the message itself – namely, go to the nominated location to attend the incident.

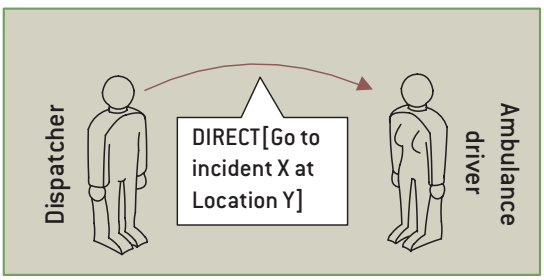


Figure 3.16 A communicative act from the domain of emergency response

3.4.4 The content of a message – signs

Sign
A pattern of significance. Something which stands to somebody for something.

Actors within organisations communicate about things of interest to them through signs. **Signs** are used within the content of a message. A sign is a larger concept than that of a symbol and should not be thought of solely in terms of a human spoken or written word. Anything used to communicate something to somebody is a sign. Hence a series of knots tied in string is a sign, as is the 'waggle' dance of the European honeybee, the squeak of a dolphin, a human facial expression and a data item formed upon an electronic record.

Within business, signs are used to refer to 'things' of importance to organisational actors, but they are also used to describe such things of importance. In Figure 3.17 customer, product, supplier and sale are important signs for private sector organisations, while patient, treatment, citizen and benefit are important to public sector organisations. Note that the things referred to or described can be physical things such as people and products or organisational/institutional things such as sales and benefits.

Semiotics
The discipline devoted to the study of signs and sign-systems.

Signs have been studied extensively in an area known as **semiotics**. According to one of the founding fathers of semiotics, Charles Sanders Peirce (1931), a sign is something which stands to somebody for some other thing.

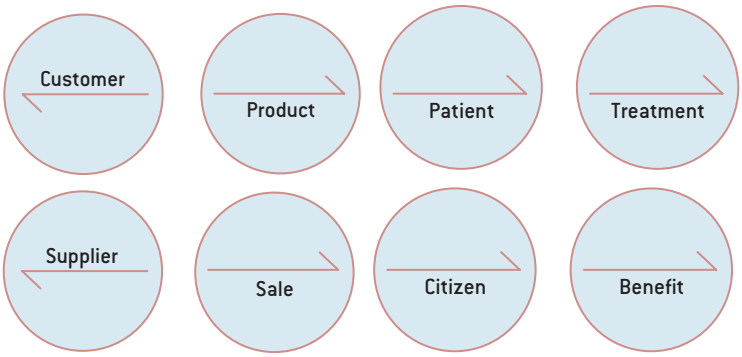


Figure 3.17 Some signs important to private and public sector organisations

In terms of human bodily expression the pointing hand is the most basic of signs. The differences made within some substance we called a symbol and such differences are what data are made of. Forming differences in the way in which the human hand is shaped and positioned can be thought of as a symbol and as data. But for any consistent set of differences to be considered signs then the symbol has to stand for something else to somebody (some actor). The pointing hand stands to other actors that observe it to direct their gaze, not to the end of the finger but to the thing pointed at by the finger.

Some signs are non-arbitrary, meaning that they do not rely upon convention and that everybody understands what they refer to. Certain human emotive facial expressions are a case in point. The smiling human face is generally understood by everybody to stand for the fact that someone making it is happy. But most symbols we use in settings such as organisations are arbitrary, meaning that the relationship between the symbol and what it refers to (referent) is based purely upon convention. Hence the same symbol can stand for different things to different actors in different domains of organisation.

Take the symbol 434 as illustrated in Figure 3.18. Within the meals on wheels domain 434 is used to stand for the number of hot meals delivered to customers in a working week to an administrator of the delivery schedule within this organisation. In the case of Goronwy Galvanising 434 is not a quantity but an identifier – it refers to a particular type of steel lintel to be galvanised by a production operator.

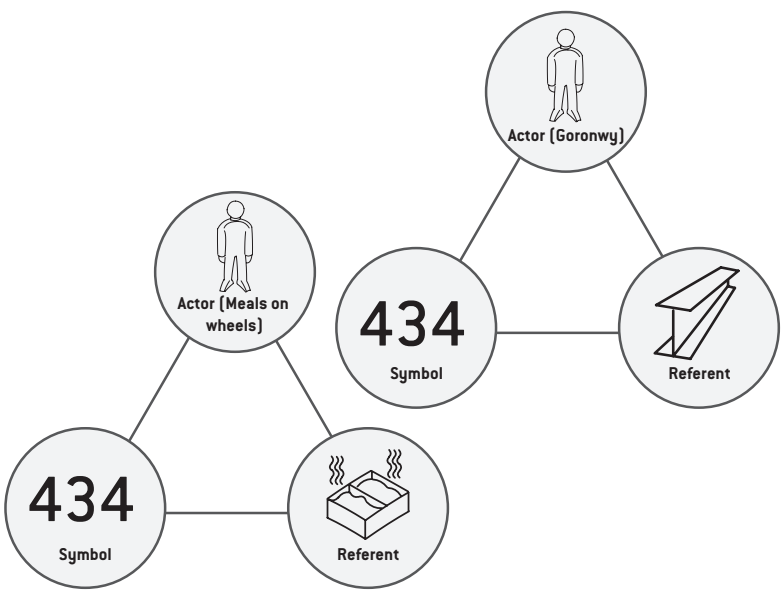


Figure 3.18 Same symbols – different referents

So the differences which make up the symbol make further differences in the 'mind' of some actor. Such differences comprise the meaning of the symbol and are the essence of information. I deliberately put the word 'mind' in inverted commas within the last sentence to emphasise that, in the modern world of organisation, it is not only human actors that can make this connection between the differences of some symbol and the differences it causes in some actor. Take the symbol in Figure 3.19. The differences made in this symbol are actually the sequence of different widths between the vertical lines. Most humans cannot make the connection between this sequence of differences and what it refers to. But a barcode scanner attached to some ICT systems can. This combination of technology can accomplish information such as the product code and manufacturer code it refers to.

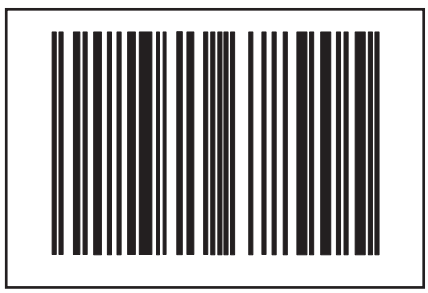


Figure 3.19 A barcode as a symbol

Hence the meaning of a symbol can be accomplished in different ways depending upon the actor and/or the context. In manufacturing, just like retail domains, barcodes typically refer to products and manufacturers. However, in a healthcare domain barcodes are frequently attached to wristbands around patients and as such uniquely identify an admitted patient – the barcode stands for a particular person.

DID YOU KNOW?

The discipline devoted to the study of signs is known as semiotics. Modern semiotics developed from linguistics and the philosophy of language. Ferdinand de Saussure (1964), one of its founders, wrote a pioneering work on general linguistics in 1916. The American philosopher Charles Morris built on the work of both Saussure and Peirce, mentioned previously, and gave them more sophistication. Claude Lévi-Strauss used semiotic approaches in anthropology in the late 1950s. You may be familiar with some of the discussions of semiotic ideas in popular as well as academic literature: for example, Umberto Eco's *The Name of the Rose* and Dan Brown's *The Da Vinci Code*. Brown's hero within this novel, Robert Langdon, is a professor of religious symbiology, which (as Brown portrays it) has much in common with semiotics.

3.4.5 Identifying things and describing things

Symbols more generally are used to do two things – to identify things or to describe things. Barcodes typically act as identifiers, referring to some instance of something, such as a product or a patient. But symbols are also used to describe, often to signify properties or attributes of things, such as the number of deliveries of hot meals, the weight of a steel lintel or a patient's age.

We also use signs to help us 'chunk' up the world – to classify and categorise things. This means that the signs we use are important to determining how we act or what we

Identifier
Some symbol which identifies something (often uniquely).

do in relation to such things. If I refer to someone by an **identifier** – such as Che Guevara – I might classify this person as a terrorist or I might classify him as a freedom fighter. The different signs we use to describe this person are likely to generate a different reaction by people.

This helps explain how signs such as barcodes do not just identify things; they get things done. In a supermarket if a can of beans is scanned at a checkout this not only causes a payment to be made but is also likely to cause replenishment of certain shelves. If a person is classified as a patient in a general hospital then in using this sign to stand for this person staff within the general hospital will take different actions in relation to this person than if they had been classified as a visitor.

REFLECT

Consider accessing two websites. One site is written in English and the other in Russian. If you are not a reader of Russian you can be informed by the English website but not the Russian one. Reflect on why this is the case in terms of the distinction made between information and data.

3.4.6 Unpacking business signs with an information model

Information model
A model of the things of interest relevant to some area of business.

Attribute
A symbol which describes some aspect of a thing.

Assuming we can analyse or unpack the content of messages used within some domain of organisation then we can describe such signs in more detail within something known as an **information model**. Within such a model, the entire set of signs appropriate to some domain of organisation is visualised in terms of information classes, relationships of association and **attributes**. Within Figure 3.20 a very simple information model is expressed which describes the typical content of certain recurrent messages evident in the domain of emergency response, such as that illustrated in Figure 3.16.

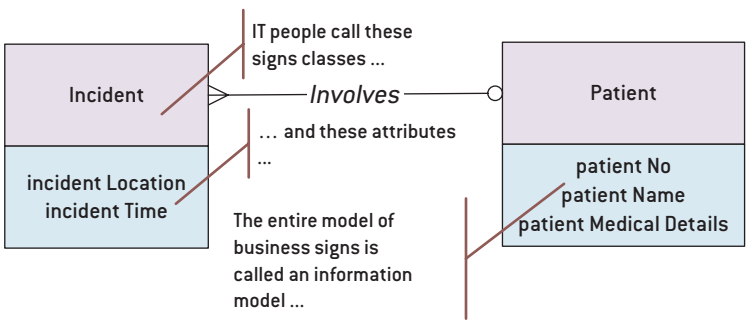


Figure 3.20 A simple information model

The boxes on this diagram indicate individual classes of information: things of interest to some business domain. The connecting lines between information classes, which are referred to as relationships, indicate that particular things are associated with other things within communications about this domain. Hence within this domain we know that an emergency incident involves a person treated – signified as a patient. The symbols attached to each relationship line represent a number of rules governing the behaviour of the association between classes. For example, a fork or crow's foot on the end of a line indicates a one-to-many relationship. So a patient could be involved in many incidents. The 'O' on the end of a relationship line indicates that the participation of the information class in the relationship is optional, meaning that in the case of Figure 3.20

there may be patients on record that are not associated with any incidents. Such data might be held, for instance, to differentiate those people who use the emergency response service a lot from those who have never used it.

The instances of information classes will need to be referred to in some way through identifiers. Hence, a patient number might identify a certain person treated. But we also need ways of adding further description of things. This is where attributes come in. Assigning the attributes *incident Location* and *incident Time* to an incident information class means that we can usefully communicate about the time and place of incidents within this domain of organisation and will probably need to record this as data within the data structures necessary for this domain of organisation.

3.4.7 Intent of communication

We are not interested in all business communication within this book. We are only interested in business communication that gets things done – communication that helps people, machines and other artefacts coordinate action. The American philosopher John Searle (1970) calls such communication *speech acts*, but we shall refer to them as communicative acts because much communication is not done these days through the medium of speech. Communication is achieved through bodily movement, the transmission of physical documents, electronic mail and so on. All communication involves the transmission and receipt of messages but communicative acts focus on doing things with signs.

Assertive
Communicative acts that explain how things are in a particular part of the business domain being communicated about.

Directive
Communicative acts that represent the sender's attempt to get the receiver of a message to perform or take an action.

Commissive
An act that commits an actor to some future course of action.

Declarative
Communicative acts that aim to change aspects of or the state of some business domain through the communication itself.

Expressive
Communicative acts that represent the speaker's psychological state, feelings or emotions.

A communicative act, as we have seen, is designed by the sender of some message to influence the action of the receiver of the message. For example, if a caller asserts that a medical emergency has taken place then a call-taker is expected to take certain action, such as to alert a dispatcher to dispatch an ambulance.

Searle maintains that there are five major ways in which people influence other people through communication – assertives, directives, commissives, declaratives and expressives (see Figure 3.21).

- **Assertives** communicate the belief by the sender that the content of the message is true. So actors may assert that something has happened or is happening. Within emergency response a call-taker might communicate to a dispatcher that a medical incident is of a certain degree of seriousness.
- **Directives** are an attempt to influence receiver action through some message. Directives consist of any act of communication in which some direct response is required from the receiver of the message. So, within emergency response a paramedic might direct a call-taker to issue certain advice to the caller.
- **Commissives** commit a sender of some message to the future course of action detailed in the message. So actors may commit themselves or others to something happening in the future. Hence, within emergency response a call-taker might promise a caller that an ambulance will be with them in a certain period of time.
- **Declaratives** are messages that change the state of some domain of organisation through the communication itself. The main difference between an assertive and a declarative is that when something is declared to be the case it cannot be undone. Within emergency response an ambulance driver might declare that an incident is closed. This change of state means that the dispatcher releases the ambulance and its crew back into the pattern of action.
- **Expressives** represent the sender's state, feeling or emotion about something. An evaluation of something or someone normally involves the use of expressives. Within emergency response, a manager might express satisfaction or dissatisfaction with some person's performance.

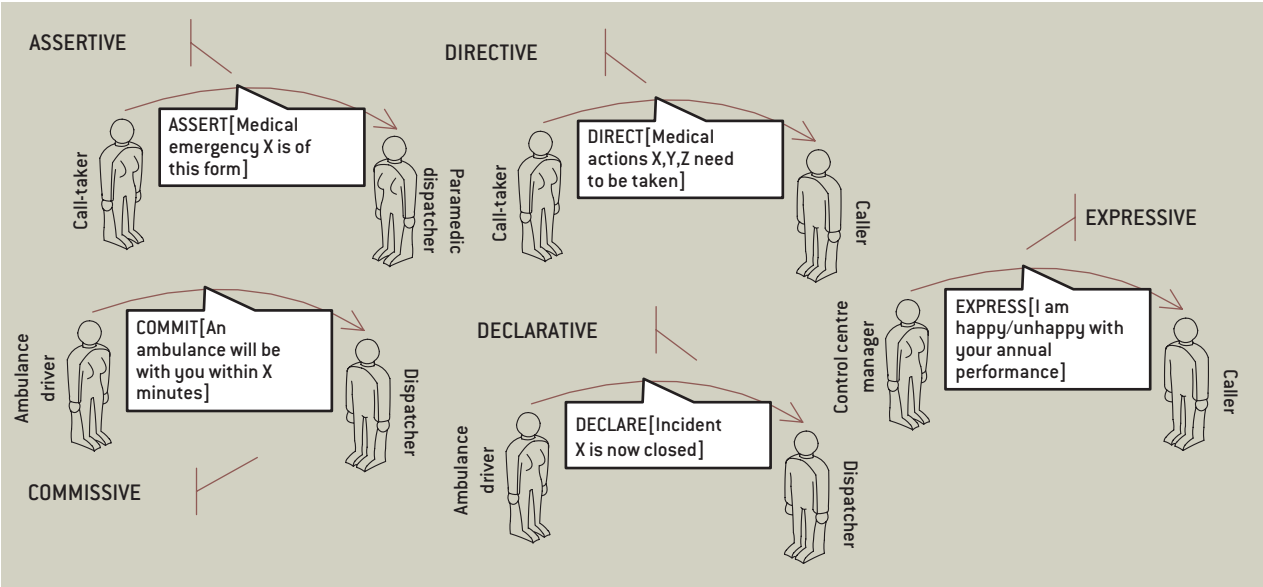


Figure 3.21 Five types of communicative act

The importance of this distinction between intent and content is that different messages may have the same content but different intent. For instance, assume within the domain of Goronwy Galvanising that the content of a message is [Product X, Location Y]. This message identifies a particular product and a particular production location. Now consider two different communicative acts that utilise the same identifiers. ASSERT[Product X, Location Y] is an assertive message. It probably asserts the belief of a particular production worker or perhaps a production ICT system that a given product is currently placed at a given production location. DIRECT[Product X, Location Y] is a directive message. Here a given actor, such as a production supervisor perhaps, is requesting another actor, such as a forklift truck driver, to move an indicated product to a designated production location.

3.4.8 Station X

CASE

The story of station X is normally told in terms of the contribution its codebreaking work made to winning the Second World War. But this establishment played a key part in the foundation of the computing and communications technology we use today. It was also instrumental in lending organisation to the activities of data security and surveillance which permeate our modern digital society.

The Second World War was a 'wireless' war. The fast military movement of machinery, men and equipment demanded constant radio intercommunication between units, generally using transmission by Morse code. All such military messages were encrypted by the German armed forces using a complex electromechanical device known as the Enigma machine. Radio communication, Morse code and encryption all form necessary background to a key 'system' of importance to this period: the intelligence work provided by the Government Code and Cypher School (GCCS) conducted at Bletchley Park in the UK during the entire period of the Second World War . This codebreaking and intelligence establishment was referred to by its secret designation, station X.

Communication by the German armed forces differed from the standard model of communication discussed (see Section 3.4.1) in having a stage of encryption and

CASE
continued …

decryption added. Encryption and decryption amount to the double encoding and double decoding of messages transmitted at a distance. A German officer would write a message in German. An Enigma machine operator would type the message into the keyboard letter by letter and note the letters being output by the machine (see Figure 3.22). This encoded message would then be passed to a radio operator who transmitted this message in yet another code (Morse code) as a radio signal using a radio transmitter. Morse code was originally invented in 1836 by Samuel Morse, as a means of transmitting messages along telegraphic wires. Letters and numbers are formed from two differences made to the length of an electromagnetic pulse – forming a 'dot' and a 'dash'.

Another radio operator in a different location received this double encoded message on a radio receiver. They first decoded the Morse code into a series of letters and this message was passed to an Enigma operator. The Enigma operator typed the letters into the machine and wrote down the letters to decode the original message in German. The main difference with the standard model of communication lies in the use of some algorithm (automatic procedure) with an associated key to both encode a message and decode a message. The algorithm in this case comprised the workings of the Enigma machine. The key consisted of the configuration of a set of rotors, with each rotor representing a set of one-to-one mappings between the letters inputted into the device and the letters outputted from the device. This configuration was changed every day of the year by Enigma operators.

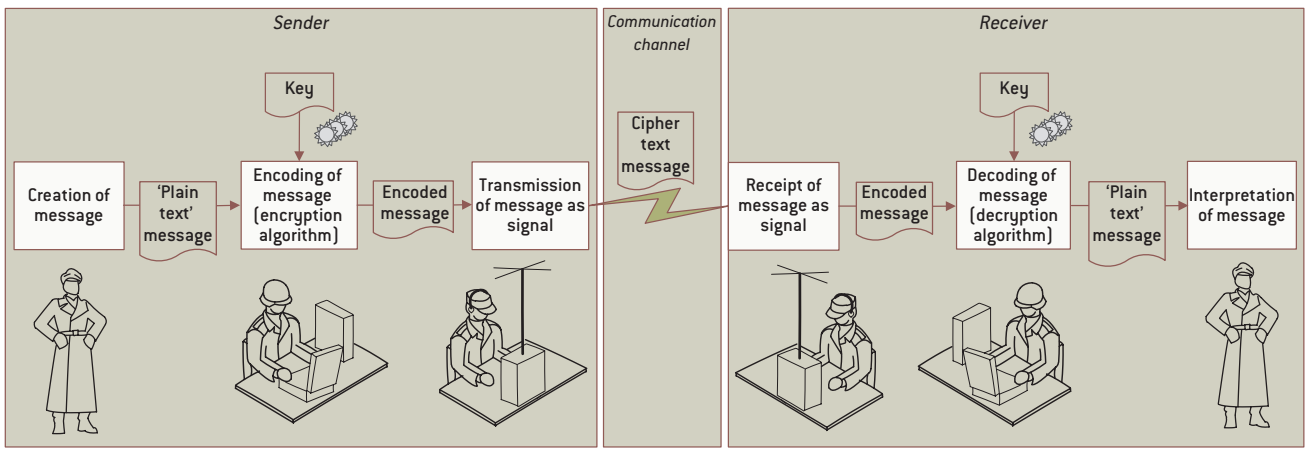


Figure 3.22 Telecommunication among the German armed forces during the Second World War

Station X cracked Enigma messages through a complex data system, illustrated in Figure 3.23. Radio messages were first intercepted by a worldwide set of receiving stations, collectively known as station Y. These encrypted messages were then passed on to the codebreaking operatives at station X. The 'key' or configuration setting for the Enigma machine for any particular day was cracked using various codebreaking techniques. This key was then passed on to a decrypt operator who produced the plaintext message. Such messages were then interpreted by intelligence officers using indexes containing abbreviations and jargon used by the German armed forces. Finally, intelligence was passed on to officers in command of Allied forces who used it to make decisions about the deployment of such forces.

Winston Churchill described station X as the '*goose that laid the golden egg and never cackled*'. The intelligence generated by this establishment contributed to the successful protection of Allied ship convoys during the Battle of the Atlantic, defeat of Field Marshall Rommel's army in the North African desert, victory against the Italian navy at the Battle of Matapan and the successful planning of the invasion of Europe by the Allies in 1944.

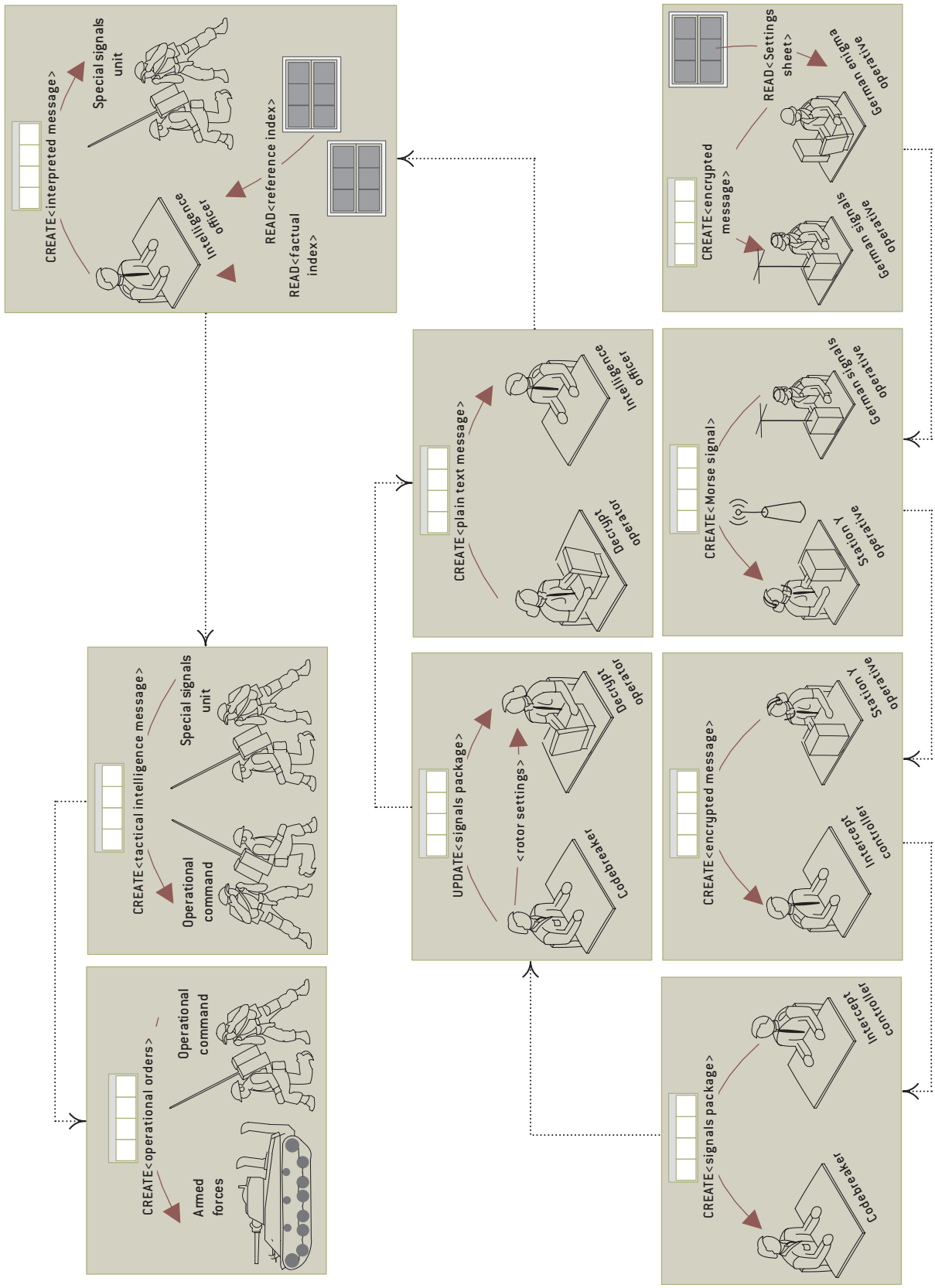


Figure 3.23 The data system of station X

CASE
continued …

The station X case describes two systems of organisation that fed off each other (see Figure 3.24). The effective movement (coordination) of German armed forces relied upon effective communication, and such communication relied in turn upon the articulation of encrypted radio messages. Decision as to the deployment (coordination) of Allied forces was very reliant upon intercepted messages (communication) and codebreaking (articulation) undertaken by station Y and station X.

RECAP

Information relies upon data structures being used in the accomplishment of communication. Communication involves the sending and receiving of messages between actors. Any message has both content and intent. The content of a message refers to and describes the common things of interest between sender and receiver, while the intent of a message establishes its purpose. The messages within communicative acts tend to be sent with one of five intentions – assertive, commissive, declarative, directive and expressive.

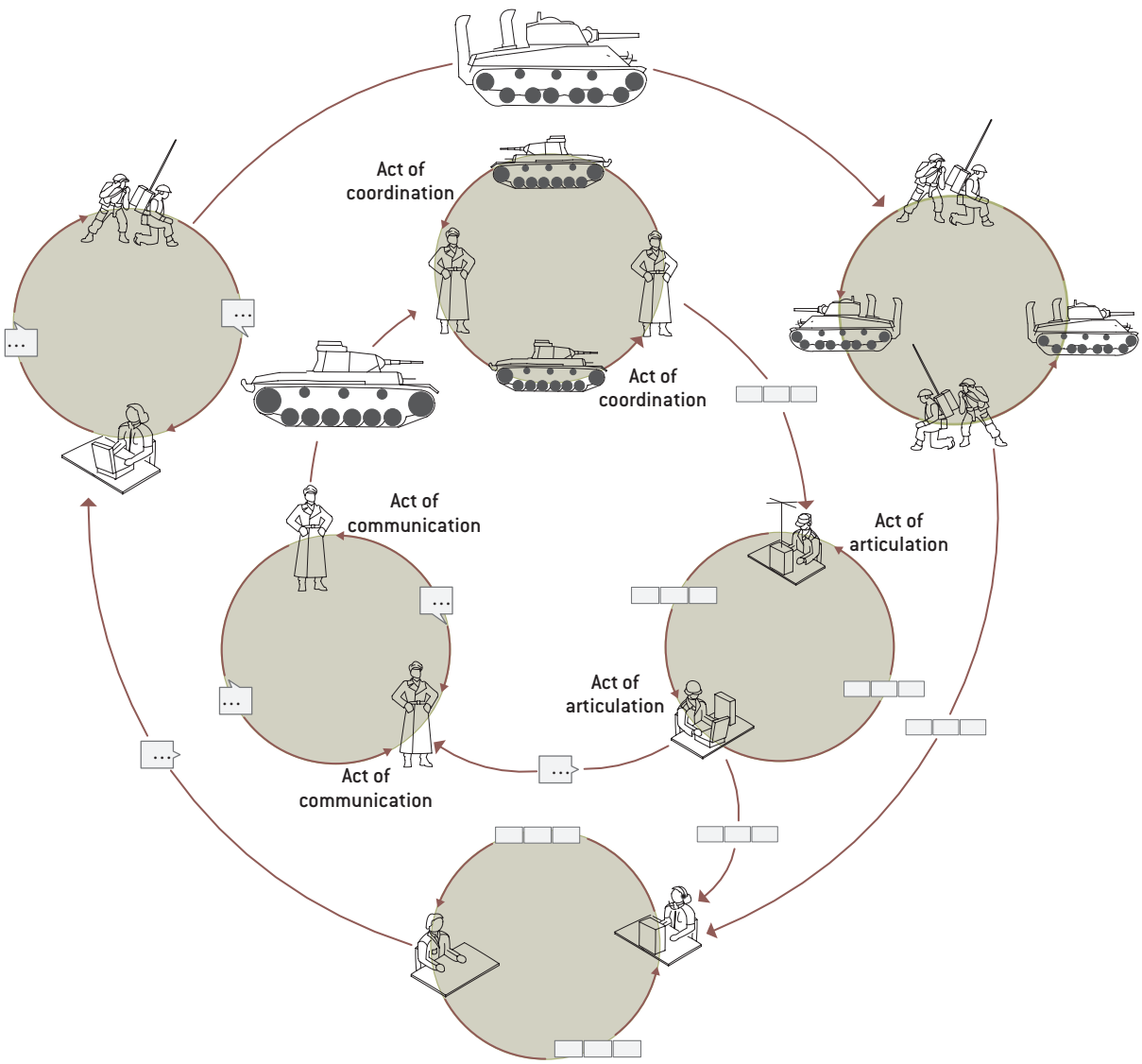


Figure 3.24 Two intertwined domains of organisation

3.4.9 Decisions

The set of communicative acts discussed amount to ways of communicating for action. Communicating for action is critically important because it is the catalyst for decision-making, which in turn facilitates coordination. Consider the decision illustrated in Figure 3.25. Here, a decision is being made as to whether or not to declare an emergency incident.

Decision
A selection between alternative courses of action.

A **decision** can be regarded as a form of internal communication, almost like a directive to oneself. An actor asks of itself, what should I do next? The decision is the response to this internal message following the accomplishment of information. In this example a call-taker consults with a paramedic dispatcher in the ambulance control room by asserting details of the emergency incident to her. The paramedic dispatcher on the basis of this information then directs the call-taker to classify the incident as either a category A incident, a category B incident or a category C incident. On the basis of this communication the call-taker decides what to do next. If the call is classified as category A (life-threatening) or category B (non-life-threatening but requiring medical response) then the call-taker proceeds to enter the details of the incident into the

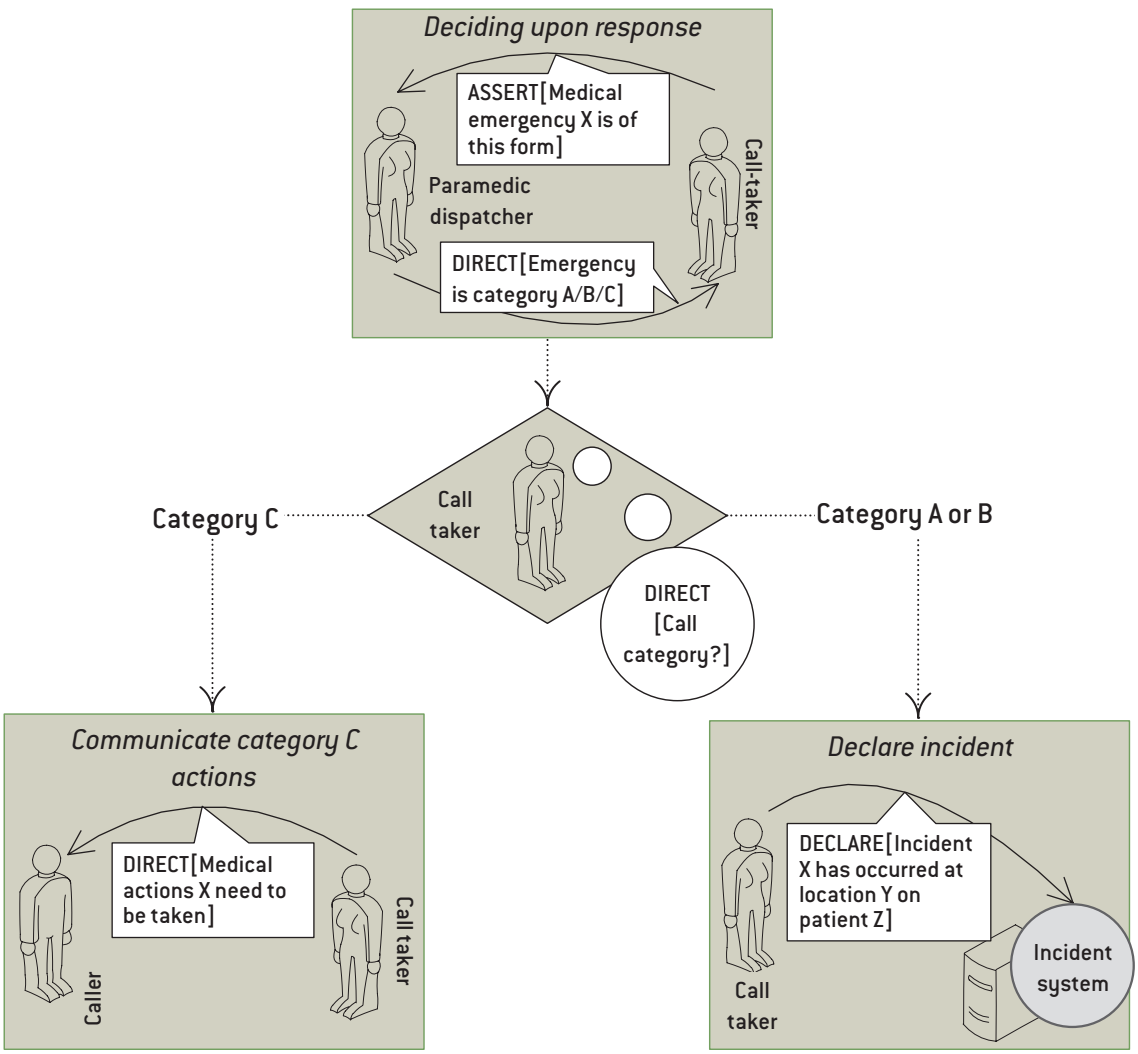


Figure 3.25 A decision within emergency response

incident ICT system. This acts as a declaration that an incident has occurred and that it must be responded to by the emergency ambulance service. If the call is classified as category C then an incident is not declared. Instead, the call-taker directs the caller to some other non-emergency healthcare provision.

REFLECT

What coordinated action does this communication support and how do these communications happen?

Much has been published on business decision-making. How do we judge whether decisions are good or not? Does better communication improve decision-making? Is good record management important to decision-making and why?

3.4.10 Decision strategies and algorithms

Decisions demonstrate the linkage between communication and control of action through decision strategies. A decision strategy is a set of functions which relate sensed data to effected actions. Within organisms such as humans, decision strategies are inherited or learned. Traditionally, within ICT applications such decision strategies are programmed as **procedural algorithms**. In many successful applications of Artificial Intelligence (AI) (see Chapter 13) such decision strategies are now learned as heuristic algorithms.

Procedural algorithm
An algorithm which specifies every step of a procedure for solving a class of problems.

Algorithm
A specification for solving a class of problems.

The term **algorithm** derives from the name of the mathematician Mohammed ibn-Musa al-Khwarizmi (AD 750–850). It refers to some specification for solving a class of problems. Traditional algorithms are procedural in the sense that every step in the solution is specified. This means that the algorithm can theoretically be represented visually as a flow chart. And, if you follow the steps of the specified procedure, then a solution to the problem is guaranteed. In a heuristic algorithm you do not specify the steps to a solution. Instead, you specify a set of rules of thumb, which when applied may or may not get you a solution.

A simple example of a procedural algorithm is the Luhn algorithm. This algorithm is used to decide whether a credit or debit card number is entered correctly. The steps of this algorithm are illustrated in Figure 3.26. Add all three rows of digits together. If any result is more than nine, subtract nine from the number. Add together the the final string of digits. If the sum produced divides by 10 then the credit or debit card number is entered correctly.

Credit card number	3	7	7	9	5	6	5	7	0	9	4	4	7	2	6
Reverse number	6	2	7	4	4	9	0	7	5	6	5	9	7	7	3
Double every second digit		4		8		18		14		12		18		14	6
Add numbers	6	4	7	8	4	9	0	5	5	3	5	9	7	5	3

Figure 3.26 An example of the Luhn algorithm in operation

Heuristic algorithm
An algorithm which specifies a series of rules for solving a class of problems.

A simple example of a **heuristic algorithm** is one used to decide upon the discount to be offered a customer when renting a car. Figure 3.27 illustrates this algorithm as a decision table, which effectively implements a set of decision rules that automatically applies appropriate discounting to a car rental.

Car group	Compact											
Rental period	Day				Week				Month			
Loyalty member	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No
> 3 days in advance	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
0%			X	X				X				
5%		X					X					X
10%	X					X					X	
15%					X					X		
20%									X			

Figure 3.27 An example of a heuristic algorithm

Algorithms, whether heuristic or procedural, are typically used to implement the decision strategies of various software actors in the modern digital economy. The algorithms of the two decision strategies described are transparent, meaning that they can be understood. But, frequently, either the way in which these algorithms work is impossible to understand because of the way they are built or the algorithm is deliberately hidden from outside inspection for commercial reasons. We consider such issues in Chapter 13.

3.5 CONVERSATIONS FOR ACTION

Conversation for action
A term used to refer to the way patterns of communication facilitate coordinated action.

Information system
A system of communication between people that supports coordinated and purposive activity.

Communicative acts do not occur in isolation. They take place within patterns of communication in support of patterns of coordination. Terry Winograd and Fernando Flores (2006) call these conversations for action. Figure 3.28 illustrates a pattern of communication with which you might be familiar. As we shall see in the next chapter, such patterns form the central core of an **information system**. Here, a lecturer requests (directive) of a student that a piece of coursework be produced by a given date. This is followed by some commitment (commissive) from the student that the coursework will be completed by the designated date. At some point, the student will then declare (declarative) that the coursework has been completed and is submitted. Finally, the lecturer will then express whether they are satisfied or dissatisfied with various aspects of the coursework. This conversation may then continue in further cycles of assessment.

But note that each communication in this cycle may be formed in many different ways. For instance, the directive might consist of a paper coursework specification given to students at the start of the module; the commitment may consist of the act of electronically registering or enrolling for a particular module; the declaration may consist of merely submitting the coursework electronically to some support ICT system prior to the deadline; and, finally, the expressive might consist of feedback embedded in a personalised email sent to the student.

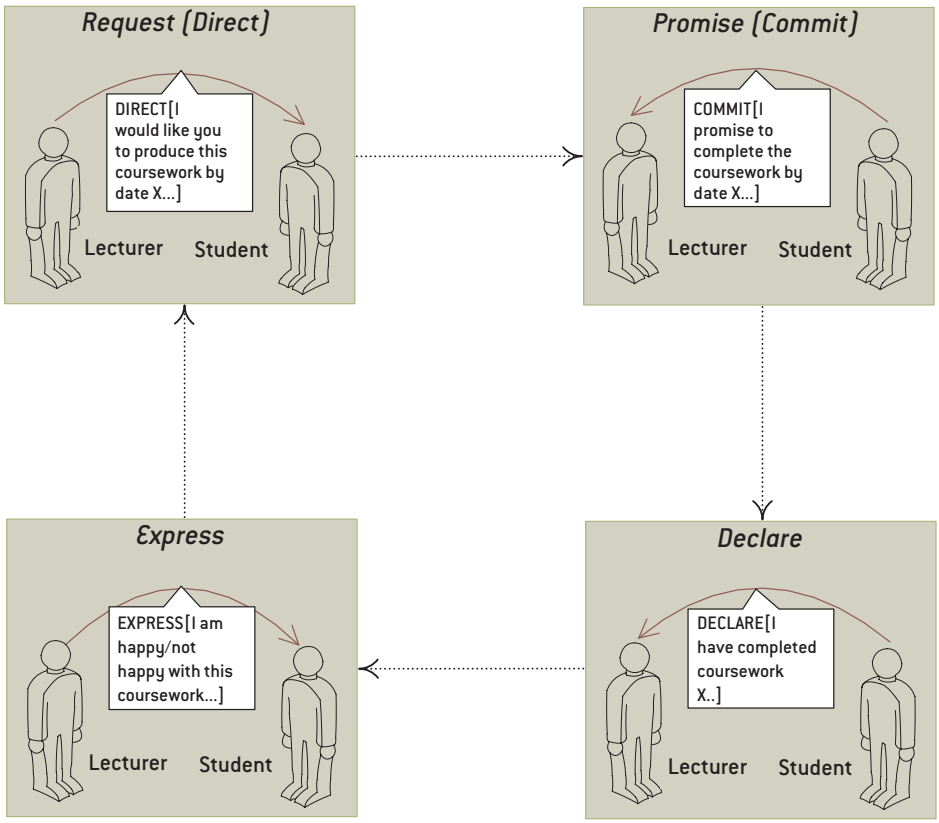


Figure 3.28 A conversation for action

3.5.1 The information system at USC

CASE

An information system is a system of communication between people. As we have seen, information systems support activity systems in the sense that the accomplishment of information is important for decision-making, and in turn for the coordination of activity to meet established goals. We can understand an information system as consisting of a recurring pattern of communicative acts. The pattern for the case of USC is illustrated in Figure 3.29. Hence, to schedule a given presentation of a course, USC administrators must communicate with potential lecturers as to their availability. This amounts to the presentation manager issuing a directive to a designated lecturer. Administrators also must gain commitment from a chosen lecturer to present a given course on a nominated date in the future. Hence, the directed lecturer must commit to a designated presentation. This leads a bookings clerk at some point to assert to potential customers who may have declared their interest in taking a certain course of instruction.

RECAP

Acts of communication normally drive decision-making and occur in patterns. Such patterns of communication and decision-making support sequences of coordinated activity.

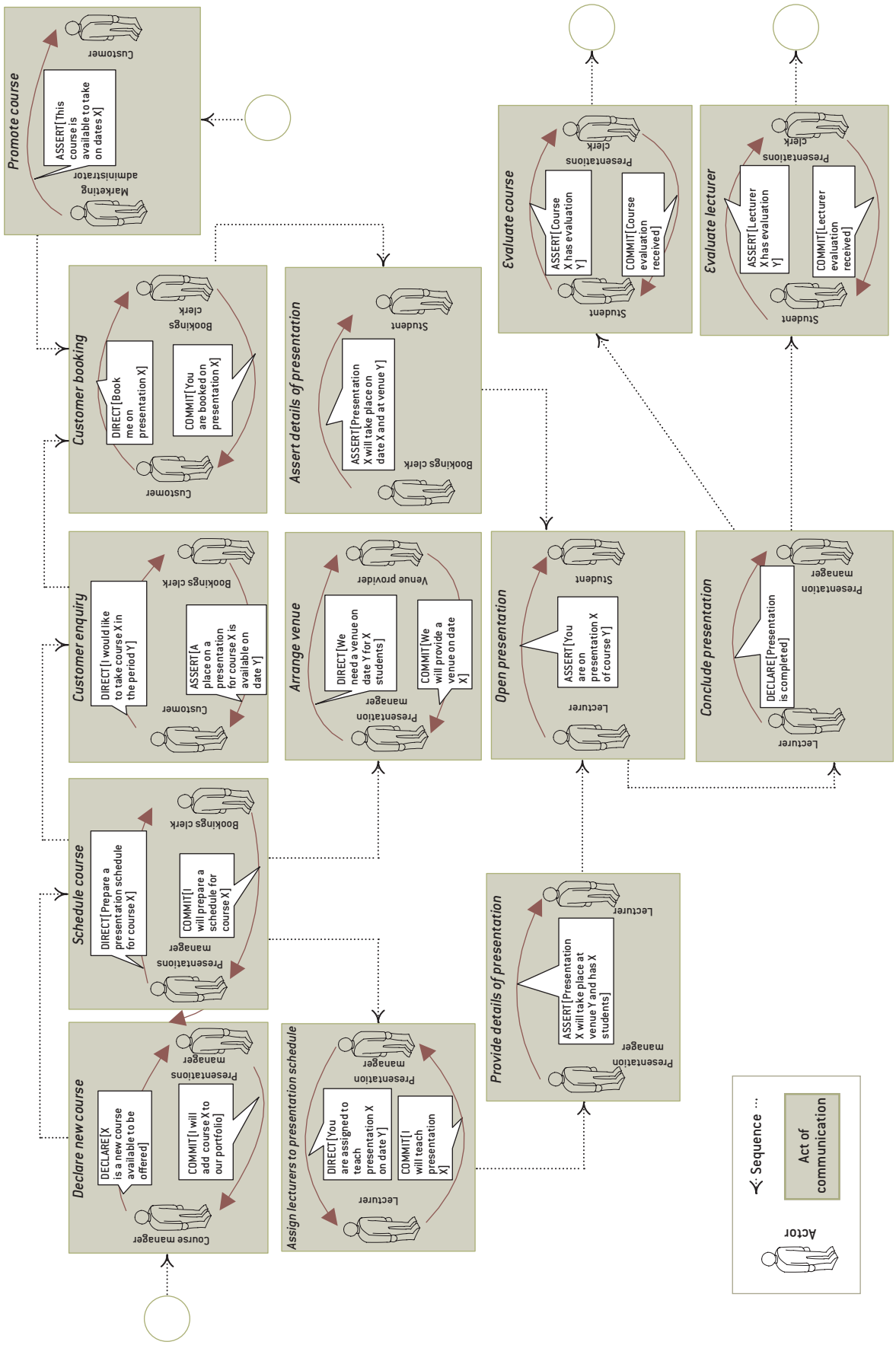


Figure 3.29 The information system at USC

3.5.2 Visualising information systems

Decision point
A point within some pattern of action which changes the course of action.

Swim-lane
A visualisation technique used to indicate different partitions of action.

Within Figure 3.29 a number of new elements of notation are added to our visualisation to adequately represent such systems as conversations for action. The meaning of these elements is described in Figure 3.30. The main element added is that of a speech bubble in which both the intent and the content of some communicative act can be indicated. It is often useful to add **decision points** to visualisations to indicate appropriate points at which the action can diverge (sometimes into separate representations known as **swim-lanes**), depending on the form of internal communication undertaken by a nominated actor.

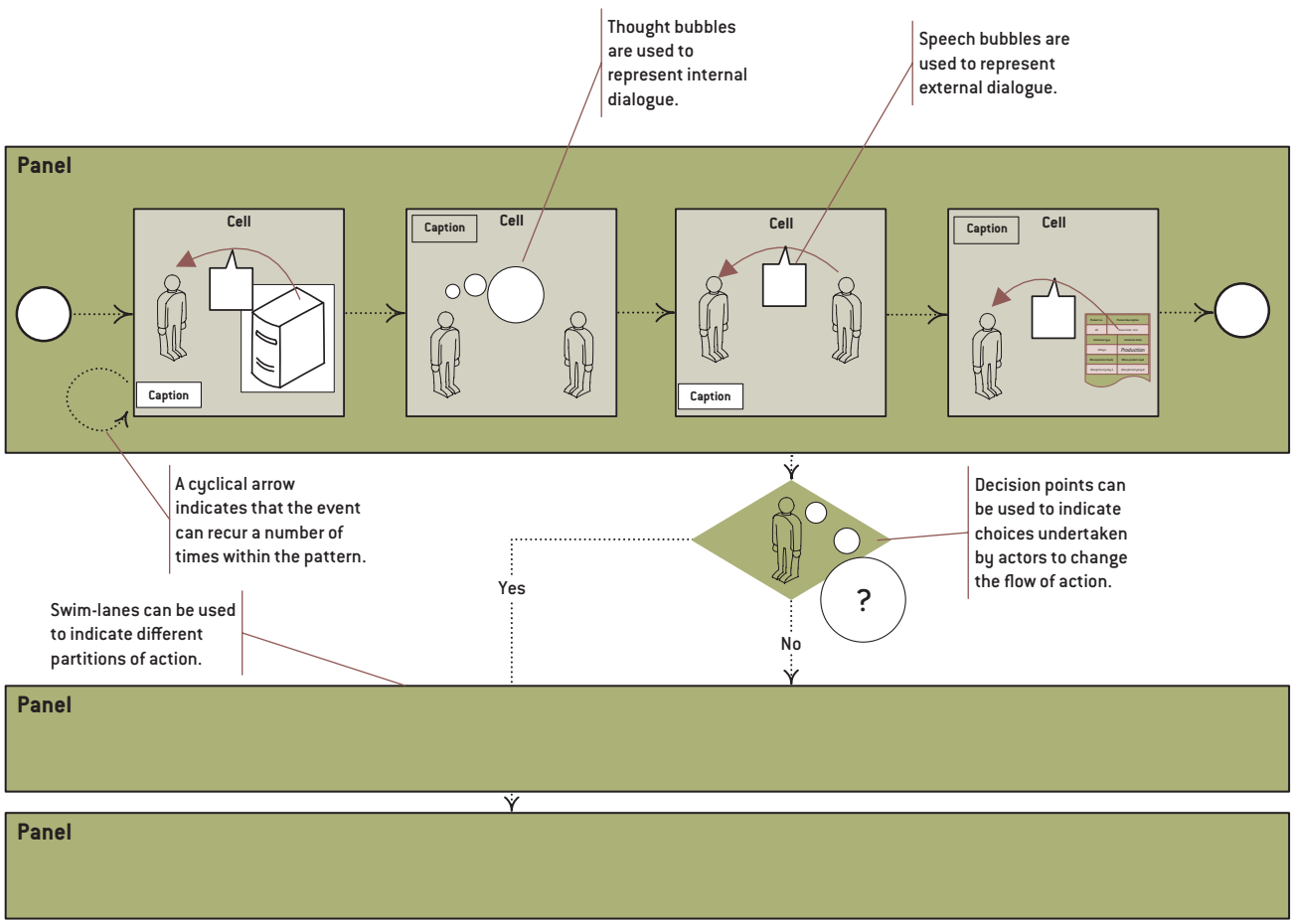


Figure 3.30 Visualising information systems

3.6 CONCLUSION

This chapter has considered the critical distinction between data and information. It has also discussed the relationship between information and decision-making.

Data are differences made in some substance, which are used to code symbols. Symbols are formed into larger entities as data structures. Data structures may be transmitted as messages or may be stored in a persistent manner as records. All forms of coding data can ultimately be translated into binary differences as bits. The volume

of data is measured in bytes. Data structures consist of data elements which in turn consist of data items. Organisational and individual action is reliant upon data structures articulated in data systems.

Information is the set of differences made in some actor through an encounter with data. Information is accomplished in acts of communication, which involve the sending and receiving of messages. Any message has both content and intent. The content of a message refers to and describes the common things of interest between sender and receiver. The intent of a message establishes its purpose. The messages within communicative acts tend to be sent with one of five intentions and such intentions are important to the coordination of activity. Acts of instrumental communication occur in patterns and such patterns support sequences of coordinated activity.

The linkage between communication and the control of coordinated action is through acts of decision-making. Decisions are acts of internal communication in that they involve a choice between alternative courses of action. Much decision-making in the modern organisation is achieved not by humans but by algorithms embedded within the software of ICT systems.

In the next chapter we move the discussion on to systems of data, information and activity. We focus upon the central concept of an information system but show how such systems relate to systems of activity and systems of data. This interrelationship of activity, information and data systems we refer to as the infrastructure of organisation.

3.7 REVIEW TEST

3.1 Data are:

Select the one most appropriate definition from those below by placing an X in the box.

- ☐ Changes in movements of certain products
- ☐ Acts of communication
- ☐ Differences made in some substance used to symbolise something

1 mark

3.2 There are four main ways of articulating data structures/elements/items.

Match the type articulation with the appropriate definition by placing the number next to the letter.

Create (A)	Involves encoding symbols in some new data structure/element/item (1)	A. ☐
Update (B)	Involves removing some existing data structure/element/item (2)	B. ☐
Read (C)	Involves changing symbols in some existing data structure/element/item (3)	C. ☐
Delete (D)	Involves decoding the symbols of some existing data structure/element/item (4)	D. ☐

4 marks

3.3 A data structure consists of a number of data elements.

True or false? (Select only one by placing an X in the box)

- [ ] True
- [ ] False

1 mark

Data system

3.4 Data systems are systems for _____ data structures.

Fill in the blank term below

1 mark

3.5 The content of a communicative act consists of things referred to and described.

True or false? (Select only one by placing an X in the box)

- [ ] True
- [ ] False

1 mark

3.6 There are five types of communicative act.

Match the type of communicative act with the appropriate definition by placing the number next to the letter.

Assertive (A)	Communicative acts that attempt to get a receiver to perform some action (1)	A. ☐
Directive (B)	Communicative acts that commit the speaker to some future course of action (2)	B. ☐
Commissive (C)	Communicative acts that explain how things are in the world (3)	C. ☐
Expressive (D)	Communicative acts that aim to change the world through the communication (4)	D. ☐
Declarative (E)	Communicative acts that represent the sender's psychological state (5)	E. ☐

5 marks

3.7 The intent of a message establishes its:

Select the one most appropriate description by placing an X in the box.

- [ ] Medium
- [ ] Purpose
- [ ] Symbols

1 mark

3.8 Place the following communicative acts in sequence.

Indicate the order using 1 to 4; with the first act in the sequence labelled 1.

DIRECT[I would like you to produce coursework X] ☐

DECLARE[I have completed coursework X] ☐

COMMIT[I promise to complete coursework X by date Y] ☐

EXPRESS[I am happy/not happy with the coursework] ☐

4 marks

3.8 EXERCISES

- Take a visual sign, such as one you might find in the *Highway Code*. Try to separate out what the sign is (data) from what it represents (information).
- Then consider the sign from the *Highway Code* in terms of what it is designed to do (activity).
- How are the signs of the *Highway Code* useful within decision-making?
- Select and analyse a written communication such as a customer order as a data structure. What makes up its data elements and data items?
- What sort of information classes might be relevant to the domain of *meals on wheels* described in Chapter 2? How do such classes relate through relationships of association?
- Emails, and other forms of electronic communication, often use emoticons, signs such as :-) or ☹, which convey emotional content. Investigate their range and use and describe them in terms of the distinctions made in this chapter.
- Hand gestures are becoming important in the control of devices such as tablet computers. Investigate how these gestural interfaces are developing.
- Consider a decision made in an organisation known to you. Work back from the decision to the data and information required to support it. What action resulted from the decision?

3.9 PROJECTS

- Using the approach described in this chapter, develop a detailed data model for an area known to you, for example, a specification of the data structures, data elements and data items relevant to student records.
- Records have been maintained for many hundreds if not thousands of years in organisations of many different forms. Nowadays, records management is seen as a significant problem for organisations. Investigate the term 'records management'. Determine why it is a significant problem and why it is increasingly important for organisations.
- Consider the diverse ways in which data are recorded in an organisation such as a retail chain. Consider the extent to which the data collected by the organisation are of the necessary quality. You might use such criteria as the degree to which it is accurate and useful.
- Identify an information system supporting activity in an organisation known to you, such as a patient records system in a GP practice, a student records system at a school, an inventory management system at a retail store or a waste collection scheduling

system at a Local Authority. Investigate and document the information model underlying your chosen information system using the approach in this chapter.

- Determine the business rules underlying an information system known to you, such as those for student progression on university courses. Specify the business rules as a decision table or as a set of IF THEN statements.
- Claude Shannon's communication theory has had a critical influence on the development of telecommunications, particularly data communications. Investigate the relevance of this theory to ICT. For instance, in what way can Shannon's theory be seen to underlie the modern conception of the Internet?

3.10 FURTHER READING

The growing importance of data to modern economies and societies is described in Kitchin's (2014) book. Stamper (1973) provided the original motivation for considering information in terms of semiotics. It is now out of print but his position is summarised in a more recent book chapter (Stamper, 2001). A more extensive study of the philosophy of information is provided in the book by Floridi (2011). The theory of communicative acts described in this chapter is based on the work of John Searle (1970). For more detail on the distinction between acts of articulation, communication and coordination see my book (Beynon-Davies, 2011).

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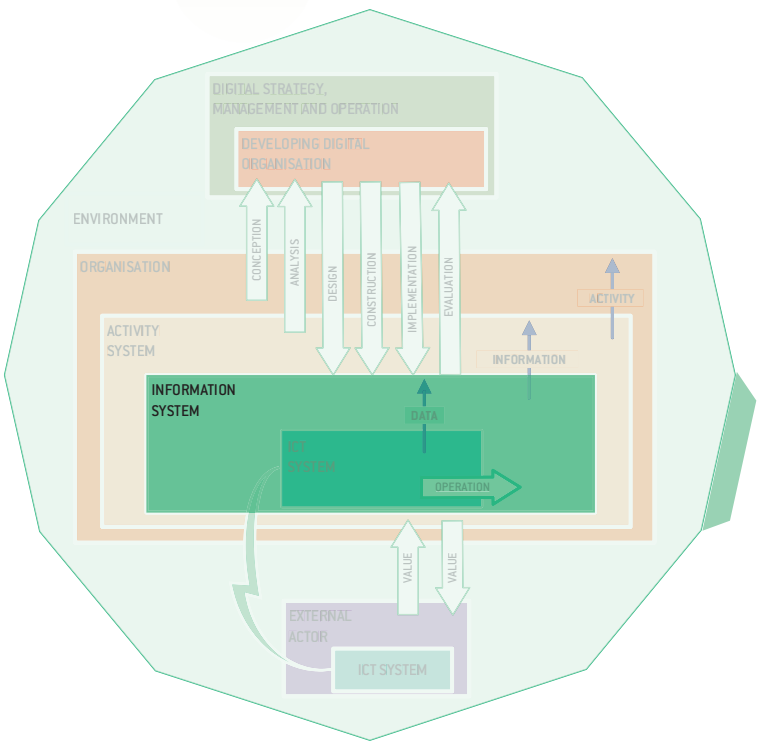
4 THE INFRASTRUCTURE OF ORGANISATION

'Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it.'
– Samuel Johnson (1709–1784) quoted in the *Life of Johnson* (1791) by James Boswell

LEARNING OUTCOMES	PRINCIPLES
Explain the distinction between and relationship between an activity system, information system and a data system.	An information system is a communication system using artefacts (ICT) in support of a given activity system. It therefore spans across the concepts of data, information, decision-making and activity discussed in Chapter 3.
Describe the concept of infrastructure and distinguish between horizontal and vertical infrastructure.	The infrastructure of organisation refers to how systems of action making up the organisation achieve purpose. Vertical infrastructure refers to the way in which data systems support information systems which in turn support activity systems. Horizontal infrastructure refers to the ways in which articulation, communication and coordination are shared across different systems of action.
Describe the high-level functionality of the key back-end and front-end information systems in the typical enterprise.	Organisations typically rely upon a core set of back-end information systems. Around such core information systems a range of front-end information systems are normally constructed.
Describe the relationship between data systems infrastructure and information systems infrastructure.	Within data systems infrastructure data structures are both articulated and shared. Such articulation through information systems serve to communicate things useful to the coordination of activity.

CHAPTER OUTLINE

4.1 Introduction
4.2 The nature of infrastructure
4.3 The infrastructure of RAF fighter command
4.4 Common infrastructure
4.5 Back-end information systems infrastructure
4.6 Front-end information systems infrastructure
4.7 Data systems infrastructure
4.8 Infrastructure, strategy and change
4.9 Conclusion
4.10 Review test
4.11 Exercises
4.12 Projects
4.13 Further reading
4.14 Bibliography



4.1 INTRODUCTION

In this chapter we shall examine infrastructure for organisation. When people come across the term 'infrastructure', they frequently associate it purely with the technology important to running the organisation, such as computer and communications hardware. In this chapter we use the term in a much broader sense to refer to the systems of activity, information and data that contribute to achieving the purpose of some way of organising. Infrastructure in this sense determines not only what can be currently done, but it also determines what can feasibly change. Infrastructure is therefore important not only to current operations but to future strategy. Infrastructure is not only an enabler of such strategy but can also constrain organisational change.

The term information system tends to be used as a synonym for an ICT system (data system) in much of the literature. Within this book we want to show how an information system is different from an ICT or data system, but which is reliant upon a data system (that might be enabled through technology). And the best way to do this is to consider a historical case of an information system which was not reliant upon modern ICT, but which was reliant upon an important data system. This information system was particularly important because it contributed to victory in the Battle of Britain, during the Second World War.

The approach described in previous chapters is then used to help define some of the core information systems found in business: that is, what we shall call the organisation's back-end information systems infrastructure. This provides the bedrock for contemporary business because it supports some of the key activity systems of modern business. The core back-end information systems infrastructure is also typically the platform for many front-end information systems, which are critical to maintaining effective relationships with key external and internal actors. This includes external actors, such as suppliers and customers, as well as internal actors such as employees and managers. So these information systems support what we shall describe in Chapter 6 as the internal value chain of the organisation as well as the wider external value network within which an organisation works.

4.2 THE NATURE OF INFRASTRUCTURE

Infrastructure
Systems of activity, communication and technology that create organisation.

Organisation of whatever form requires infrastructure. **Infrastructure** consists of systems of activity, communication and articulation that generate what we mean by organisation.

To help understand the nature of infrastructure, consider the notion of a transport infrastructure and, in particular, a road infrastructure. As a technological infrastructure it consists of motorways, carriageways, major roads and minor roads, as well as other structures such as bridges. But such a road infrastructure is designed with a purpose, of enabling people and goods to be transported in vehicles from one point to another. In this sense, infrastructure is enabling – it allows certain activities to happen. Also, infrastructure is enabling in the sense that we can build upon existing infrastructure and extend it, such as when we build a new road and connect it to the existing network. But infrastructure can also be disabling or constraining. Hence having a network of roads might prevent us from developing other forms of transport, such as rail, tram or cycling.

We shall see that the infrastructure of organisation is similar in being both enabling and constraining. It enables what we can do as an organisation, but also constrains how we can change things. Infrastructure can also be considered vertically, in terms of levels of system, and horizontally, in terms of relationships between systems.

4.2.1 Vertical infrastructure

Vertical infrastructure
A term used to refer to the three layers of infrastructure applicable to organisation and the way they are coupled.

Vertically, there are three layers of infrastructure: activity systems infrastructure, information systems infrastructure and data systems or ICT systems infrastructure (Figure 4.1). Each of these layers is critically dependent on the layer below it.

Activity systems, as we have seen, are social systems, so they are sometimes referred to as 'soft' systems. They consist of actors engaging in coordinated and usually instrumental activities in fulfilment of some goal(s) or purpose(s). The activity systems of organisation transform value. They consist of the ways in which the overall purpose of some organisation is achieved.

In contrast, data systems are technical systems. They are often called 'hard' systems because they consist of an assembly of artefacts, which are designed to articulate or manipulate data. In the modern organisation, as we shall see, data systems primarily consist of digital computing and communications technology, and as such comprise ICT systems.

Information systems clearly mediate between 'hard' technical systems and 'soft' social systems. When people communicate in organisations they frequently use technologies to store and transmit the data which represent the messages being communicated. Such messages, as we have seen, are used to coordinate people's activities. In this sense, some people think information systems are key examples of what are called sociotechnical systems; they are hybrid systems that involve communication using technology, directed at the coordination of activity.

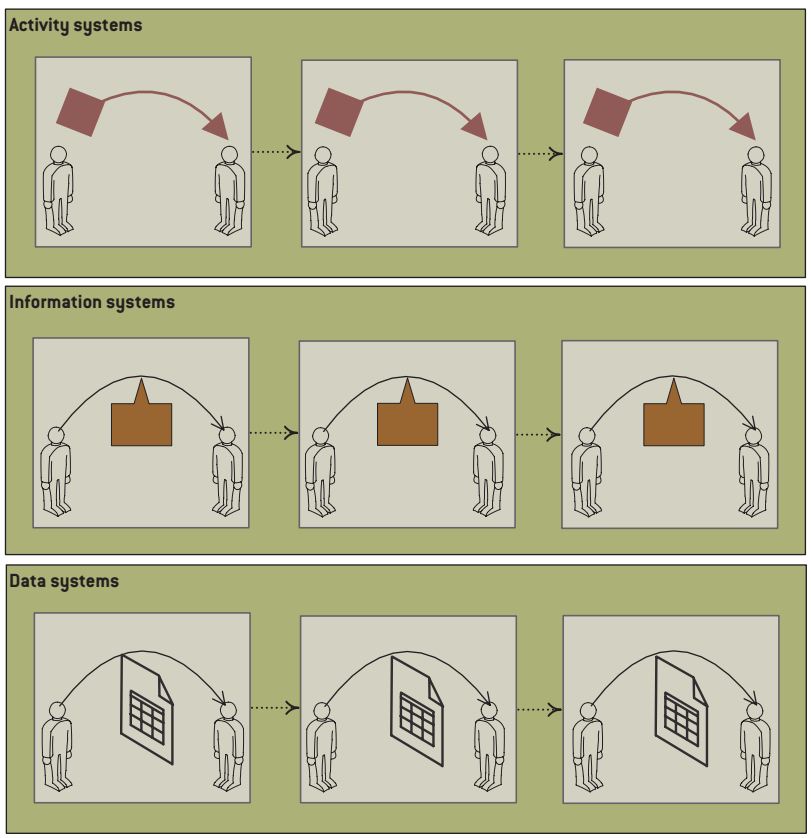


Figure 4.1 Vertical infrastructure

4.2.2 Horizontal infrastructure

Horizontal infrastructure
A term used to refer to the ways in which distinct activity, information and data systems are coupled across the organisation.

It is also important to think of infrastructure in a horizontal sense (see Figure 4.2). Organisations are traditionally divided into functional units such as sales, production, inventory management etc. These can be thought of as separate but interrelated activity systems. To ensure coordination across these functional units, actors within different activity systems must communicate with each other. Much communication in the modern organisation is conducted through the sharing of data structures between functional units such as sales orders of stock movements.

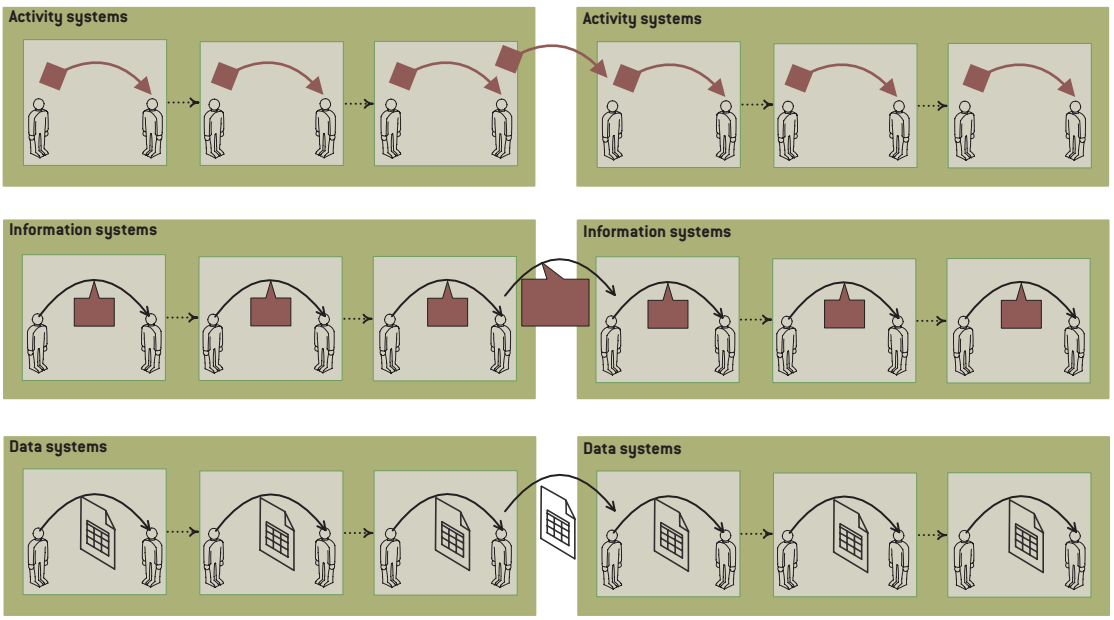


Figure 4.2 Horizontal infrastructure

4.2.3 Coupling data, information and activity

Coupling
The way in which various types of action are bound together.

To understand both vertical and horizontal infrastructure more clearly, we need to understand how data systems support information systems and information systems support activity systems. This support is enacted through the **coupling** between articulation and communication, which we referred to in Chapter 3 as data, and the coupling between communication and coordination, which we referred to in Chapter 3 as information. Articulation is the action associated with the manipulation of data structures, while communication is the accomplishment of meaning in engagement with such data structures. Coordination is the achievement of joint activity by a group of actors through communication.

Let's consider a simple example from manufacturing, where structures of data are used to accomplish information, which in turn facilitates coordination. Within an area known as pull production (sometimes referred to as Kanban production) two data structures are used – a production card and a move card (see Figure 4.3). Each of these is a physical piece of cardboard on which certain data are recorded. Such cards are placed in plastic sleeves attached to production containers, sometimes called stillages.

Kanban or pull production is really an attempt to resolve a type of coordination problem – how to get the right quantity of material transported along a chain of production units in time for its use within production. Consider just the relationship

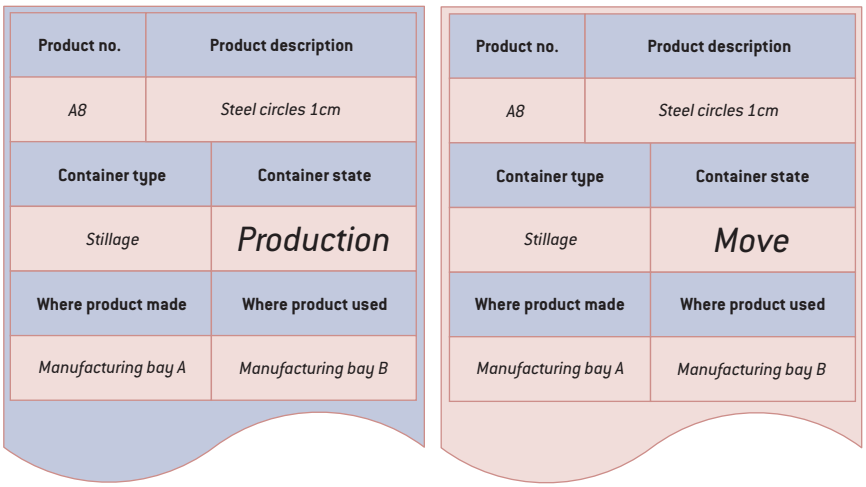


Figure 4.3 Production and move cards

between two production units: production unit 1 and production unit 2. Production unit 1 produces material for use within production unit 2. Full production containers need to be moved from production unit 1 to production unit 2 by forklift truck drivers. And empty production containers need to be moved from production unit 2 to production unit 1 by forklift truck drivers. This cyclical pattern of activity is illustrated in Figure 4.4.

Kanban coordination domain

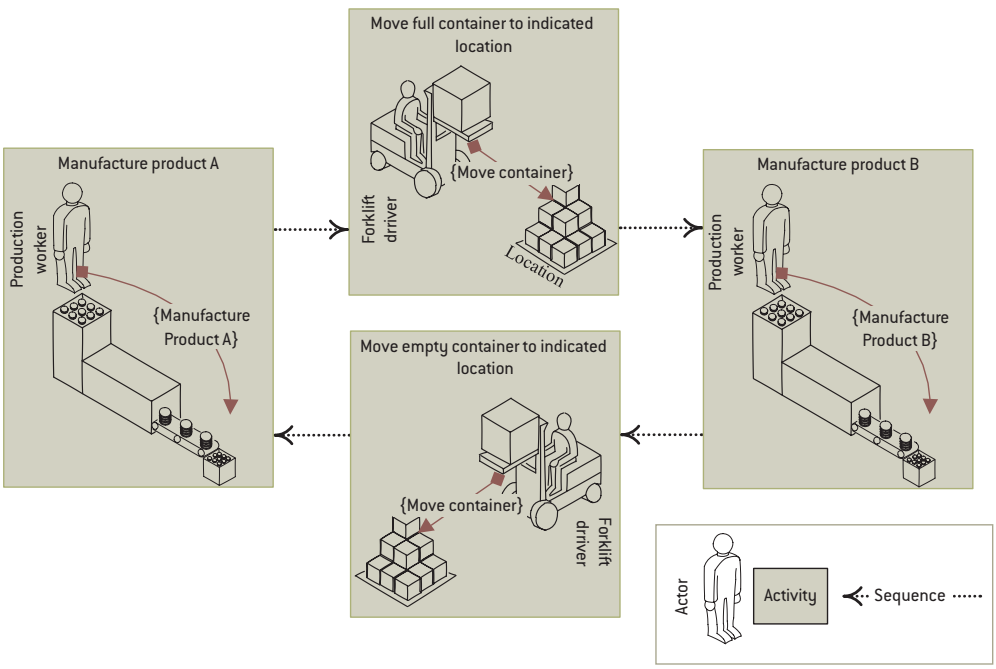


Figure 4.4 The activity system of pull production

Kanban
A pull-production system designed around the articulation of data structures.

Let us next look at how **Kanban** cards are articulated as a pattern of action between these two production units (see Figure 4.5). At production unit 1, when a stillage is full the production card is removed from the plastic sleeve attached to the stillage and replaced with a move card. A forklift truck driver reads the move card attached to the stillage and moves the stillage to production unit 2. When the stillage is received in

production unit 2 the move card is taken out and the material in the stillage is used in production. When the stillage is empty the move card is placed back in the sleeve. The forklift truck driver reads the card and moves the empty stillage back to production unit 1. The move card is then removed from this stillage at production unit 1 and replaced with a production card.

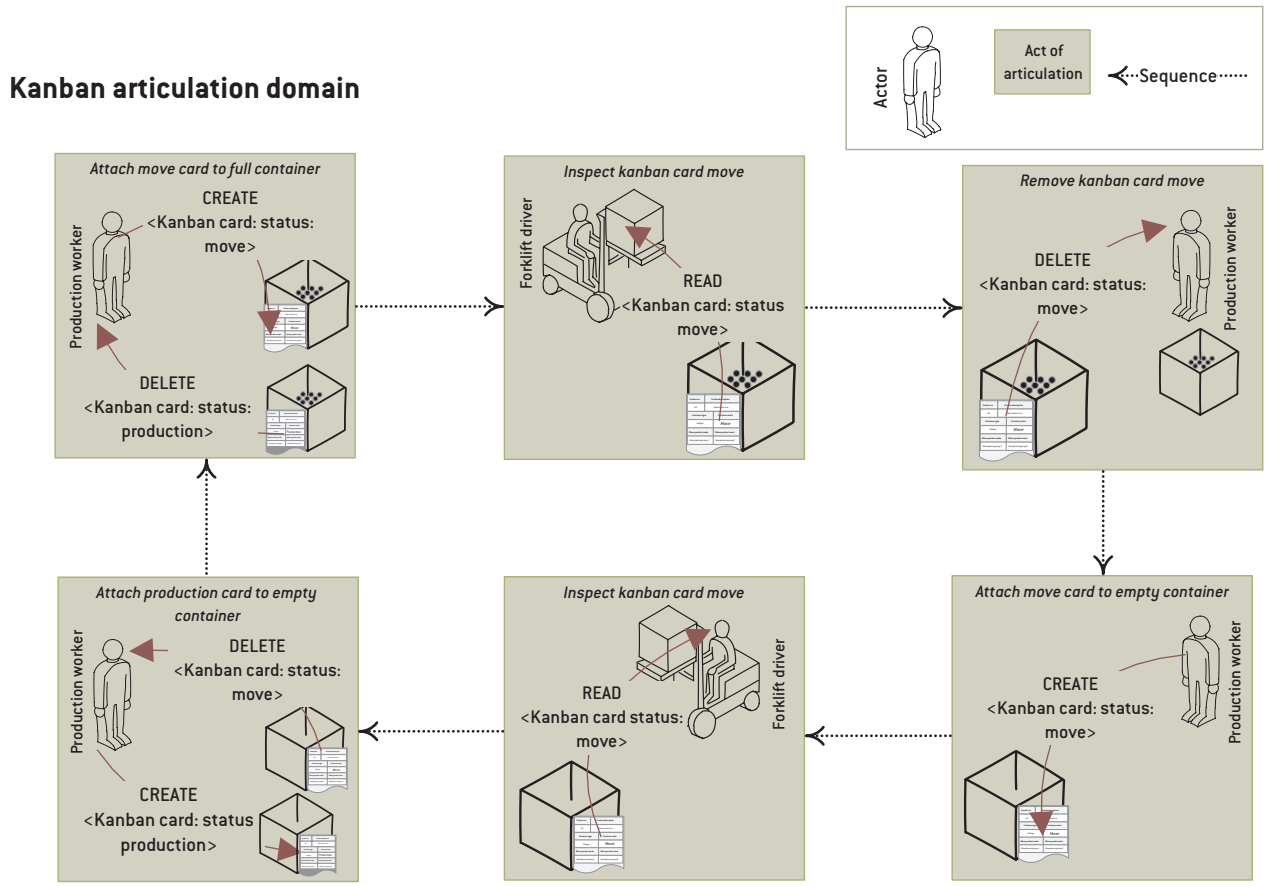


Figure 4.5 The data system of pull production

Figure 4.6 illustrates the associated pattern of communication for pull production. Acts of articulating data structures communicate various things to different actors working within this domain of organisation. Taking a production card out of a sleeve and replacing it with a move card are acts of articulation. By replacing the production card with the move card, fellow production workers are informed what has happened and what should happen. The move card asserts to fellow production workers that this stillage is full and hence not to add any more material to the stillage. The move card directs the forklift truck driver to move the stillage to production unit 2.

So, in any domain of organisation, patterns of articulation (data systems) support patterns of communication (information systems), which in turn support patterns of coordinated activity (activity systems).

This is vertical infrastructure. Data structures are also shared across units of organisation and enable units to communicate with each other about what has happened, what is happening and what should happen. This serves to coordinate activity across the organisation and forms horizontal infrastructure. The way in which these three levels of actions are coupled vertically in the case of pull production is illustrated in Figure 4.7.

Kanban communication domain

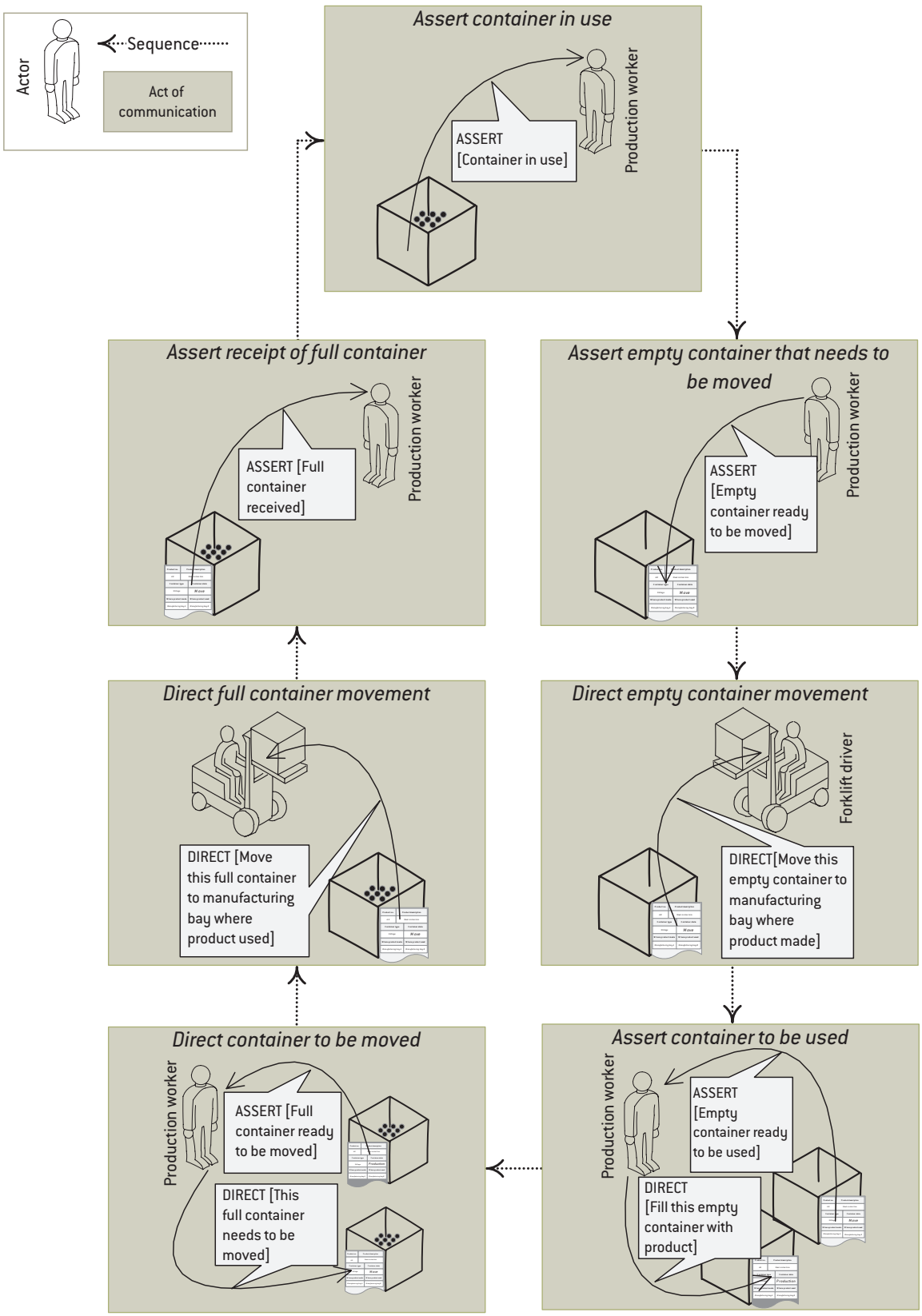


Figure 4.6 The information system of pull production

DID YOU KNOW?

The idea of Kanban is generally attributed to work in the 1940s by the industrial engineer Talichi Ohno who worked for Toyota Automotive in Japan.

RECAP

The infrastructure of organisation refers to how systems of action making up a domain of organisation achieve purpose. Vertical infrastructure refers to the way in which data systems support information systems which in turn support activity systems. Horizontal infrastructure refers to the ways in which articulation, communication and coordination are shared across different systems of action.

4.3 THE INFRASTRUCTURE OF RAF FIGHTER COMMAND

CASE

During the summers of the late 1930s, the Royal Air Force (RAF) Fighter Command created an early warning network which played a part in a decisive battle against the German Luftwaffe – the Battle of Britain in 1940. Hitler needed control of the skies if he was to invade Britain by sea, but the Battle of Britain caused him to abandon the planned invasion and turn his attention eastwards to the Soviet Union. This in turn made it possible for the Allies to invade continental Europe in 1944.

During the early 1930s accepted military strategy for air defence was to fly so-called 'standing patrols' on flight paths likely to intercept bombing raids by an enemy. This constituted an extremely expensive military strategy in that aircraft had to be kept permanently in the skies. Not surprisingly, this strategy was eventually replaced with the use of interceptor flights that could take off quickly and attack incoming bomber raids. However, the key question remained: How was an air force to determine the precise position of incoming enemy aircraft in sufficient time to enable effective interception? The key solution to this problem involved the utilisation of radio technology to detect aircraft – a technology that became known as radar. Both the Germans and British had access to this technology and indeed German radar was technically superior to its British equivalent at the time. The crucial difference was that the British were better able to utilise the technology in action.

To do this, the British Fighter Command constructed a chain of radar stations around the British coast. This was supplemented with a chain of posts manned by persons observing incoming aircraft, known as the Observer Corps. There were two chains of radar station, one for detecting high-flying aircraft and one for detecting low-flying aircraft. Over a thousand observer posts and fighter airfields were also connected to headquarters by dedicated Post Office teleprinter and telephone lines.

The second crucial step was the creation of effective systems of both activity and communication in which the technology could be utilised. During the summers between 1936 and 1939, a series of teams formed from physicists, engineers and RAF personnel engaged in practical exercises with the aim of solving the fundamental problem of turning raw data from radar and observer posts into information for pilots to fly to the precise point at which to intercept enemy raids. The eventual infrastructure of activity, information and data systems that was created allowed an initially under-strength RAF to successfully compete with a numerically greater force of enemy aircraft.

The organisation of Fighter Command was divided into four geographical groups covering major parts of the country. Each group was in turn divided into sectors with a sector HQ at each of the airfields. Group HQ had tactical control within their area and Sector HQ had control of pilots when airborne.

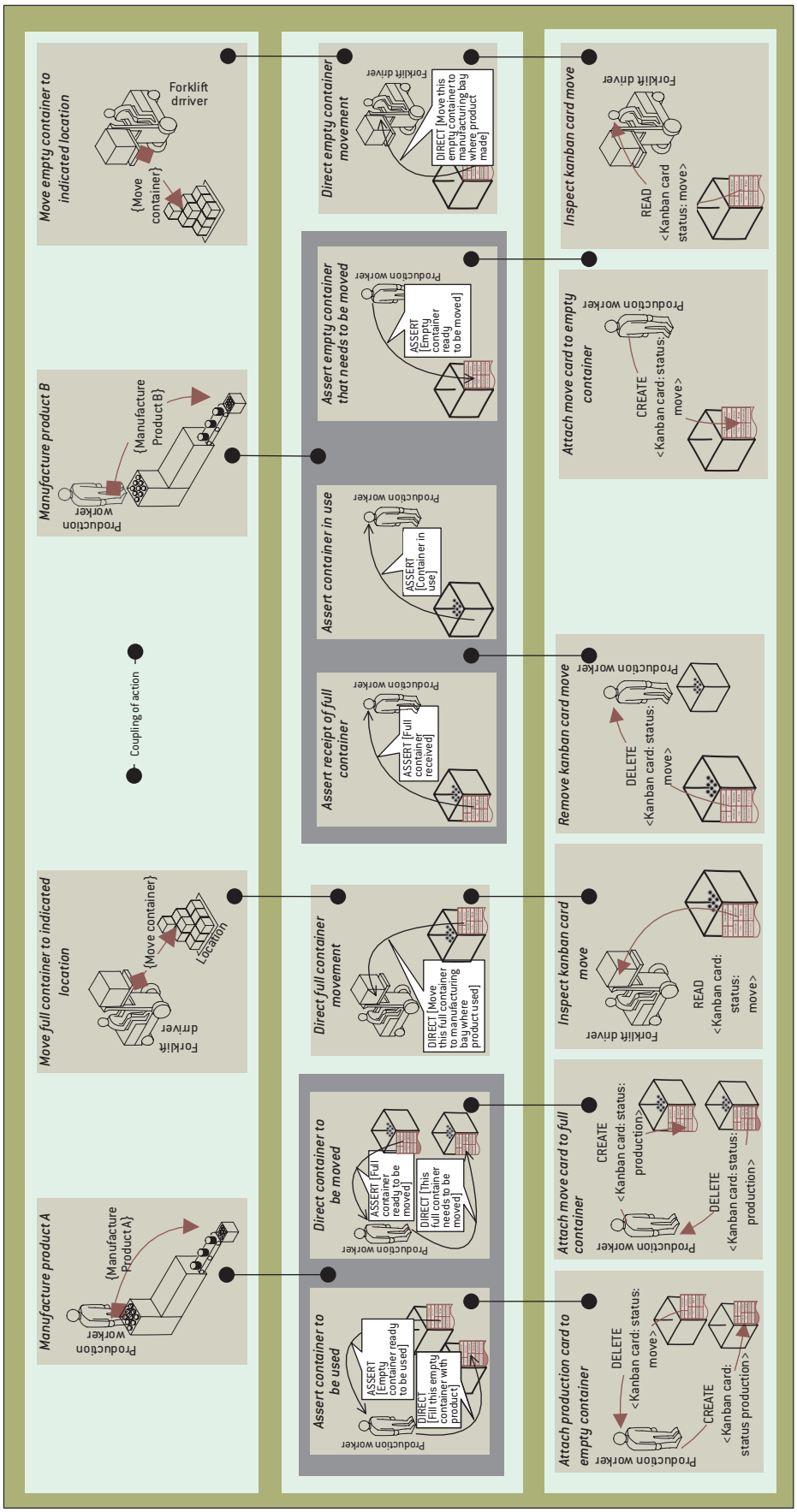


Figure 4.7 The vertical infrastructure of pull production

CASE
continued…

Data from radar stations were telephoned to Fighter Command HQ. These data went first to a filter room where the quality of the data was assessed. Filtered data were then passed on next door to the Fighter Command Operations Room. Filtered data and classified plots were recorded by members of the Women's Auxiliary Air Force (WAAF) with the movement of wooden blocks or counters against a large-scale map of the UK. These counters indicated the height, strength and direction of enemy raids. In addition, a display (a slotted blackboard) called the 'tote' recorded enemy raids and the state of readiness of RAF squadrons (available 30 minutes, 5 minutes, take-off readiness 2 minutes or in the air) – indicated by a series of lights. Changes to the positioning of counters and updates to the tote were conducted simultaneously at headquarters, group and sector level.

The operations room at group and sector levels worked in the same way except that the maps used represented group and sector areas respectively. Group HQs received data from the observer posts that were passed on to command and sector HQs.

The sector room was set up with one unit duplicating the picture at command and group level. The second unit plotted on the map the exact location of their own planes from their radio transmissions. From here aircraft were assigned to a designated raid and their interception courses were continually plotted using compass, ruler, pencil and paper. The sector operations controller scrambled selected aircraft on command from the group HQ. Once in the air, command passed over to the flight leader until combat was over. There were also links from the system to Anti-Aircraft Command, the Observer Corps, the BBC and civil defence organisations such as those sounding air raid warnings.

4.3.1 The activity system of RAF Fighter Command

CASE

Activity systems, as we have seen, are social systems. They consist of people and machines engaging in coordinated and collaborative action. In the case described, the activity system consisted of the command and control of fighter aircraft flown by the RAF.

The RAF faced a key coordination problem in the 1930s. To intercept enemy aircraft in sufficient time to prevent them bombing strategic targets in the UK, Fighter Command needed to know where they were in sufficient time to react. They also needed to know the current deployment and state of readiness of their own forces. To ensure coordinated action of this nature RAF fighter squadrons were positioned at multiple airfields around the country. These squadrons needed to be informed in sufficient time to take off and intercept the enemy in sufficient force.

The infrastructure of Fighter Command proved its worth in action during the period from July to the end of October 1940. On Sunday 15 September 1940 the system was severely tested. A hundred German bombers crossed the Kent coast at 11:30 that day. Seventeen squadrons from three groups of the RAF went to intercept them. At 14:00 the same day a second wave came in and was met by 31 squadrons (over 300 planes in all). At the end of the day RAF losses were 27 aircraft with 13 pilots killed. The Luftwaffe lost 57 aircraft. But the success of this infrastructure was not due to the technology, communication or the activity in isolation. The success of Fighter Command during the Battle of Britain was due to the effective way in which technology was used to improve communication and decision-making and through this to support purposeful action.

REFLECT

Within wider literature the term information system is used in a much looser way than we have used it in this chapter. Some see an information system as a system of people, processes and technology. Consider whether the definition applied in this book is better or not in terms of some area known to you.

4.3.2 The warning network as a data system

CASE

Within the case description provided in the previous section there are clear component elements of a data system, but this data system involved use of different technologies from the modern day. We might say that broadly, information and communications technology is any collection of artefacts used to support aspects of an information system. The ICT described in the example was subtly different from modern information and communications technology. ICT during the Second World War involved elements like radar, telephone communications and the use of maps, plotting tables and tote devices. The use of such technology constituted the data system of the time, the key elements of which are illustrated in Figure 4.8.

Data identifying and describing incoming enemy aircraft were received from various sources as telephone messages from radar stations, the Observer Corps and station Y. Data were also continuously sent as telephone and radio messages from Fighter Command airfields and squadrons which identified and described the current state of friendly aircraft.

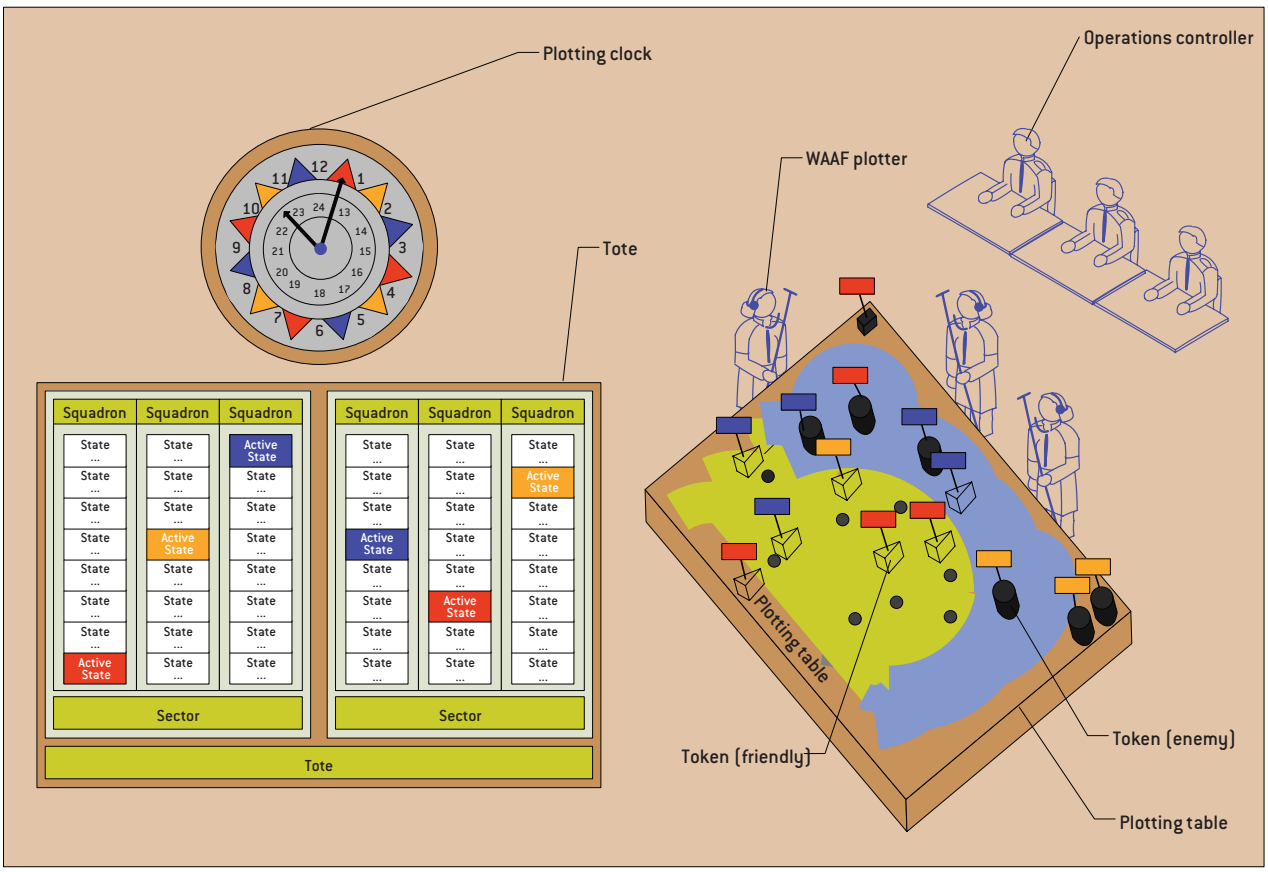


Figure 4.8 Elements of the operations room

Decisions first were made about the correctness and importance of these data. Only data regarded as relevant were passed on to the plotting room. Within the plotting room data representing both enemy and friendly aircraft were formed on the plotting table using wooden tokens. Differences made with these tokens signified different things to different people working in the control room, particularly people working as operations controllers (see Figure 4.9). For example, the shape of the wooden token indicated whether the token represented a squadron of friendly or enemy aircraft, the position of

CASE
continued…

the wooden token upon the plotting table indicated the last known position of a squadron of aircraft. A flag of one of three colours was also added to each token to indicate the recency of data. A yellow, blue or red flag coded a 5-minute interval upon the plotting clock. The flag added to a token thus indicated to actors in the plotting room how old the data pertaining to this token were.

Operations controllers made decisions based upon what data communicated to them about friendly and enemy dispositions within the battles of a particular day. The decisions they made were then communicated as messages to sectors, airfields and flying aircraft through telephone, teleprinter and radio.

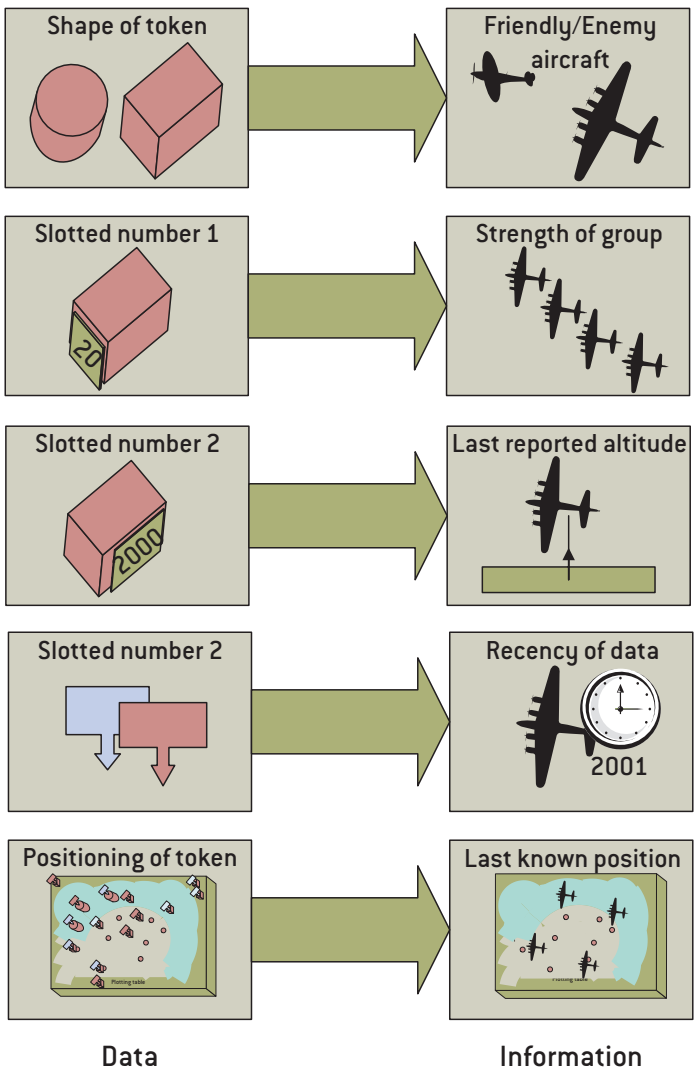


Figure 4.9 Differences on the plotting table

4.3.3 The warning network as an information system

CASE

The articulation of data within the warning network was used to communicate different things to different actors within this domain of organisation (see Figure 4.10). To the left of the figure various actors are asserting what they believe to be the current status of significant things of interest such as the position of enemy aircraft. For instance, a radar

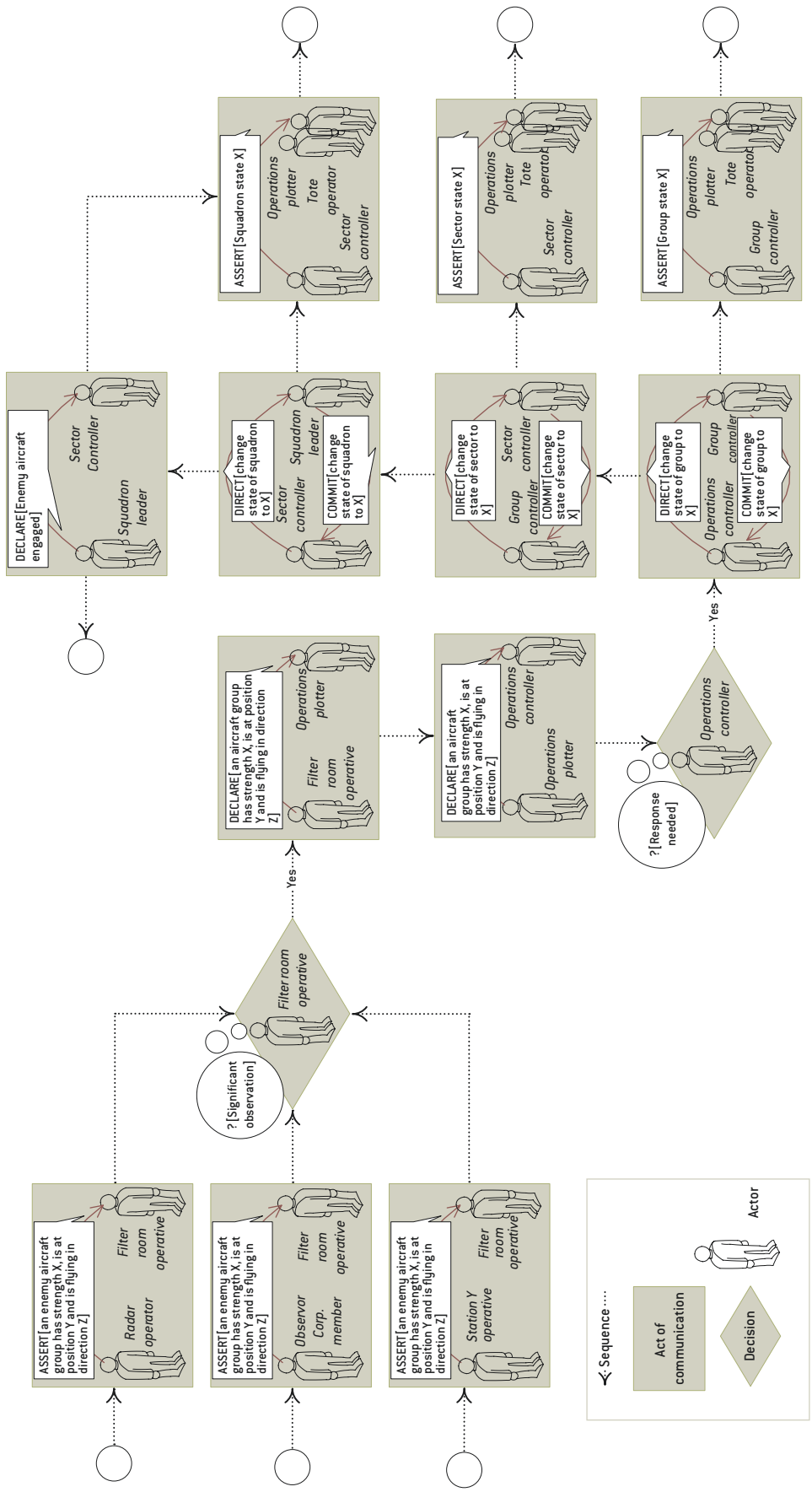


Figure 4.10 The information system of the warning network

CASE
continued…

operator will continuously make assertions such as – ASSERT[an enemy aircraft group has strength X, is at position Y and is flying in direction Z]. Actors then filter such communications and declare the current state of the battle in the skies. Hence a plotter within the operations room declares the position of an enemy aircraft group by moving a given token on the plotting table. This serves to DECLARE[an enemy aircraft group has strength X, is at position Y and is flying in direction Z]. Such declarations are then used within decisions about the orders to be issued down the chain of command. Such orders constitute directives such as an operations controller requesting a group controller to change the state of readiness of the sectors under their control – DIRECT[change of state to sector readiness to X]. To ensure that these directives are received and acted upon an associated commitment is required in each case. Therefore a sector controller confirms that a squadron has scrambled to a group controller – COMMIT[Squadron X to state Y]. Finally, various actors provide updates back to control of their current actions through assertives.

4.4 COMMON INFRASTRUCTURE

You would expect that organisations that create the same type of value (have similar purpose) have similarities in their infrastructure. For example, you would expect manufacturing organisations to have certain data, information and activity systems in common. Likewise, you would expect certain government agencies delivering benefits to have common elements of infrastructure or various charitable organisations, such as social enterprises dealing with care for the elderly, to share particular aspects of infrastructure.

To illustrate this, Figure 4.11 plots some of the typical activity systems found within manufacturing organisations as boxes – such as sales, aftersales, marketing, purchasing, receiving, warehousing, production, human resources, packing and shipping. It also indicates how value is transformed as it moves between different activity systems in terms of broad arrows starting and finishing at particular activity systems. It also shows how certain data structures are exchanged between internal and external actors as narrow arrows.

The flow of data supports the flow of communication which in turn supports the flow of activity. On the one side, sales orders from customers act as the major data structure input into the organisation. Sales orders trigger packaging and shipment of goods from customer-side inventory back to the customer. This part of infrastructure therefore supports activities within what we shall refer to as the customer chain. Marketing and aftersales service also engage in an attempt to build a long-term relationship with the customer. On the other side, purchase orders from the company trigger the shipment of raw materials by suppliers. Hence this aspect of infrastructure is relevant to what we shall call the supply chain. Such material is received into supply-side inventory management. Such supply-side inventory drives production which replenishes customer-side inventory with finished products. Finally, payments from customers are recorded in a central finance system as well as payments to suppliers and employees (Figure 4.11).

The upshot of this is that one would expect that activity systems that have much in common would rely upon similar patterns of communication, and hence would have similar information systems. For example, the dispatch of ambulances to emergency incidents has much in common with the dispatch of fighters to intercept enemy aircraft as described in the warning network case. This can be seen from Figure 4.12, which

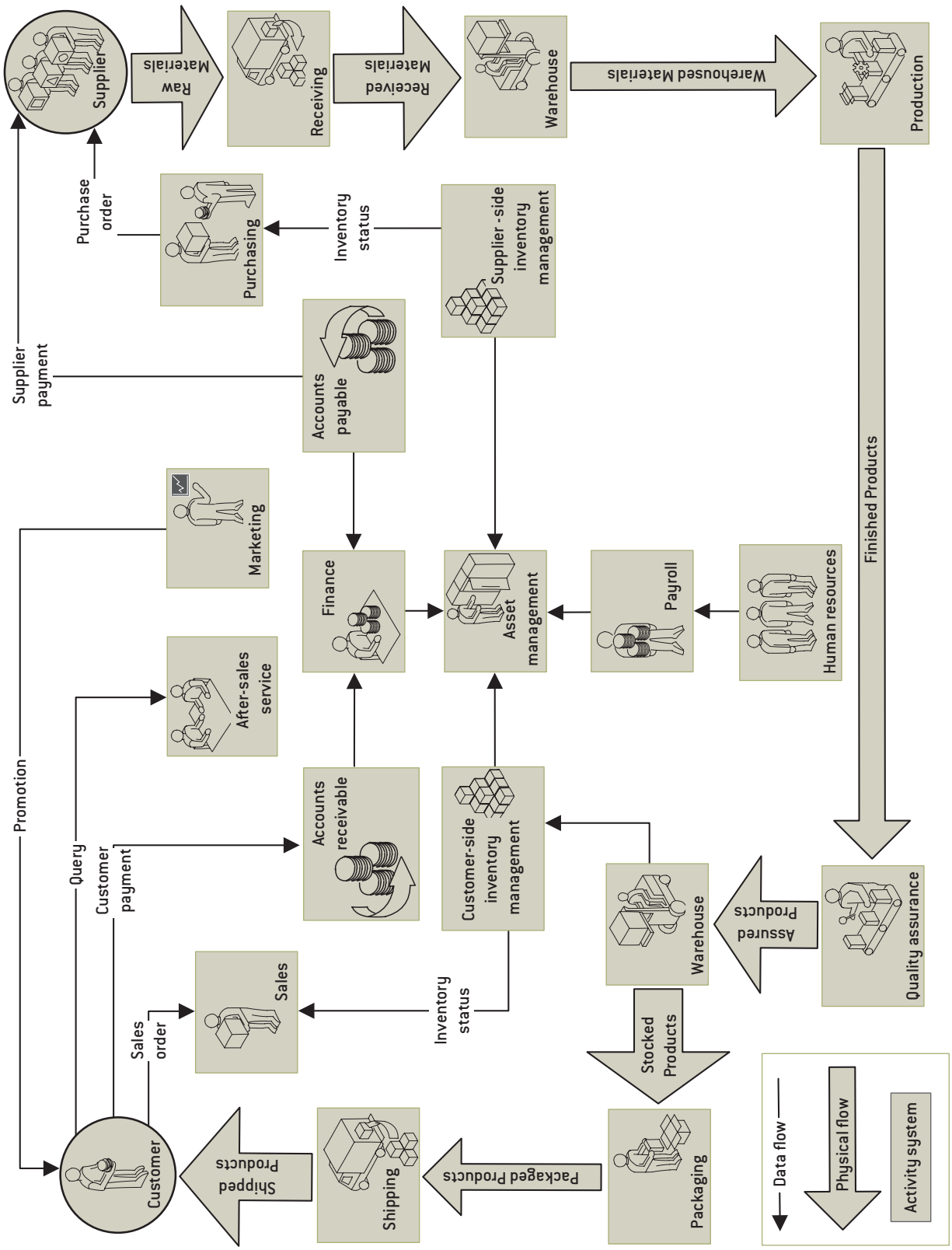


Figure 4.11 Common elements of manufacturing infrastructure

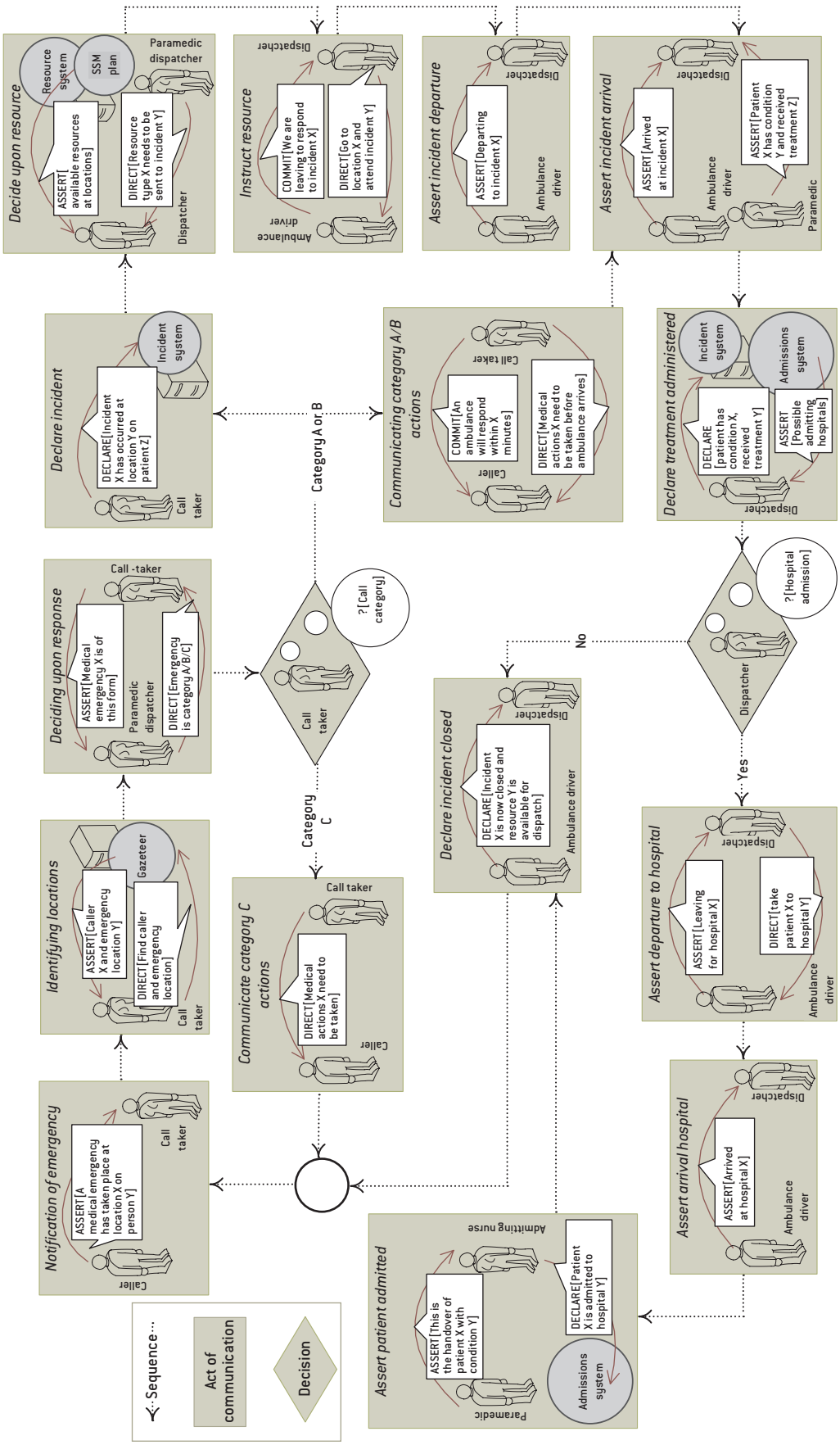


Figure 4.12 The information system of emergency response

illustrates the pattern of communicative acts applicable to an emergency response service, and which has many points of similarity with the pattern evident in Figure 4.10. Within the warning network numerous actors asserted the strength and position of enemy aircraft. Within the emergency ambulance service, numerous people assert incidents of trauma to the emergency service. At some point within the warning network actors make decisions about what enemy aircraft to respond to. This is similar to declaring events within emergency response that need ambulances to be sent to. Various friendly aircraft have to be dispatched to intercept enemy aircraft or various ambulance resources have to be directed to dispatch ambulance resources to incidents. Fighter aircraft in the sky then have to assert when they have left the airfield, when they have intercepted the enemy, and when they have disengaged and are returning home. Likewise, dispatched ambulances have to indicate when they leave a depot, when they arrive at an emergency incident and when they have handed over a patient into a general hospital.

RECAP

Organisations have both similarities and differences in infrastructure. Similarities and difference both in front-end and in back-end infrastructure.

4.5 BACK-END INFORMATION SYSTEMS INFRASTRUCTURE

Back-end information systems infrastructure
The core set of interrelated information systems supporting business operations.

The same argument can be made for common information systems infrastructure. In other words, there are certain core information systems that, at a high level, most businesses have in common (see Figure 4.13). These are sometimes referred to as the back-end or back-office information systems. The term back-end or back-office is taken from Victorian times when people either worked in a front-office interacting with external actors, such as customers, or in the back-office undertaking value-creating tasks.

Financial data is the lifeblood of most business organisations and is subject to a vast range of external regulation in the sense that companies must prepare their financial reports in well-established ways. Therefore, it is no surprise to find that, in most business organisations, ICT was first applied within the accounting or finance department and that financial information systems form the core around which a number of other information systems are located.

Most companies of whatever size will need an information system for recording orders for products/services from customers, orders made to suppliers for products/services and the amounts paid or due to employees. Many businesses that sell products are therefore founded around a number of such key information systems.

- Sales order processing is an information system that communicates details of sales orders from customers.
- Inventory management is the information system that maintains the inventory of raw material from suppliers and finished goods stored in warehouses ready to be shipped to customers.
- Purchase order processing is that information system that communicates details of purchase orders to suppliers.
- Finance is that system that communicates amounts owed and paid by customers, amounts owed to and paid to suppliers, and amounts paid to and owed to employees.
- Payroll is the information system that communicates details of wages and payments made to employees.

Businesses which sell services will operate differently in the sense of having different activity systems. Hence, although they will have core information systems in similar areas these will operate differently from that described here.

DID YOU KNOW?

One of the earliest forms of writing, Sumerian cuneiscript, which was used from the sixth to the third millennium BC, appears to have been invented not to convey narrative but to support early forms of financial administration. Because of cases such as this, some have even argued that without the need to record assets, written language might never have emerged. Re-examine the Inka khipu case and reflect upon this.

4.5.1 Communicative acts

It must be remembered that a model of some activity system diagram is an abstraction of a number of activities evident in some organisational situation. Likewise, a model of some information system, such as the one in Figure 4.13, is an abstraction of a number of communicative acts supporting activities. Hence the arrow labelled delivery note in

Back-end information systems infrastructure

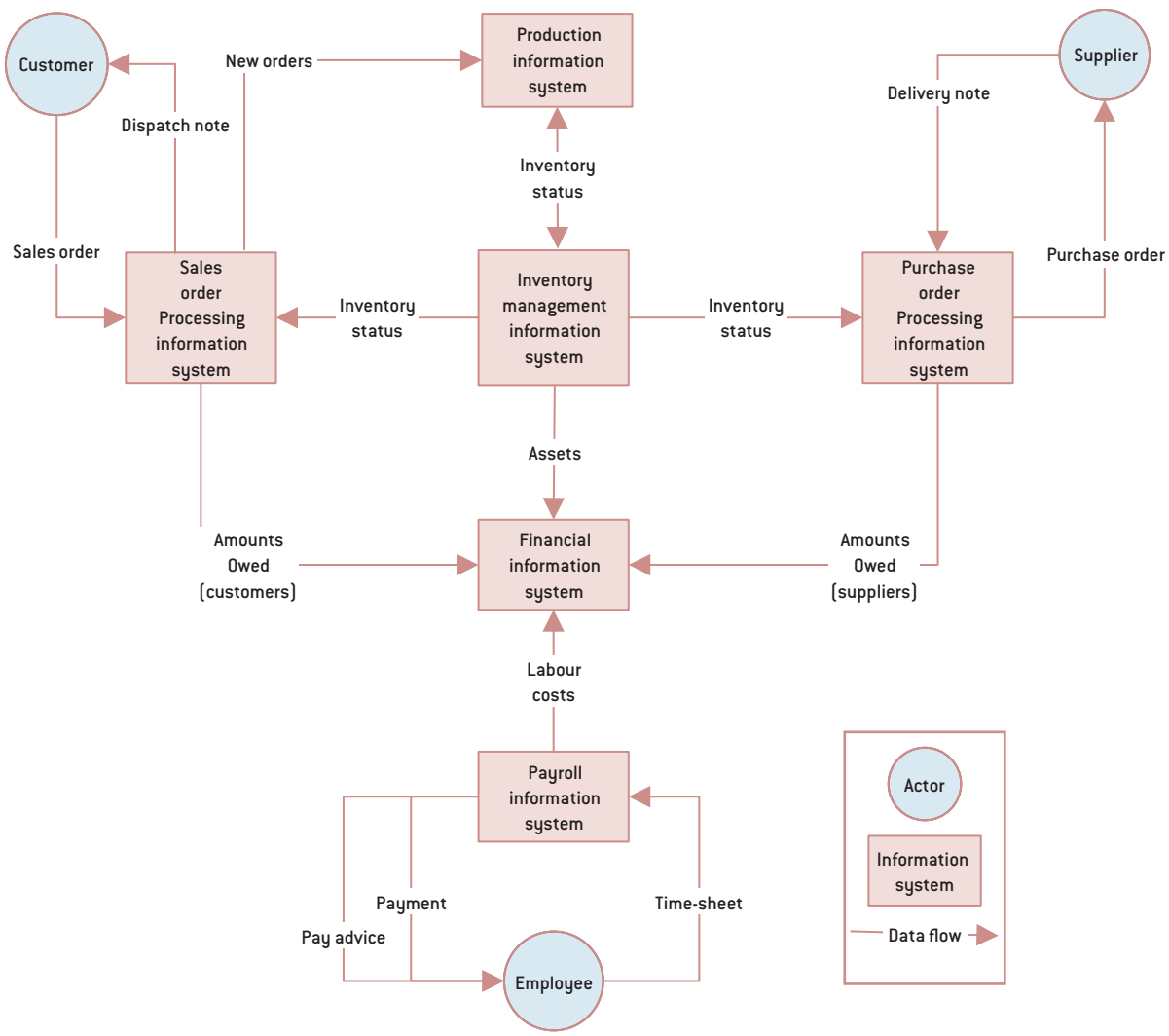


Figure 4.13 Common elements of information systems infrastructure

Figure 4.13 which flows between the actor *supplier* and the activity *purchase order processing* can be seen to effectively represent an abstraction of an assertion that a particular order has been delivered between some business actor in the supplier organisation (such as a supplier clerk) and a business actor in the manufacturing organisation (such as a purchasing clerk). Likewise, the arrow labelled *purchase order* that flows between the same activity and the supplier can be seen to represent a directive communicative act between two business actors. In other words, it represents a request for some materials to be delivered. This linkage between elements of an information systems diagram and specific communicative acts is illustrated in Figure 4.14.

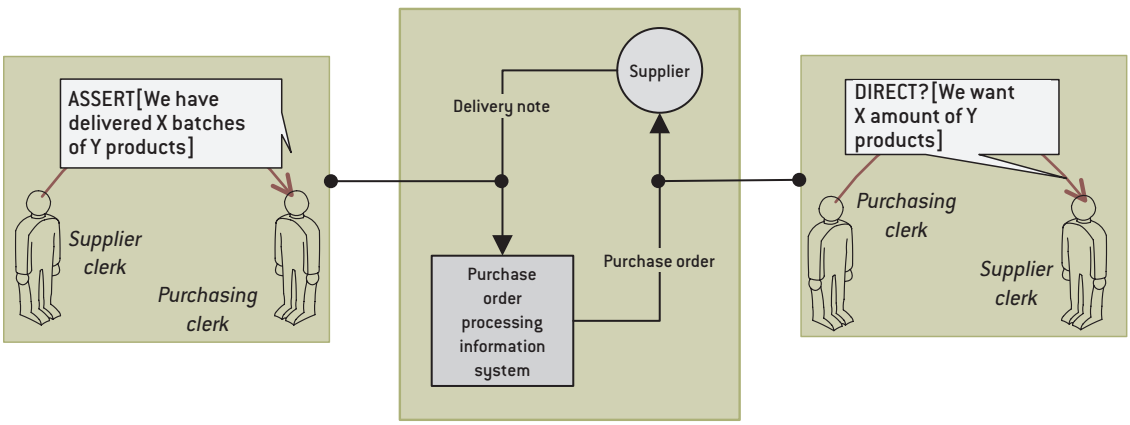


Figure 4.14 Sharing data structures and communication

4.5.2 A financial information system

The advantage of systems abstraction is that we can consider at a high level the entire system, as in Figure 4.13. Or we can take one of the subsystems indicated and blow it up into more detail, as in Figure 4.15.

Figure 4.15 outlines how a standard financial information system, or accounting information system, works within the typical organisation. Normally, this information system is divided into three major subsystems: accounts receivable, accounts payable and general ledger. The names of these three subsystems are taken from earlier types of data structure employed within offices for many hundreds of years. Each consisted of the maintenance of a large paper book or ledger consisting of written records of the monetary transactions of a business, posted in the form of debits and credits.

Therefore, we introduce an additional symbol on Figure 4.15, known as a data store, which acts as a repository for data – a place where data collect and are retrieved from. In a manual information system this might be a filing cabinet, card index or a ledger. In an information system making use of digital computers and communications, it is generally a database. We represent a data store by a labelled open box.

The data store used by the accounts receivable system is generally called a sales ledger, because it records details of the amounts owed by customers. The data store used by the accounts payable system is sometimes called the purchase ledger, because it details monies owed to suppliers.

The general ledger system is used to record details of all the financial transactions relevant to an organisation: income, expenditure and assets; thus it receives data from accounts payable, accounts receivable and inventory management systems.

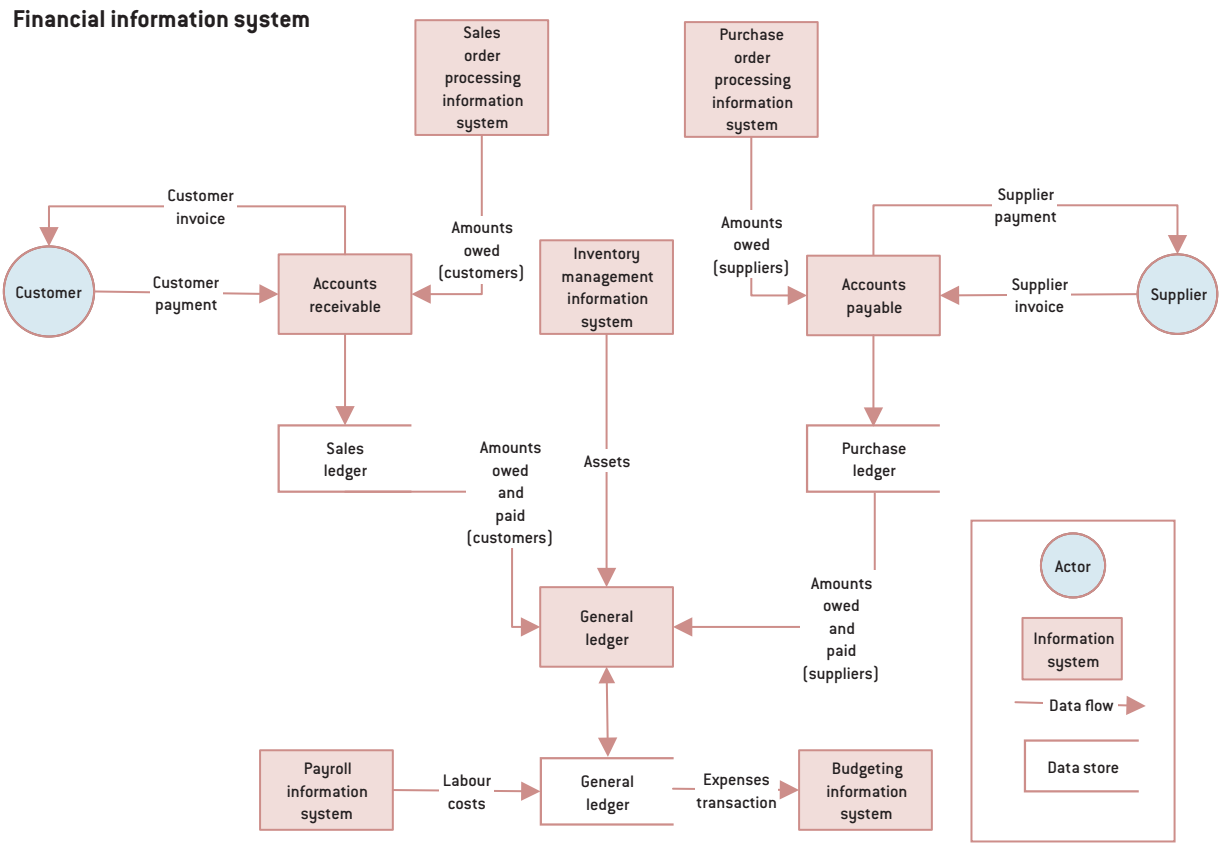


Figure 4.15 The elements of a financial information system

The accounts receivable system is essential for managing cash flow. When goods are shipped to customers, the system invoices them and updates their account with details of the amount owed. When customers send payments, their credit balance is reduced by the appropriate amount. The data about customer credit and amounts paid are regularly used to update the general ledger system.

The accounts payable system is also essential for managing cash flow. When goods are ordered from suppliers the system receives a record of the amount owed, and the supplier's account is updated. When payments are made against invoices received, the balance owed is reduced accordingly. These data too are regularly used to update the general ledger system.

The third key input into a general ledger system is a payroll information system, which regularly updates the general ledger with the costs incurred in paying staff. There will also be an input into the general ledger from the inventory management information system, so that a record is kept of the financial value of assets held.

CASE

LEO stands for the Lyons Electronic Office, a business-oriented computer system created by J. Lyons & Co. Ltd., one of the UK's leading catering and food manufacturing companies in the first half of the twentieth century (Mason, 2004). The LEO I (Lyons Electronic Office I) was the first computer used for commercial business applications. Modelled closely on the Cambridge EDSAC, LEO I ran its first business application in 1951. In 1954, Lyons formed LEO Computers Ltd to market LEO I and its successors LEO II and LEO III to other companies. LEO Computers eventually became part of English Electric Company (EELM), then International Computers Limited (ICL) and ultimately Fujitsu. LEO series computers were still in use up until 1981. (See an extended view of this case in Chapter 5.)

RECAP

A common back-end information systems infrastructure for the typical organisation includes sales order processing, purchase order processing, inventory management, finance and payroll. Such systems implement formal patterns of communication between diverse organisation actors.

REFLECT

If core information systems tend to have common features across organisations, what potential is there for gaining competitive advantage through information systems? In what sense are these core information systems critical for regulating the business organisation? What role do management information systems play in the regulation of organisations? How important is it that the information systems in this back-end infrastructure transfer data between systems easily?

4.6 FRONT-END INFORMATION SYSTEMS INFRASTRUCTURE

Front-end information systems infrastructure
The set of related information systems that interact with the major stakeholders of the organisation.

The core *back-end* information systems of a company are critical to the performance of core activity systems within business such as sales and production. Such information systems primarily involve the communication necessary to operating the major value chain activities of the organisation.

Around this core, a number of *front-end* information systems will exist. Such systems face the major internal and external actors of the business: managers, employees, customers and suppliers. These information systems are critical for operating value network activities such as maintaining relationships with customers and suppliers. Hence we refer to such front-end information systems in terms of four groups: management information systems, employee-facing information systems, customer-facing information systems and supplier-facing information systems (Figure 4.16).

DID YOU KNOW?

The discipline of information systems was originally referred to in many quarters as Management Information Systems or MIS for short. You may still find courses and modules with this title taught around the world.

4.6.1 Management information systems

Management information systems
A type of information system supporting management activities, particularly tactical decision-making.

In terms of information systems supporting the management of organisations we may distinguish between three major types of information systems: transaction processing systems (TPS), **management information systems** (MIS) and decision support systems (DSS)/executive information systems (EIS).

Transaction processing systems are the operational information systems of the organisation. In a business, organisation examples include order entry, accounts payable and inventory management information systems, as described above. Such information systems process the detailed data generated in the day-to-day operations of the business. The detailed data structures used within such systems are normally referred to as transactions and include customer orders, purchase orders, invoices etc. Such data structures are essential to supporting operations that help a company add value to its products and/or services. Hence transaction processing systems are sometimes referred to as the lifeblood of the organisation because they are so critical to effective everyday activity within organisations.

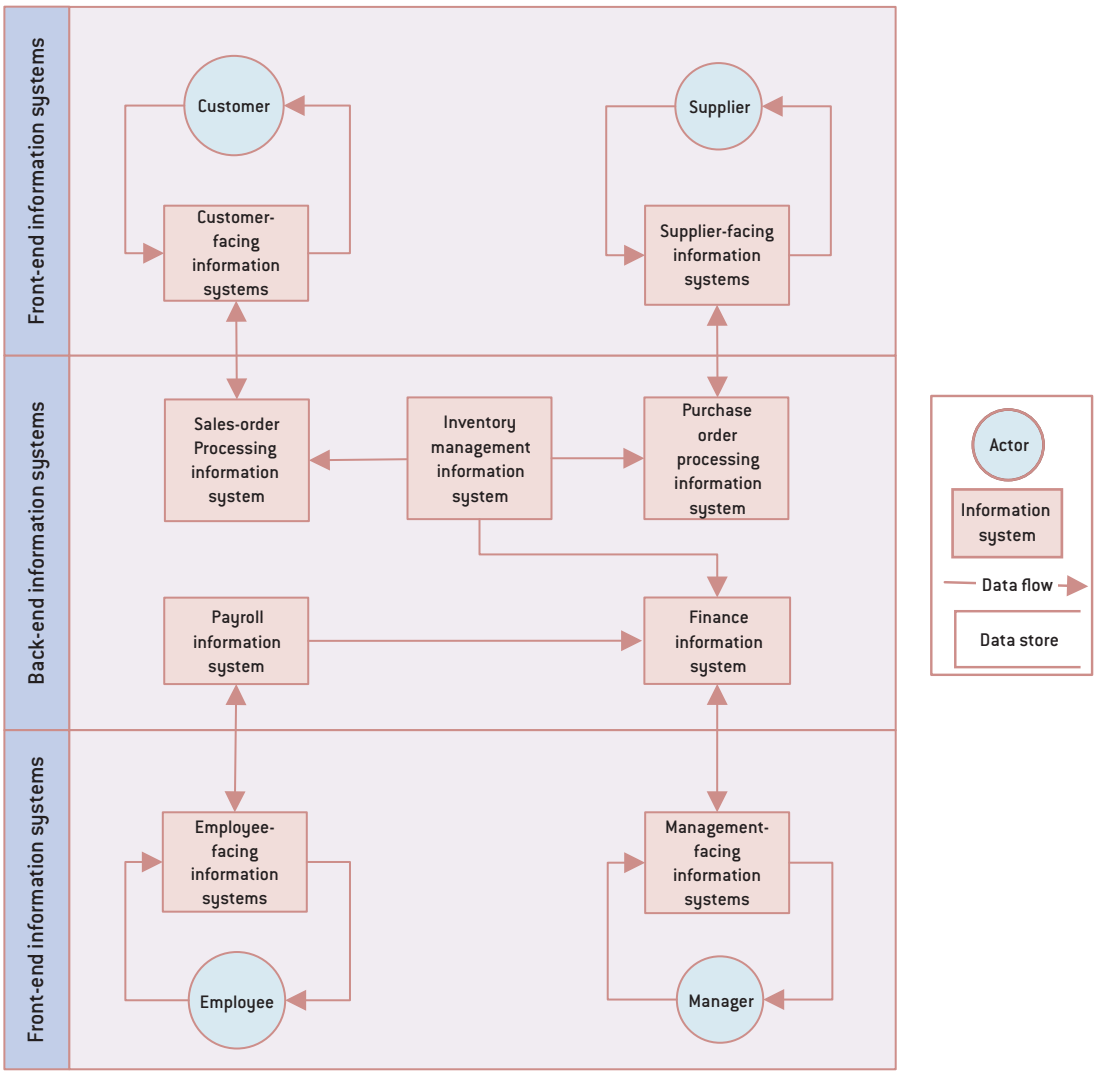


Figure 4.16 Front-end information systems infrastructure

Management could be considered as a key control process for organisations. As a system of human activity, management needs information systems to perform effectively. Management information systems (MIS) are used particularly by some operational layer of management to monitor the state of the organisation at any one time. From an MIS, managers would be expected to receive updates about current production levels, number of orders achieved, level of inventory, current labour costs and other relevant managerial information.

Whereas MIS are generally used to enable effective short-term, tactical decisions about the operation of the organisation, DSS and EIS are generally expected to support longer-term, strategic decision-making. DSS/EIS will utilise the management data generated by MIS to model short-term and long-term scenarios of company performance. These scenarios are used to ask 'what-if' questions within business planning and to generate policy decisions in the area of business strategy. DSS and EIS are therefore critical to effective performance at the strategic level of management and will probably need data generated from key environmental sensors (such as a range of other front-end information systems) to function effectively.

For example, in a supermarket chain a management information system will be used to monitor stock in warehouses and cash flow through the company. In a local authority, a management information system may be used to monitor revenues from local taxes against expenditure.

Major things of interest such as employees, customers, orders, finance and inventory are important to the information systems infrastructure of our model organisation, and data shared about such things are likely to form the key inputs into a management information system for some organisation. Using such a system, operational managers can continually monitor the state of the organisation. This is indicated in Figure 4.17 as one large management information system. In practice, it may form a number of integrated MIS perhaps for particular business areas. One of the key outputs from the MIS will be summary reports on major trends affecting the company such as labour costs, current levels of assets and current levels of spending. This reporting may be written to a planning data store for use by an executive information system. The EIS is likely to be used to formulate high-level strategic decisions affecting the company.

REFLECT

Could management in the modern organisation be performed effectively without management information systems? In what way do these information systems provide models of the organisation?

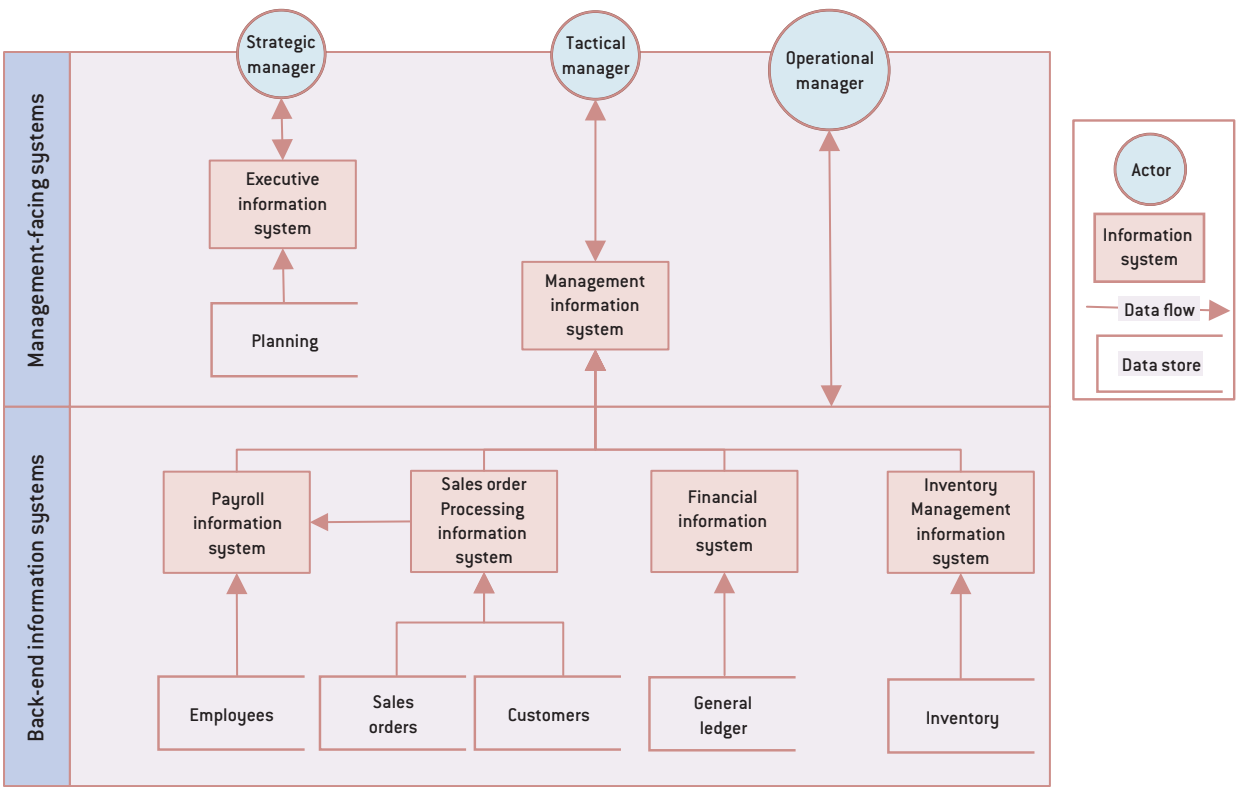


Figure 4.17 Management-facing information systems

4.6.2 Employee-facing information systems

Employee-facing information systems A type of information system supporting interaction with employees of the organisation.

Employee-facing information systems support the internal value chain within organisations. Typical employee-facing information systems include human resource management and production control systems and they are likely to interact with key back-end information systems such as payroll.

A company is likely to need to build systems to record, process and maintain large amounts of data about its employees, such as payroll data. Companies will also want to maintain detailed histories of the employment of their employees. Collectively, this would be referred to as a human resource information system.

A production information system will be involved in scheduling future production and monitoring current production. It will also interface with the inventory management information system in terms of requisitioning raw material for production and replenishing supplies of finished goods.

Some of the relationships between the key employee-facing information systems are illustrated in Figure 4.18.

Human resource management systems and production or manufacturing systems are likely to integrate around data about activities. Hence detailed work patterns of employees may be integrated with production scheduling.

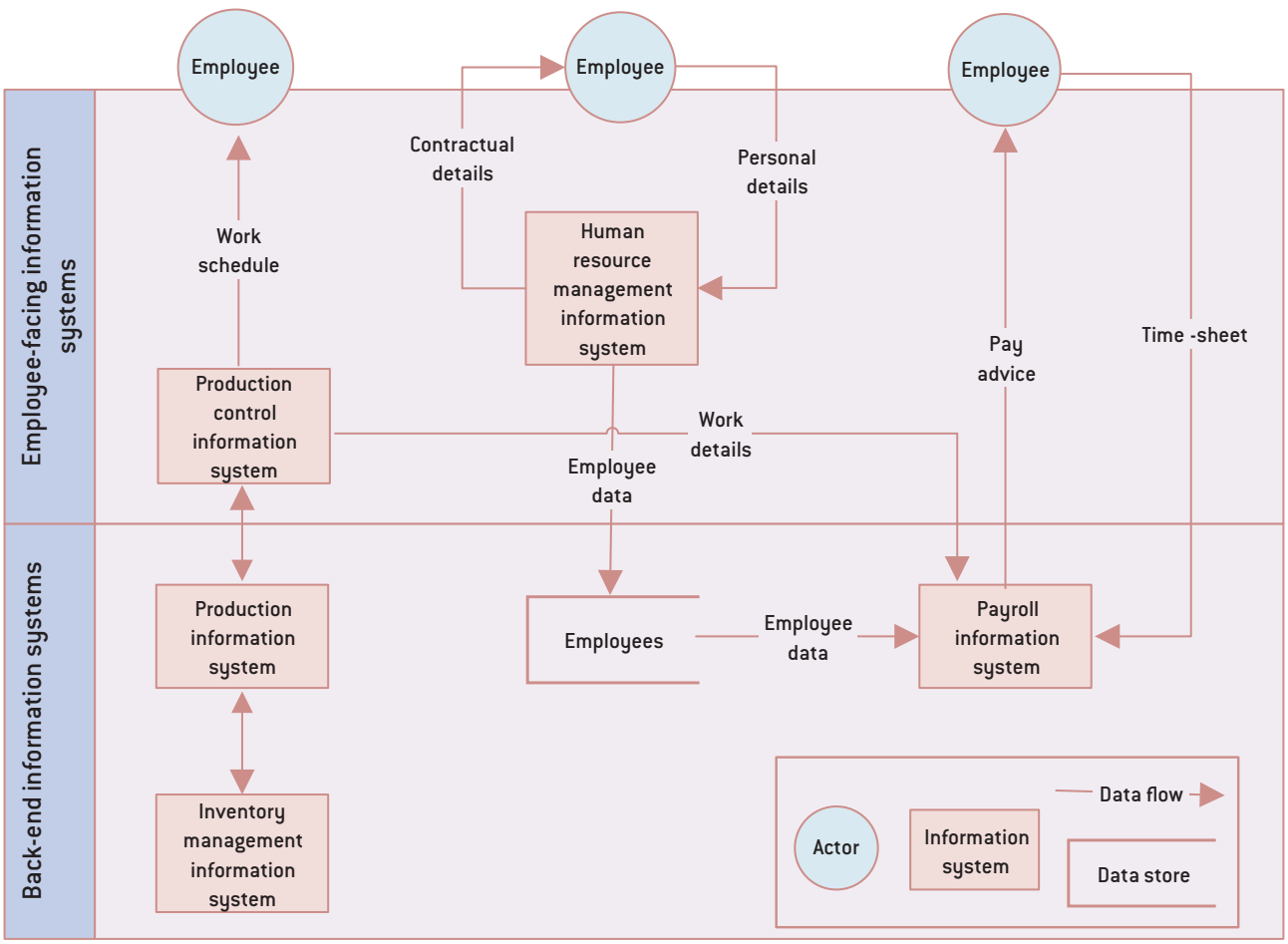


Figure 4.18 Employee-facing information systems

4.6.3 Customer-facing information systems

Customer-facing information systems A type of information system supporting interaction with the customer of the organisation.

Customer-facing information systems support demand-chain activities and typically interface between back-end information systems such as sales order processing, inventory management and the customer. Traditional customer-facing information systems include sales, marketing, outbound logistics and aftersales systems. In many organisations, there has been increased emphasis on integrating such systems together to form a customer relationship management or customer chain management information system.

In terms of sales, within some companies, particularly those associated with high-value products such as automobile sales or industrial equipment, customers would not normally fill out orders themselves. They are more than likely to interface with some sales force in relation to making orders. Hence a sales information system is a common component of the information systems infrastructure of such organisations. This system will record the activities of the sales force in terms of what sales have been made, to whom, by whom and when. These data will frequently be used to calculate commission owed to sales people on products sold.

Marketing is the organisational process devoted to promoting the products and/or services of some organisation. Good marketing is reliant on good customer data. Marketing is likely to utilise the data held about its existing customers to prepare and manage advertising campaigns for company products and services. A marketing information system is also likely to store details of various promotions, which customers have been contacted and the results of contacts made.

The distribution of goods to customers is sometimes referred to as outbound logistics. Orders processed by a sales order processing information system will typically be passed to an outbound logistics or distribution system. This is a particularly important information system for medium to large companies with lots of customers, minimal stock and many points of distribution. Delivering products to customers efficiently and effectively is critical to customer retention. Hence aspects of this logistics system will be concerned with optimising the use of delivery channels to customers. Such channels may involve management of intermediaries such as parcel post distributors.

An aftersales information system will be involved in tracking customer support and product maintenance activities following a sale and probably on a continuous basis for a number of years. The complexity of this system will probably vary with the type of product or service sold by the company. For low-value goods, such as books or CDs, aftersales may merely track customer complaints and product replacements. For high-value goods such as automobiles, aftersales is likely to involve the recording of maintenance or service schedules. For example, the lift manufacturer OTIS uses an aftersales system which proactively schedules maintenance of lifts by their engineers.

Each of the four systems of sales, marketing, outbound logistics and aftersales interacts with the customer in different ways and records different information associated with each interaction. Customer relationship management (CRM) has become a popular philosophy in the recent management literature. Winning new customers and keeping existing customers happy is seen to be critical to organisational success. But effective CRM demands a unified view of the customer. This is provided by a CRM information system.

A CRM system would ideally track all customer interactions with a company from initial enquiries through making orders to the whole range of aftersales services that might be offered to and consumed by the customer. Typically then, CRM systems integrate the range of front-end and back-end information systems that have a bearing

on the customer. Some of the relationships between the key customer-facing information systems are illustrated in Figure 4.19.

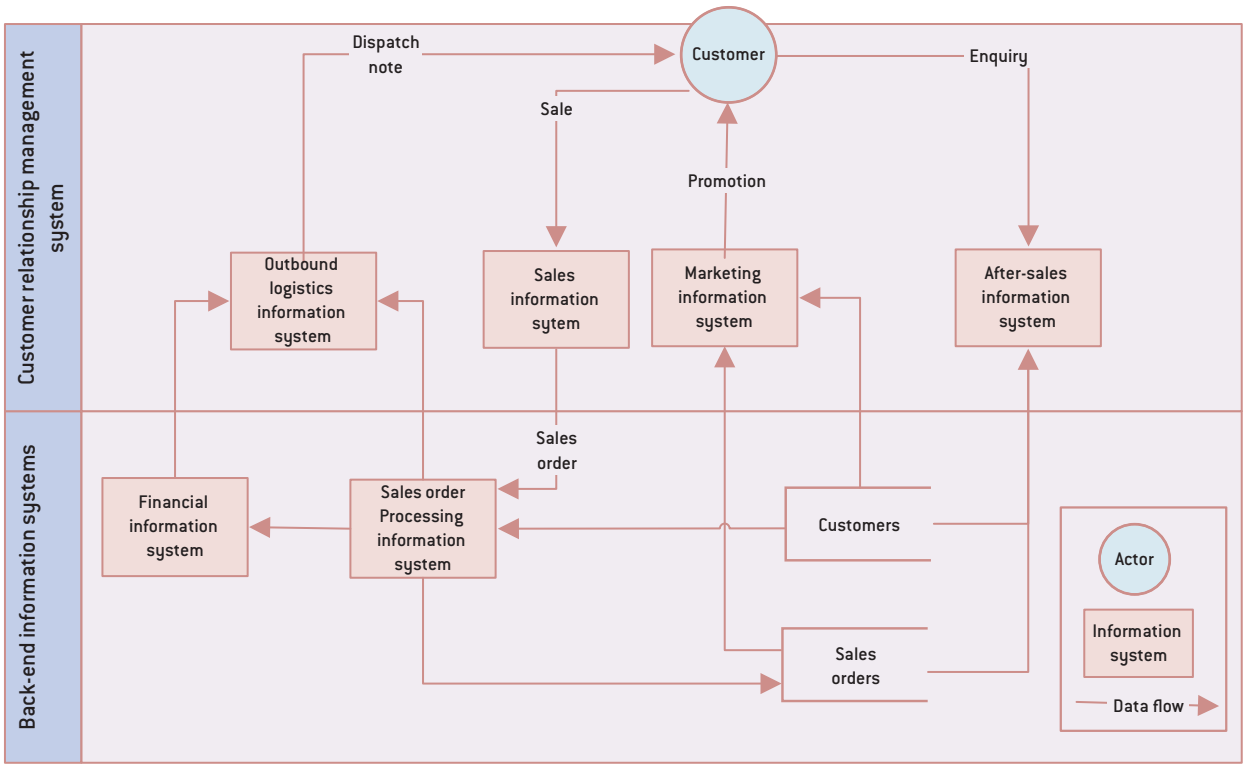


Figure 4.19 Customer-facing information systems

REFLECT

Is it true that the introduction of a CRM system will necessarily and automatically contribute to increased customer service?

4.6.4 Supplier-facing information systems

Supplier-facing information systems A type of information system supporting interaction with the suppliers of the organisation.

Supplier-facing information systems support supply chain activities. Traditional supplier-facing systems include inbound logistics and procurement, and typically interface with back-end information systems such as purchase order processing, finance and inventory management. Not surprisingly, given the symmetric nature of buy-side and sell-side activities there has been increased emphasis on integrating supplier-facing information systems together to form an integrated supply chain management or supplier relationship management system.

Inbound logistics is the process devoted to managing the material resources entering an organisation from its suppliers and partners. In the retail sector, for instance, large food retailers are likely to have fleets of vehicles involved in the delivery of goods to stores. These vehicles may have to make up to 100 deliveries in any given working week. Clearly, effective and efficient systems are needed to plan and schedule routes for vehicles to deliver foodstuffs to stores using the lowest mileage possible.

Procurement is that process devoted to the purchasing of goods and services from suppliers at acceptable levels of cost and quality. It can be considered as the sister process of sales. A procurement system will be concerned with managing this process of procuring goods, services and raw materials needed by the company to operate effectively. It is likely to interact with both the purchase ordering information system and the inventory management information system.

Supplier relationship management is the sister system to the customer relationship management system. It keeps track of all supplier interactions with the company and integrates the data used by supplier-facing information systems such as procurement and inbound logistics.

Some of the relationships between the key supplier-facing information systems are illustrated in Figure 4.20.

Electronic procurement is the trend which involves using ICT to integrate many supply-chain processes. Procurement information systems and supplier relationship management information systems in general are important parts of electronic procurement.

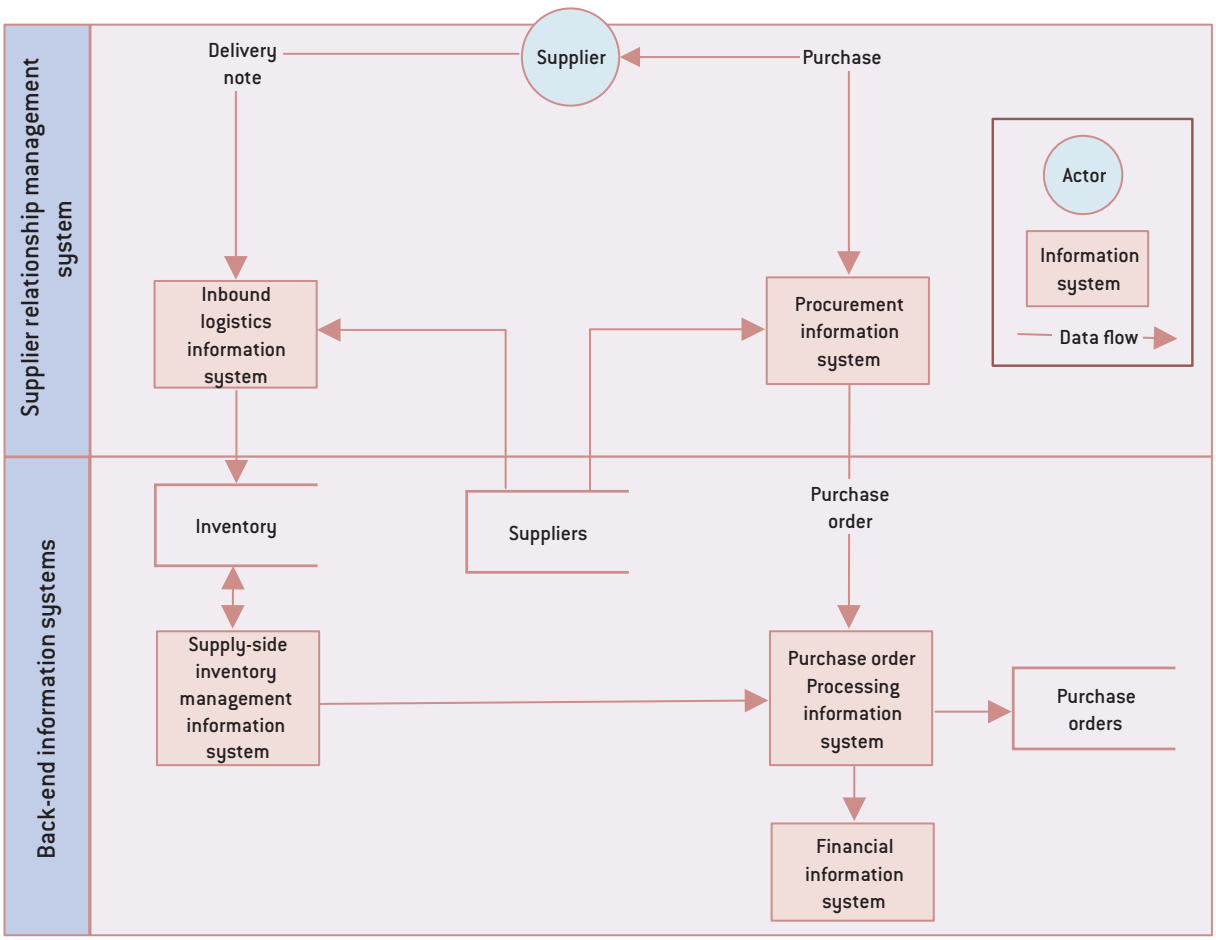


Figure 4.20 Supplier-facing information systems

REFLECT

What potential business problems might arise from poor data transfer between systems?
What part do front-end information systems play in organisational performance?

RECAP

Front-end information systems interface directly with major internal and external stakeholders: managers, employees, suppliers and customers. Such systems enable communication between such stakeholders in support of coordinated action.

4.7 DATA SYSTEMS INFRASTRUCTURE

Data systems infrastructure
The collection of data systems appropriate to some domain of organisation.

The final level of infrastructure we need to consider is **data systems infrastructure**. Within such infrastructure data structures are both articulated and shared between information systems and serve to communicate things useful to coordination. Various data structures, such as customers and sales orders, will be shared between various internal information systems within the organisation.

4.7.1 Sharing data internally

The information systems infrastructure of organisation relies upon a data systems infrastructure. This fundamentally means that data need to be integrated such that they can be easily shared across the organisation. Figure 4.21, for instance, expresses part of the data infrastructure for the typical manufacturing company as a set of tables: delivery advices, delivery items, suppliers, purchase orders, purchase order items etc. Each of these tables is represented as a collection of attributes or columns. Hence a sales order row or record will consist of a sales order number, customer number and a sales order date. Each table has one or more attributes which form the primary key for the table. These attributes, which are underlined in Figure 4.21, serve to uniquely identify each of the rows of a table. Hence, in the purchase orders table, purchase order number acts as the primary key for this table. There are also keys within each table which cross-relate to the data held in other tables and which are known as foreign keys. Hence, in the purchase orders table, the supplier number attribute serves to relate to a supplier record or row held in the suppliers table, identified by the primary key supplier number.

The key aim of most organisations is to integrate data across the ICT systems forming the data systems infrastructure. Over the last two decades organisations have typically chosen to buy in large suites of ICT systems with in-built integration. This is an enterprise resource planning (ERP) package, mega-package or sometimes the enterprise ICT system.

Enterprise resource planning (ERP) system
A package that implements an enterprise architecture for some organisation.

ERP systems typically have the following characteristics:

- They constitute a suite of software modules that support a common range of different organisational functions.
- Such modules can be implemented in an integrated manner across the organisation.
- Each of these modules runs on a common set of data structures (such as the ones illustrated in Figure 4.21).
- Data can be updated and accessed in real time (meaning near to instantaneously).
- The user interfaces to the software systems have a consistent look and feel.

The term ERP was first applied by the consulting organisation Gartner Group in 1990. They used the term to describe developments built upon material requirements planning and manufacturing resource planning (MRP) systems. Such systems

Delivery notes	Delivery no.	Delivery date	Supplier No.	Instructions		
Delivery items	Delivery no.	Delivery item No.	Supplier product code	Delivery quantity	Delivery item price	Purchase item No.
Suppliers	Supplier no.	Supplier name	Supplier address	Supplier Tel.No.	Supplier email	
Purchase orders	Purchase order No.	Supplier No.	Purchase order date			
Purchase order items	Purchase order No.	Purchase item No.	Supplier product code	Purchase item quantity	Purchase item price	
Product types	Product type code	Product description	Product length	Product weight		
Product items	Product item code	Product type code	Item qty			
Item movement	Product item code	Movement type	Movement date	Movement time	Delivery No.	Dispatch No.
Warehouses	Warehouse code	Warehouse location	No. Storage units			
Storage unit	Storage unit code	Warehouse code	Product item code			
Sales orders	Sales order No.	Customer No.	Sales order date			
Sales order items	Sales order No.	Sales item No.	Customer product code	Sales item quantity	Sales item price	Sales item No.
Customers	Customer No.	Customer name	Customer address	Customer Tel.No.	Customer email	
Dispatch notes	Dispatch No.	Dispatch date	Customer No.	Instructions		
Dispatch items	Dispatch No.	Sales order No.	Customer product code	Dispatch quantity		

Figure 4.21 Data structures as part of data systems infrastructure

experienced widespread adoption up to 2000 as many large- and medium-size companies sought to replace their aging ICT infrastructure.

Initially, ERP systems focused on automating back-office functions. More recently, modules in front-office functions, such as customer relationship management (CRM), have been offered by vendors. Also, in recent times, many such systems have been rewritten to run using web-based standards, such as those in web services discussed in the next section.

Figure 4.22 illustrates the typical suite available in a mega-package. These systems promise the seamless flow of data across an organisation: financial and accounting data, human resource data, supply-chain data and customer-chain data.

CASE

SAP AG is the largest European software company and has its headquarters in Waldorf, Germany. Its main product is the SAP ERP package, an integrated suite of ERP software targeted at supporting medium- to large-scale organisations in a number of industries and sectors.

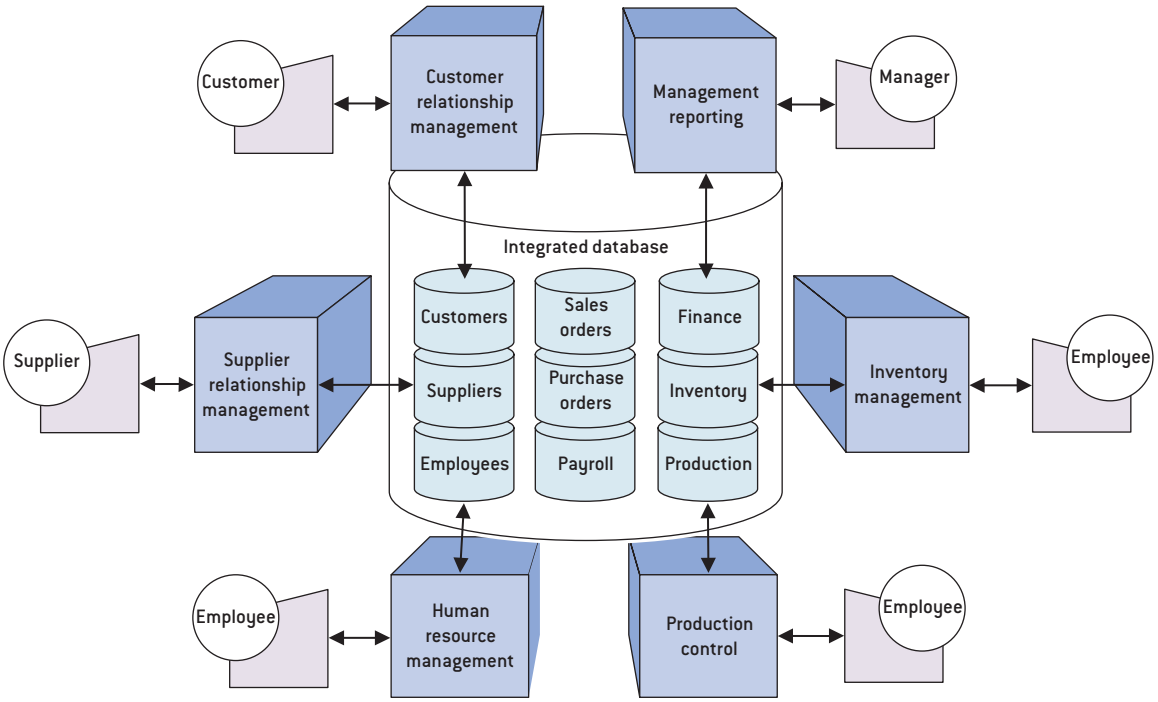


Figure 4.22 A typical ERP package

4.7.2 Sharing data externally

Data are of course important not only for the proper operation of internal activity systems within the value chain but also for the effective operation of interorganisational activity systems within the wider value network. Within the private sector, a good example of this is the way in which inventory data are shared with suppliers to enable just-in-time delivery of raw materials. Consider also the way in which data are shared about a common customer between a hotel chain, a car hire company and an airline to facilitate a partnership. Within the public sector electronic or digital government normally relies upon sharing a common citizen record among the data systems of diverse government agencies.

4.7.3 The Turing machine

CASE

No matter what the material used, any computer is theoretically based in a construct known as the Turing machine, after its creator, Alan Turing. The elements of a Turing machine are illustrated in Figure 4.23. An infinite piece of tape is proposed as the substance on which symbols are written by a write mechanism and from which symbols are read by a read mechanism. A series of stored instructions held in the control mechanism tell the machine what to do or execute next, such as moving the tape forward by one cell or writing a particular symbol upon the tape.

Turing showed mathematically that a device such as this had the potential to solve any problem that was solvable by algorithmic means. A certain class of such problems were faced by codebreakers at station X (see Chapter 3) and so Turing formed part of a team that built a series of devices according to the principles of his Turing machine. One of the most successful devices was the Bombe, so-called because of the ominous ticking noise it made while rejecting millions of incorrect codebreaking possibilities very quickly.

Figure 4.23 The Turing machine

4.8 INFRASTRUCTURE, STRATEGY AND CHANGE

The case of the warning network demonstrates the importance of infrastructure in enabling. The data systems, information systems and activity systems in interaction not only produce the value of an organisation, they can also be used to leverage new forms of value creation. In contrast, legacy systems (large and aging corporate ICT systems) generally constrain the organisation, in the sense that they determine the way in which much corporate data must be collected, manipulated and distributed. Often, they have been so heavily maintained that they become difficult to change and interface to other systems.

If an organisation wishes to change it must take its existing infrastructure into account. But chief executives tend to develop strategy (Section 11.7) purely in terms of considerations of activity infrastructure. They tend to forget that any change to activity demands change to information and to data, and that this can cause problems if not managed properly. Consider the case of two electricity suppliers who wished to merge their respective businesses. This formed the major strategy for the two companies. Since the activity systems of both companies were similar (they both supply electricity as a commodity) the merger was planned by executives and implemented. However, the merger eventually fails because the ICT infrastructure (Chapter 5) of both companies is substantially different, and their legacy ICT systems (such as their customer billing systems) made it very difficult to integrate.

We mentioned previously that organisations must know a number of things if they are to perform effectively: they must know what they do, they must know what they communicate about what they do and they must know what they represent about what they do and communicate. Another way of phrasing this is that organisations should ideally have explicit infrastructure, and probably they should have documented models of this infrastructure.

However, many organisations, both large and small, have much implicit infrastructure. They have never taken the trouble to document the activities they perform, how they communicate with each other and what records they make to help them do their work. Therefore, it is probably true to say that most organisations have a mix of explicit and implicit infrastructure. Often this happens because there has not been any systematic analysis of activities, information and data requirements within the business.

There are clearly a number of advantages to having a more explicit business infrastructure. As we shall see, effective business analysis is a necessary pre-condition for effective business design (Chapter 10). Making things more explicit through models makes it more feasible to integrate activity, information and ICT systems, and make them interoperable, and that in turn makes their management and development more straightforward.

4.8.1 Outsourcing infrastructure

Outsourcing
The strategy in which the whole or part of the informatics service is handed over to an external vendor.

Outsourcing is the use of external agents to perform one or more organisational activities. A contract is negotiated with an external supplier, normally in the form of a service-level agreement. There are a number of claimed benefits for outsourcing. For instance, scale and specialisation enable vendors to deliver the same value for less money than insourcing. More effective control of vendors is also claimed to lead to a better quality of service, and fixed-price contracts and service-level guarantees eliminate uncertainty for the business. Business growth can be accommodated without quantum changes in infrastructure, and scarce and costly aspects of infrastructure can be refocused on higher value activity. For such reasons many organisations have decided over the last couple of decades to outsource aspects of their information systems and ICT infrastructure.

Offshoring
The relocation of one or more activity systems by some organisation to another country.

Offshoring stands for the relocation by some organisation of one or more of its business processes or activity systems from one country to another. Offshoring might involve an operational process, such as manufacturing, or a supporting process, such as some aspect of informatics infrastructure. In recent years much of ICT outsourcing has occurred through offshoring to geographical areas such as Bangalore on the Indian subcontinent. Currently, India is the offshoring destination for global firms like IBM, Accenture, Microsoft, Oracle Corporation, Cisco and SAP.

RECAP

Infrastructure both enables but also constrains change and is therefore critical to considerations of strategy. Certain organisations have decided as a strategy to outsource infrastructure, particularly data (ICT) infrastructure.

4.9 CONCLUSION

This chapter has defined two of the book's final foundation concepts – that of business infrastructure and that of an information system. An information system is a sociotechnical system, a communication system in which humans use ICT in support of coordinated and collaborative decision-making and action (that is, an activity system).

Information systems, like the human activity reliant on them, have been in existence for many thousands of years. Modern digital computers were invented during the Second World War, and stimulated enormous growth in technologies

associated with data capture, processing and communication. They rapidly came to be used in business organisations, and this stimulated rapid growth in the applications supporting not only the internal value chain but also the wider value network between organisations.

Three layers of infrastructure are critical to the modern business: activity systems, information systems and data systems or ICT infrastructure. Each level supports the others. Every business organisation's information systems are necessarily different, but there are similarities, especially across organisations in the same business sector, so it is possible to develop generic descriptions or models of both back-end and front-end information systems infrastructure.

Key business back-end information systems include sales order processing, purchase order processing, inventory management, finance and payroll. The sales order processing information system records details of customer orders and supports activity systems such as sales and aftersales service. The inventory management information system maintains an inventory of raw material and finished goods. It is important for providing sales staff with accurate information on quantities and pricing of products. It also supports procurement activity. The purchase order processing information system records details of purchase orders and supports the procurement process. The financial information system records amounts owed by and to, and paid by and to, customers, suppliers and employees. It supports other infrastructure activities such as management and planning. The payroll information system records details of wages and payments made to employees, and is a critical element of human resource management activity.

Front-end information systems interface directly with major stakeholder types: managers, employees, suppliers and customers. Management-facing information systems are built on the foundation of back-end information systems. Management information systems are used by operational management to monitor the state of the organisation. Decision support systems and executive information systems generally support longer-term, strategic and tactical decision making. Typical customer-facing information systems include sales, customer relationship management, marketing and outbound logistics. Typical supplier-facing information systems include procurement, inbound logistics and supplier-relationship management systems. Typical employee-facing information systems include human resource management and production control systems.

Chapter 2 considered systems of activity, and Chapter 3 the way in which data and information support business activity. Chapter 4 has set the context for business infrastructure and considered systems of communication in which business actors accomplish information. The next chapter turns its attention to systems of data technology. It provides a high-level overview of the typical ICT infrastructure that supports current forms of business or public sector organisation and offers significant potential for the design of new organisational forms.

4.10 REVIEW TEST

Information system

4.1 An information system is the same as an activity system.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

4.2 An information system is a system of _____ action.

Fill in the blank term below.

☐

1 mark

4.3 An information system can be thought of as a: _____

Select the most appropriate description by placing an X in the box.

- ☐ Sociotechnical system
- ☐ Technical system
- ☐ Computer system

1 mark

Infrastructure

4.4 Place the layers of organisation infrastructure in order. In other words, which layer supports which other layer?

Indicate the order using 1 to 3; with the highest layer labelled 1.

- ☐ Data systems infrastructure
- ☐ Activity systems infrastructure
- ☐ Information systems infrastructure

3 marks

4.5 Infrastructure both _____ and constrains change.

Fill in the blank term below.

☐

1 mark

4.6 The front-end information systems infrastructure includes the following types of information system.

Select all that apply by placing an X in the box.

- ☐ Customer-facing information system
- ☐ Management-facing information system
- ☐ Production-facing information system
- ☐ Employee-facing information system
- ☐ Supplier-facing information system

4 marks

4.11 EXERCISES

- Take a company known to you and determine what its core information systems are. Determine the degree to which these systems are integrated.
- Try to provide more detail on one chosen pattern from a system in the core information systems infrastructure. Draw a model to describe how this pattern works.
- Draw a model of another information system associated with an activity system known to you, such as student admissions at a university.
- Take an area of activity known to you and determine what form of information system supports it.

- Identify a management information system in an organisation known to you and try to determine how it works.
- Take a public sector organisation such as a local authority. Try to identify the key front-end information systems relevant to it.
- Try to identify the types of activity data that might be generated from an information system used to control manufacturing production. In what way might this information system update a human resource information system? What other information systems are likely to feed off a production system?
- Try to identify some of the purposes that the data collected by a customer relationship management system might be used for.
- Consider the management-facing information systems of an organisation known to you. Is it possible to identify distinct EIS and MIS? Develop a high-level model of the information held in the EIS or MIS.
- Investigate the distinction between EIS, DSS and MIS in more detail. Investigate the emerging role of big data within such systems.
- Find a company close to you. Take along one or more of the generic models discussed in this chapter. Compare the operations of the company to those described on the model. How closely do they match? In what ways are they different?
- Consider a future situation in which corporations become involved in mining asteroids within the solar system. Would the information systems infrastructure of such corporations be different from the one discussed in this chapter?
- Produce a brief description of the functionality of one or more of the customer-facing, supplier-facing or employee-facing information systems of a company in the services rather than the manufacturing sector.

4.12 PROJECTS

- Choose a historical information system and build a case description of its use along the lines of Herman Hollerith's invention and use of his tabulating machine for running the US national census. Some possible cases include the operation of Lloyd's of London's insurance activities and the production of the *Domesday Book*. Distinguish between the activity system, information system and the information technology used in each historical case.
- Construct a high-level map of an organisation's information systems, perhaps using the modelling notation for information systems discussed in this chapter. Include both computerised (ICT) and non-computerised information systems. Consider the scope for extending ICT systems within the organisation.
- Choose an organisation and investigate the degree of integration between its information systems. Recommend ways in which the systems can be better integrated in the future. Use information systems models for this purpose.
- Choose an organisation and investigate the relevance of the distinction between management information systems and transaction processing systems for it. In other words, is it possible to identify systems specifically used by management and those used by other workers? Identify clearly the current users of such systems. Try to determine whether they help accomplish the information required by such users.
- Draw a detailed map of the information systems used in a business organisation known to you, using a hierarchical series of information systems models. Determine the extent to which they diverge from the systems described in this chapter. To what extent do they map onto the systems described in this chapter?

- Choose an organisation and attempt to develop a case study of the way in which its ICT systems have been built up over the last 20 years. On the lines of the Goronwy Galvanising case in Chapter 1, try to determine how these systems were planned for and designed. Does it have explicit or implicit informatics infrastructure? Do people in the organisation describe such infrastructure as enabling or constraining?
- Extend the information infrastructure model detailed in this chapter to include information of relevance to all the back-end and front-end information systems discussed.

4.13 FURTHER READING

There are many textbooks on information systems but most take a rather atheoretical approach to the subject. The text by Laudon and Laudon (2020) is representative of US books of this tradition. The concept of an information system is considered from a soft systems perspective in Holwell and Checkland (1998b), which also provides one of the earliest descriptions of the warning network case described in this chapter. Hay (1996) provides coverage of a range of 'patterns' or generic information models making up the information infrastructure of a typical company, on which the discussion of information infrastructure in this chapter is based.

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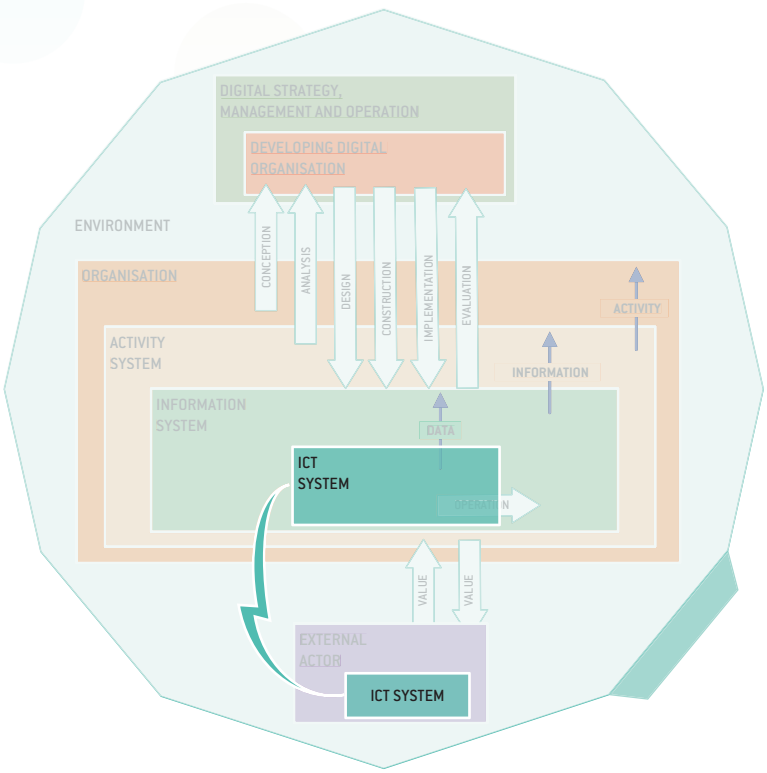
5 ICT INFRASTRUCTURE

'Man did not weave the web of life, he is merely a strand in it. Whatever he does to the web he does to himself.'
– Chief Seattle (1786–1866)

LEARNING OUTCOMES	PRINCIPLES
Describe the idea of ICT infrastructure.	Modern business relies upon ICT infrastructure consisting of access devices, communication channels, front-end ICT, back-end ICT and core data management.
Distinguish between the Internet and the World Wide Web, identify some of the critical components of the Internet and explain some of the technologies underlying the Web and their relevance to business.	Modern communication infrastructure relies upon two critical technologies – the Internet and the Web. The Internet consists of a set of technologies which facilitate the interconnection between data communication networks globally. The Web is an application which runs on the Internet and consists of standards for the creation and transmission of hypermedia documents.
Define the concept of an ICT system in terms of a number of interacting functional layers.	An ICT system may be defined in terms of interdependent functional layers such as an interface, business and data management layer.
Identify some of the ways in which digital infrastructure is changing.	A third layer of infrastructure has emerged with the commercial Web. Data are increasingly important to organisational decision-making through big data. As more business moves online the issue of data security assumes greater importance.

CHAPTER OUTLINE

5.1 Introduction
5.2 Communication networks
5.3 The World Wide Web
5.4 ICT systems
5.5 Internet, Intranet and Extranet
5.6 The benefits of ICT infrastructure
5.7 Web 2.0 and the commercial Web
5.8 Cloud computing
5.9 Big data
5.10 Cyber-security
5.11 Conclusion
5.12 Review test
5.13 Exercises
5.14 Projects
5.15 Further reading
5.16 Bibliography



5.1 INTRODUCTION

The eminent British scientist Michael Faraday once gave a tour of his laboratory to the then Prime Minister of the UK. He was asked what use the discovery of electricity could possibly have. '*I cannot say,*' Faraday replied, '*but one day Her Majesty's government will tax it*'.

Predicting the impact of technology is an inherently tricky business. For decades, predictions have been made as to the revolutionary potential of ICT in relation to business. Many such predictions have missed the mark, but many others have hit the target. ICT has been applied over the last 70 years as a catalyst for changing internal business practices. More recently, innovation within this area has shifted to a focus on the application of such technology within external activities and in support of relationships with external stakeholders. ICT is also, of course, now increasingly critical to performing everyday activity outside of work, such as in the consumption of entertainment and keeping in touch with friends and family.

ICT infrastructure
The set of interrelated ICT systems used by some organisation.

In Chapter 4 we introduced the concept of infrastructure to refer to systems of activity, communication and articulation that generate what we mean by organisation. In this chapter we examine the nature of ICT as critical to implementing the data systems infrastructure of organisations. As such, **ICT infrastructure** is particularly concerned with the transmission and storage of data within data structures using digital computing and communications technology. Figure 5.1 provides a useful way of viewing the typical ICT infrastructure of the modern organisation. Such infrastructure enables the creation and storage of data structures as records as well as the creation and transmission of data structures as messages. Internal actors communicate with each other and with external actors through such ICT infrastructure and through such data structures. External actors also communicate with organisational actors through ICT infrastructure.

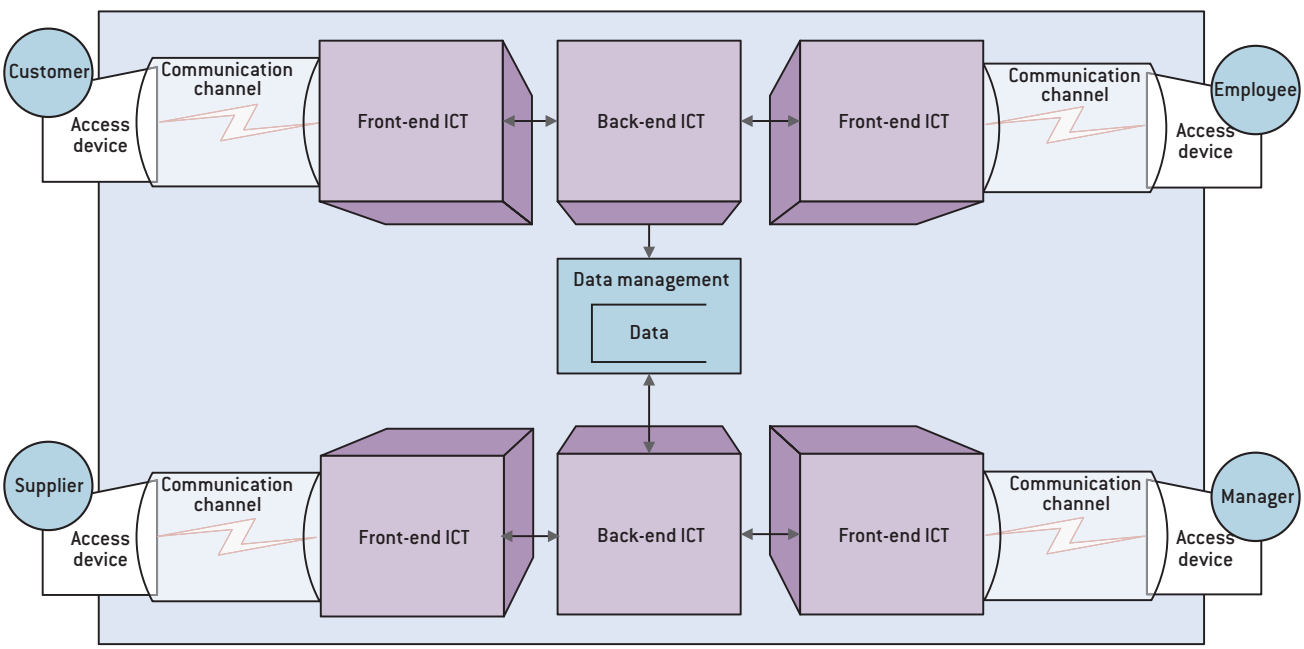


Figure 5.1 Elements of ICT infrastructure

5.2 COMMUNICATION NETWORKS

Vannevar Bush was an American engineer and scientific administrator known for his work on the early analogue computer and his role as chief organiser of the Manhattan Project, the large-scale scientific effort which developed the first atomic bomb. Bush is also cited for a thought experiment he conducted in the 1940s. Bush imagined a '*device which is a sort of mechanized private file and library … in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory*'. This device Bush named the memex – short for memory extender. The memex is normally seen as the forerunner of a technology known as hypertext or hypermedia, which in turn underlies the World Wide Web. But the World Wide Web is an application running on a range of communication networks working with a common protocol – the Internet protocol. We examine the Internet and the Web as important layers of ICT infrastructure in this section.

5.2.1 Access devices

Access device
A device that enables access to organisation ICT systems.

Within Chapter 3 we described the basic model of communication. However, it is clear that much of what we think of as communication is no longer face-to-face communication between organisational actors. Most communication between external actors and actors within the organisation, as well as between actors working in dispersed units of organisation is now communication at a distance – telecommunication. It is also as such mediated communication because it demands use of certain technologies. To enact any telecommunication, then, two types of technology must mediate the communication – an access device and an associated communication channel (see Figure 5.2). **Access devices** allow the creation and transmission of messages and sometimes records between external and internal actors and the front-end ICT systems of organisations.

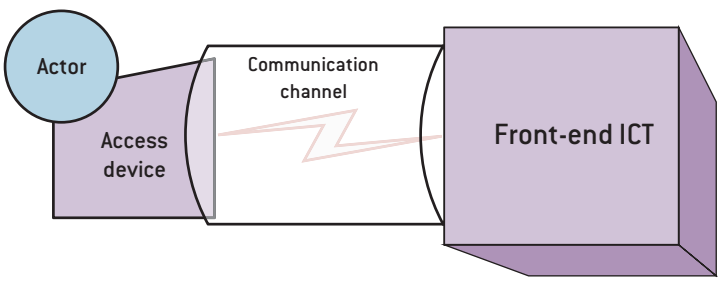


Figure 5.2 Access devices and communication channels

Traditional access devices are the fixed telephone and the personal computer, both of which connect through the standard telephone network. More recent access devices such as interactive digital televisions and smart devices such as central heating controllers can also connect through home telephone points. Mobile devices such as smartphones and tablets connect through the cellular wireless network or through other wireless networks (see Figure 5.3).

5.2.2 Communication channels

Communication channel
The medium along which messages travel.

Access devices work with communication channels. A **communication channel** (or more accurately a telecommunication channel) is enabled over communication networks, a set of telecommunication devices connected together with communication links of various forms.

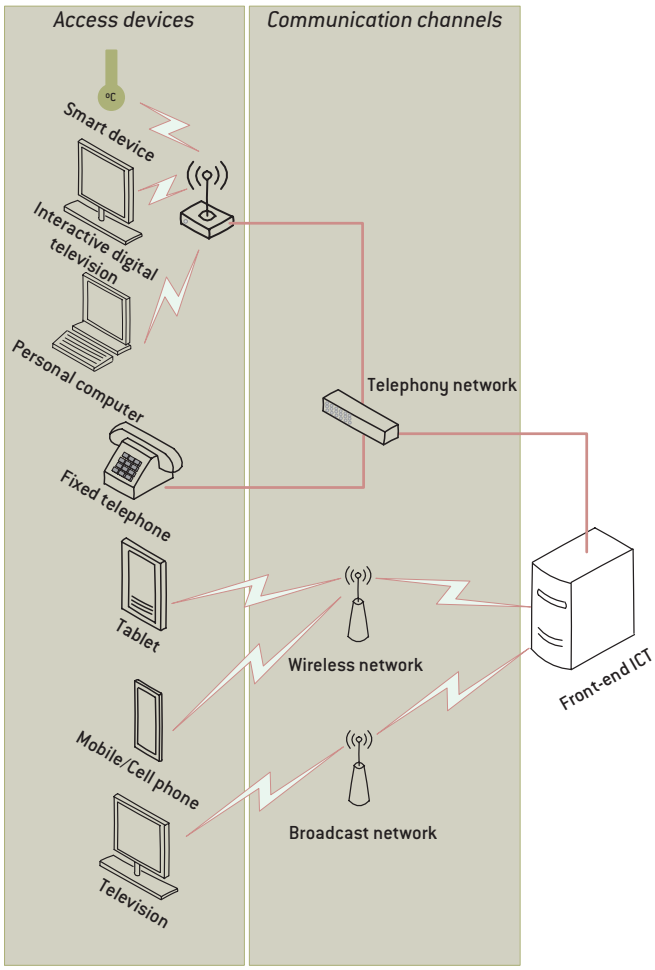


Figure 5.3 Types of access device

There are several different kinds of communication network, defined by their coverage.

- In a local area network (LAN), the devices are situated near each other: often in one building, or a few buildings that are close together. These are often used to link a group of personal computers and related devices such as printers, using either dedicated communication cables or wireless communication.
- In a wide area network (WAN), the nodes are geographically remote. WANs may consist of a mix of dedicated and non-dedicated communication lines as well as microwave and satellite communications.
- A value added network (VAN) is a network that a third-party organisation sets up and maintains, selling the right to use it.

5.2.3 The Internet

Internet
A set of interconnected computer networks distributed around the globe that adopt the TCP/IP standard.

Most existing communication networks work with a set of standards established for the internetwork or **Internet** in the 1970s by the defence research agency in the United States. The Internet is a WAN consisting of a set of interconnected communication networks distributed around the globe. Access to the Internet is provided through a series of layers. Users of some access device, such as a personal computer, connect via their local telephone exchanges to an Internet service provider (ISP),

which connect in turn to Internet application providers (IAP). These providers connect through a network access point to a high-speed communication backbone (see Figure 5.4).

The Internet can be considered on a number of levels. Its base infrastructure is composed of packet-switched networks and a series of communication protocols. On this layer run a series of applications, such as electronic mail (email), and more recently the World Wide Web, or the Web for short.

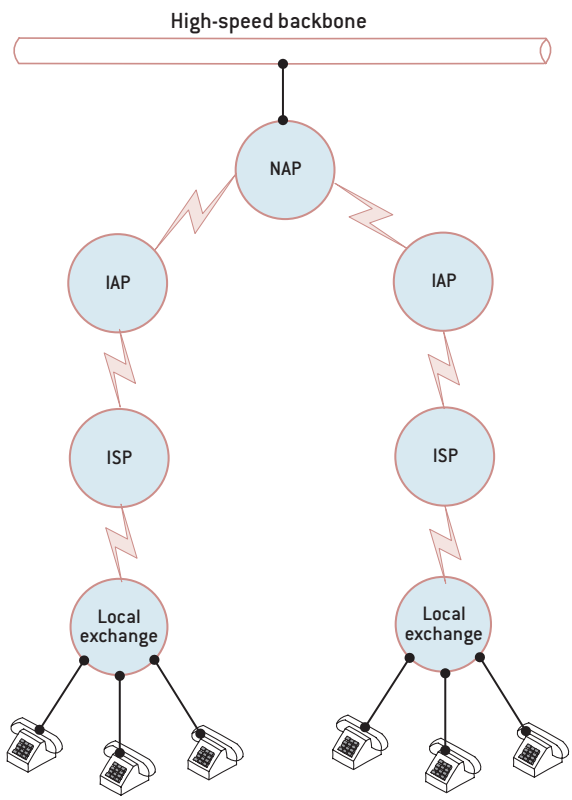


Figure 5.4 Layers of the Internet

5.2.4 Internet protocol

Internet protocol
A communication protocol standard that drives the Internet.

Each device on the Internet is given a unique address, known as an **internet protocol** (IP) address. Messages are then structured as packets with an IP address and routed over communication networks to reach their destination, using a communication protocol known as Transmission Communication Protocol (TCP) (Figure 5.5).

Figure 5.5 Transmitting messages over the Internet

IP address
A unique identifier for computers on a communication network using TCP/IP.

126.203.97.54 is an example of an **IP address**. To send some message from one device to another over the Internet the message is first divided into packets. Each device is given the IP address of its common destination. Each packet of the message is then directed to its destination, sometimes via different routes, by devices known as routers. At the destination device the message is reconstituted into its original form (see Figure 5.6).

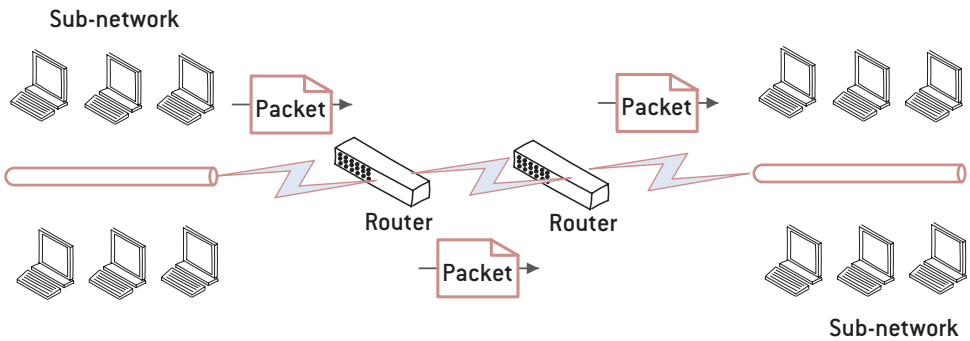


Figure 5.6 Packet switching

5.2.5 Growth of the Internet

The number of users of the Internet has grown astronomically since the early 1990s (see Figure 5.7). However, note that the 38 billion users of the Internet estimated for 2018 is still less than a quarter of the global population – meaning of course that much of the world's population is still excluded from access to digital infrastructure. Much of the current Internet access is no longer through fixed personal computers but through mobile devices, particularly smartphones.

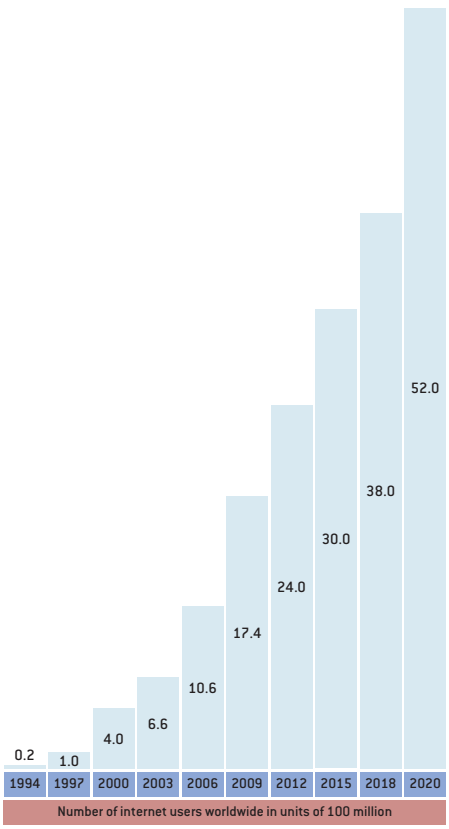


Figure 5.7 Growth of the Internet

5.2.6 Internet of Things

Internet of Things
The use of the Internet to connect digitally enabled devices.

The Internet as an internetwork was originally designed to connect together access devices such as personal computers with organisational ICT systems. As the range of devices has grown that either are or can be digitally enabled, then interest has grown in building an **Internet of Things** – usually abbreviated with the acronym IoT. Such devices might communicate directly with humans or work relatively autonomously communicating with other devices. This opens up potential for digital innovation in areas such as the home, where fridges, central heating systems and lighting systems might all interact to reduce energy consumption. We examine the IoT again in Section 13.2.6.

5.3 THE WORLD WIDE WEB

Web
The World Wide Web – an application that runs over the Internet supporting the use and transmission of hypermedia documentation.

HTML
Hypertext Markup Language. A standard for marking up documents for publishing on the Web.

We mentioned that the **Web** – or World Wide Web to give it its proper title – is an application which runs on the Internet. Since its inception the use of this application layer has grown to the extent that many front-end ICT systems are now built using the set of standards initially established for the Web in the 1980s by Tim Berners-Lee.

Figure 5.8 illustrates the fundamental elements of the Web. The core of the Web consists of a set of standards for building data structures (web documents or web pages) in **Hypertext Markup Language (HTML)**. To transfer web documents as data structures over the Internet we need another protocol known as Hypertext Transfer Prototcol (HTTP). A specialist piece of software known as a browser runs on some access device and decodes a HTML document, presenting it on the display of the device for the user.

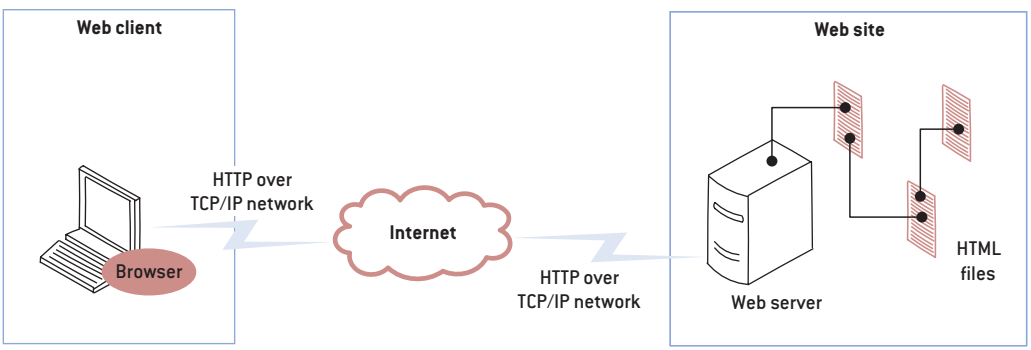


Figure 5.8 Elements of the Web

DID YOU KNOW?

Tim Berners-Lee was working at the European Organisation for Nuclear Research (CERN) in Geneva when he came up with the idea of using a language for specifying hypermedia documents and a protocol for transmitting hypermedia documents over the Internet. The original purpose of the system was to enable physicists based around the world to better share data.

Website
A collection of HTML documents stored on some web server.

The data structures of the Web are normally collected together in websites. A **website** normally resides on a device known as a web server and consists of a number of web pages which interact with data structures held in databases (see Figure 5.9).

HTML is made up of a series of tags which define what to do with the content of some web page (see Table 5.1). An HTML document contains both content and tags. The document content consists of what is displayed on the computer screen. The tags constitute codes that tell the browser how to format and present the content on the screen.

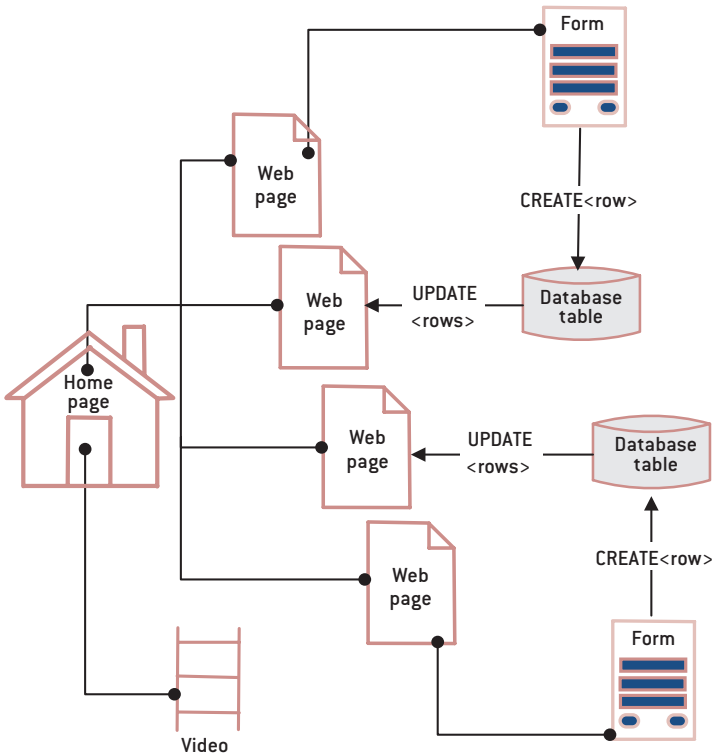


Figure 5.9 Elements of a website

Table 5.1 Some common HTML tags

Tag name	Functionality
<html>	Start of a html document
<head>	Establishes the header of a web page
<body>	Establishes the body of a web page
<h1><h2>...	Used to establish various levels of heading
<p>	Start of a paragraph
<b>	Embolden enclosed text
<i>	Italicise enclosed text
<u>	Underline enclosed text
<i>	Italicise enclosed text
<u>	Underline enclosed text
	Establish an item in a list
	Centre text
<font>	Used to establish the font type, size and colour of some text
<img>	Short for image – used to refer to an image file for insertion within the text
<a href>	A tag for linking to parts in or outside a document
	Start of an unordered list
	Start of an ordered list

RECAP

ICT infrastructure is particularly concerned with the transmission and storage of data structures. Access devices are technologies used to allow actors to remotely communicate with ICT systems. Access devices work with communication channels, normally adopting Internet standards such as IP. Front-end ICT systems are typically built using web standards, such as HTML. ICT systems are now normally built in a tiered architecture.

5.3.1 Growth in the Web

The number of websites globally running on the Internet has grown steadily (see Figure 5.10). The United States has consistently maintained approximately 50% of all websites. Much of the communications traffic on the Web goes to 1% of these websites.

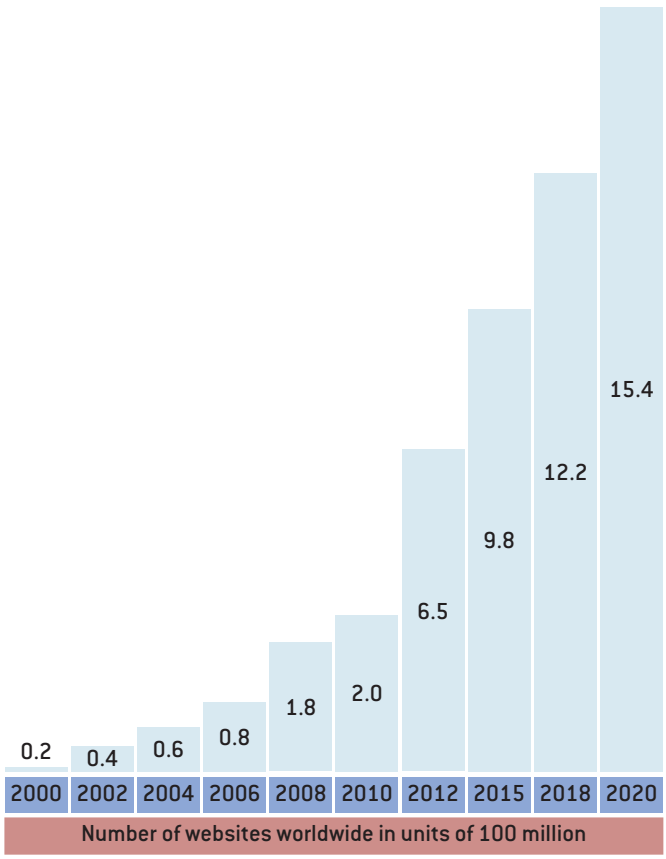


Figure 5.10 Growth in the number of websites globally

REFLECT

Do you think we would have the Internet today without defence spending? In what respect do you feel the Internet is creating a global information society?

One of the most important factors for business is the reach of the Internet into their potential customer population. Is it likely that we will ever achieve 100% penetration of the Internet into people's homes? What do you feel is the most important application of the Web within business?

5.4 ICT SYSTEMS

ICT system
An ICT system is a technical system sometimes referred to as a 'hard' system. An ICT system is a system of data representation and processing. In the modern organisation it generally consists of an organised collection of hardware, software and communications technology designed to support aspects of some information system.

Modern **ICT systems** run over the Internet and utilise certain aspects of the Web. But modern ICT systems are built from more than the Internet and the Web. Modern ICT systems are built in layers or tiers. Each tier may be placed on a different device and connected with other tiers through a communication network (see Figure 5.11).

Communication by human actors with the ICT system is conducted through the interface tier. The business layer provides the core logic of the ICT system. Data is held within data structures maintained within the data tier.

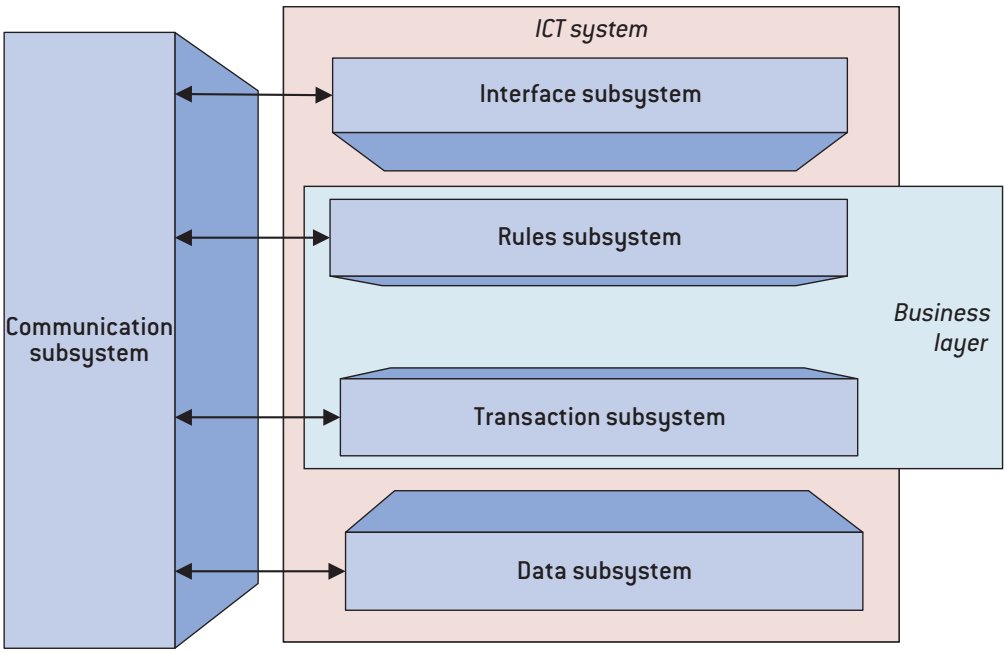


Figure 5.11 Layers of an ICT system

5.4.1 User interface

The user interface is responsible for managing the dialogue between a human and the ICT system. The interface effectively acts as a way of getting data into and out of an ICT system. Within Figure 5.12 a human user is communicating with the ICT system, asserting here that something has happened in the domain of organisation in question, namely that a sale has been made. Further layers in the ICT system will cause some data element, such as a sales order, to be eventually created and stored.

5.4.2 Business rules

Business rule
A rule which specifies how a particular part of an ICT system should behave.

Data entered at the user interface are first inspected by a number of business rules which implement much of the logic of the ICT system. **Business rules** particularly enforce constraints upon data entered into the ICT system. For instance, within the Goronwy ICT system a user might want to enter a new job record. This update to the job's data structure will trigger a certain business rule in which a check is made that a delivery advice and a product number exist for this job. It also checks that the manufacturing job has not previously been created by someone else using the system. If and only if all these constraints are satisfied will the data be passed down to the transaction tier.

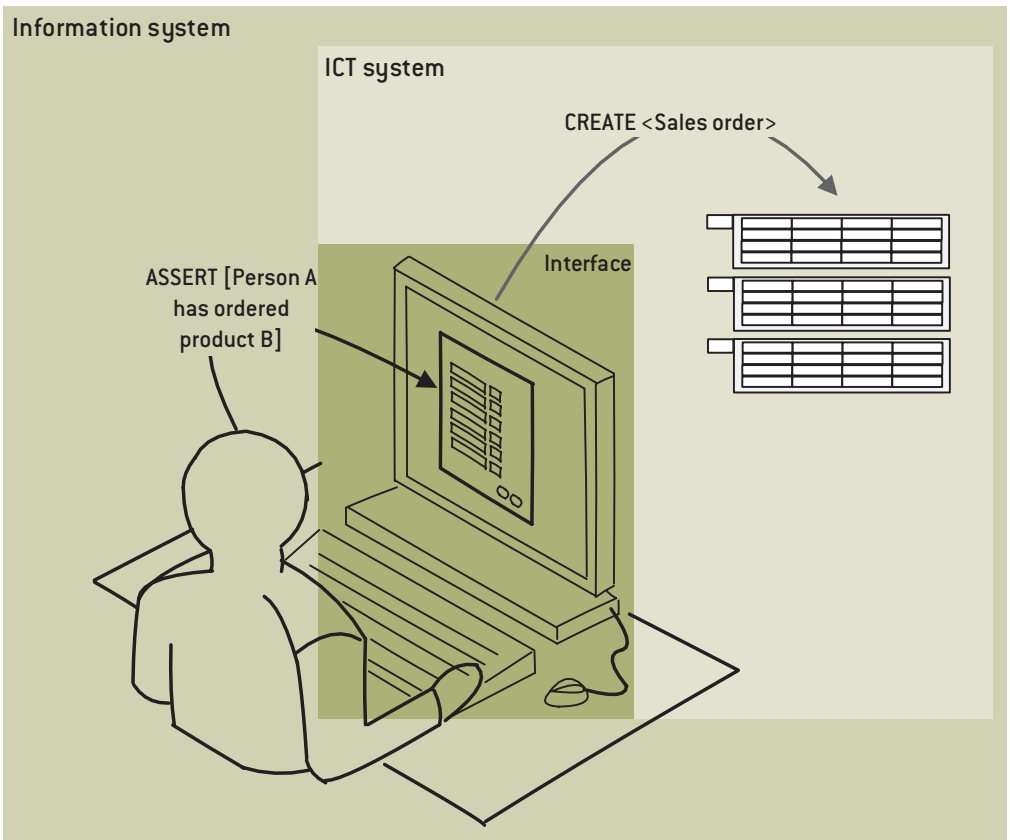


Figure 5.12 The user interface

5.4.3 Business transactions

Business transaction
A unit of work performed by some ICT system which articulates data structures within the data system.

Within Section 3.3 we indicated that there are four main types of data articulation that are utilised within any data system. A transaction is a unit of work performed by some ICT system which creates, reads, updates or deletes data structures within its data system. For instance, one transaction relevant to the company Goronwy Galvanising might be as follows:

CREATE ('012345', '2233445', 16/03/2011, 'pallet', 'P234', 20, 200, 0, 0) IN Jobs

Here, a new data element is being created in the Jobs data structure.

Most transactions are written in a language called SQL. SQL is a database programming language standard which is used in most data management that follows the relational data model. One important type of transaction is the read or retrieval transaction which is used to extract data from the data structures of some database. For instance, to retrieve all the rows in the Jobs data structure we would use the command:

SELECT * FROM Jobs

where the asterisk stands for 'all data items and all data elements' from the data structure.

The transaction tier exists primarily to manage multi-user access to the data tier. In other words, it manages the cases in which many different actors are attempting to update the same data structures many times within a working day. For instance, in the case of USC many different bookings clerks will be attempting to update the bookings data structure at any one time. The transaction tier handles the interleaving of such transactions and in doing so ensures that the data stored within data structures remain consistent.

5.4.4 Data management

Database
An organised repository for data.

The data tier manages the data structures required by the ICT system. Within Figure 5.13 two data structures are used to record data about dispatch advices important to Goronwy Galvanising. Such data structures are shared by various parts of the ICT system that interact with different actors within this company. Data held in the two tables are connected by a common key, an identifier (Dispatch No.) which is present in both tables.

Dispatch notes

Dispatch No.	Dispatch date	Customer code	Instructions
101	22/01/2012	BLW	
102	25/02/2012	TCO	
103	10/03/2012	BLW	

Dispatch items

Dispatch No.	Sales order No.	Customer product code	Dispatch quantity
101	13/1193G	UL150	20
101	44/2404G	UL1500	20
101	70/2517P	UL135	20
101	23/2474P	UL120	14

Figure 5.13 Two tables in a database

DID YOU KNOW?

The idea of representing data structures as tables linked with keys is due to Ted Codd, who proposed the idea back in the 1970s. The theory underlying so-called relational databases was based on the key insight that aspects of mathematical set theory – particularly the idea of tuples, organised sets – could be mapped onto a data structure that had been around for many thousands of years, that of the file.

REFLECT

Databases have been seen to be perhaps the central technology for modern business. Why do you think this might be the case?

To what extent do you think common structures for data affect the degree to which ICT systems can be integrated?

5.4.5 Lyons Electronic Office (LEO)

CASE

In this case we shall examine the development of the first programmable electronic computer applied to business problems – the Lyons Electronic Office (LEO) (Mason, 2004). The first Lyons teashop opened in Piccadilly, London in 1894, being one of the first fast-food outlets created. By the end of the 1950s Lyons employed over 30,000 people, making it one of the largest British companies of the time. Lyons gradually implemented a

CASE
continued . . .

unique strategy of taking as many of its supply-chain activities under its control as possible, clearly as an attempt to reduce its coordination costs (see Section 6.2.4). It baked its own cakes, printed its own packaging, distributed its own products to teashops and other outlets; it even owned its own tea plantations.

The typical customer of a Lyons teashop bought a bun and a cup of tea, costing no more than a few pence. Lyons made something like a farthing (a quarter of a penny) on each customer transaction. Key to the success of the company was therefore two things: the volume of customer transactions (typically 150 million per annum) and the efficiency of its operations – ordering, manufacturing and distributing foodstuffs (such as cakes) with a limited shelf life.

Lyons set up a systems department under John Simmons to continually analyse and redesign its activities with the aim of improving its efficiency. Simmons was quick to realise that many clerical activities might be improved with the introduction of automatic calculating machines. For instance, the systems department employed many human 'computers' (yes, they were called computers) involved in calculating the energy required to bake a loaf of bread or determine the optimal amount of jam to spread on a Swiss roll.

With this vision in mind, Simmons sent two of his employees – Oliver Standingford and Raymond Thompson – to the United States in the early 1950s to explore the development of early computing machinery there. Unbeknownst to the world, the first programmable electronic computer had been produced years earlier at station X (see Section 3.4.8). But Colossus, as it was known, was kept a secret for many decades. So Lyons looked to developments in computing being undertaken in the United States, which were much more open to public scrutiny, such as the Electronic Numerical Integrator and Calculator (ENIAC), developed at the University of Pennsylvania.

In the late 1940s John Von Neumann and his colleagues defined what was to become the fundamental architecture of the programmable digital computer, and which underlies the design of all modern computing devices. The architecture looks something like that illustrated in Figure 5.14, and is fundamentally an electronic implementation of the abstract notion of the Turing machine (see Section 4.7.3). Data are entered into the computer using some input device. The logic unit performs various operations upon the data stored and retrieved from internal memory and based upon instructions from the control unit. Data are then either output on some device or stored in some external memory for later use.

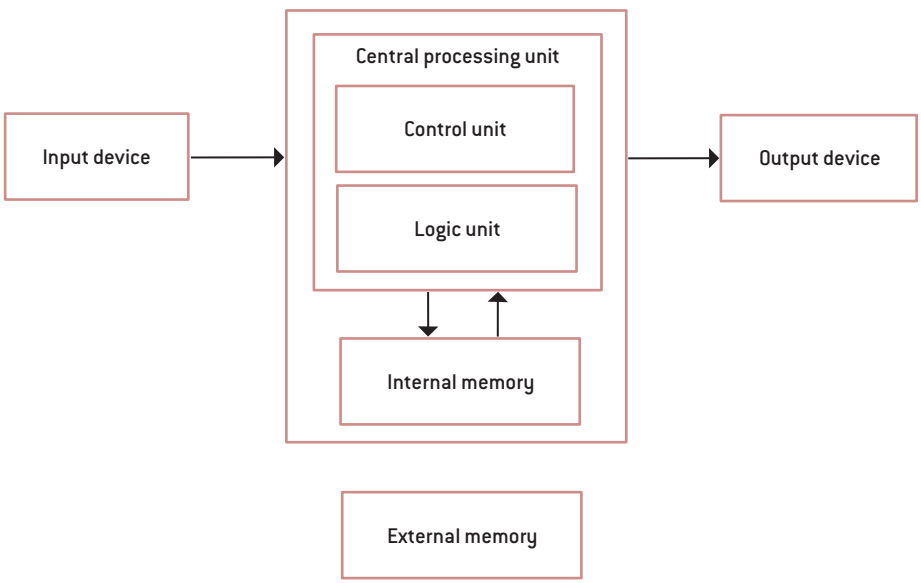


Figure 5.14 Component elements of a digital computer

CASE
continued…

The logic unit of a computer implements data operations in terms of Boolean logic, which is implemented in physical devices known as logic gates. Boolean logic was invented by George Boole in the nineteenth century and is a form of algebra in which all values are reduced to true or false. There is hence a synergy between the truth values of Boolean logic and the representation of data as binary digits – zeros and ones. A logic gate performs an operation upon one or more binary inputs to produce a single binary output.

Take an AND logic gate. If we input a zero and one in any order of inputs this gate always produces a one as an output. Logic gates are implemented in digital computers using digital circuits and containing switching circuits. In the first computers, such as Colossus and ENIAC, the switching circuits were implemented by thermionic valves, which generated lots of heat and were prone to break down. In modern computers switching circuits are implemented as transistors, which are much more reliable and can be miniaturised.

On their return from the United States, Standingford and Thompson produced a report recommending that Lyons employ a computer in improving its operations, but there was a problem with existing computers. Early computers, such as ENIAC, were designed to support scientific and military applications, such as computing ballistics – missile trajectories. Such applications of computing work with relatively small amounts of data but involve complex processing of such data. In contrast, the type of business applications that Lyons had to deal with demanded large amounts of data processed through relatively simple but repetitive processing, such as counting the number of teacakes consumed across Lyons outlets.

The systems department therefore decided to adapt the scientific computers of the day to their own needs, by building their own specialist computer, which they christened LEO. Subtle changes were made to a computer designed at the Computing Laboratory of the University of Cambridge. This primarily involved adding a greater number and variety of input and output channels. The machine was completed in 1953.

The first business application to run on 1st generation of LEO was bakery valuations, which calculated the weekly output from Lyons bakeries and related this to inputs such as labour, materials used, etc. The computer was then applied to payroll, then to ordering for the supply of teashops nationally. The computer even started to run programs for other organisations such as the Ford motor company and the UK taxation authority.

Lyons eventually set up a division, LEO Computers Ltd in 1954 to build and sell computers to other organisations. This division was innovative in offering a full analysis of the requirements of the purchasing organisation as part of its sale – a process which eventually became known as systems analysis, and which is now a part of business analysis (see Chapter 10). Lyons eventually merged LEO Computers with English Electric and the merged company formed part of International Computers Ltd, which existed up until the 1980s.

RECAP

ICT systems are now normally built in a tiered architecture. The interface tier manages human-computer dialogue. The business rules layer codes the core 'logic' of the ICT system. The transaction tier manages data articulation as units of work. The data layer manages data structures in databases.

5.5 INTERNET, INTRANET AND EXTRANET

Intranet
The use of Internet and Web technology within the confines of a single organisation.

The tiered architecture of an ICT system allows component elements of it to be distributed across a communications network. This distribution of functions also allows it to be used by different actors in different ways. Within Figure 5.15 an external actor (a customer) accesses a customer website over the Internet. An internal actor (an employee) also uses it to access an internal application over an internal Internet (**Intranet**), meaning that only authorised internal actors are allowed access to this ICT

Extranet
A network established such that external users can gain access to specified parts of the internal network of some organisation.

system. Finally, another external actor (a supplier) accesses an internal ICT system over the Internet (**Extranet**), meaning that only authorised external actors are allowed access to this application.

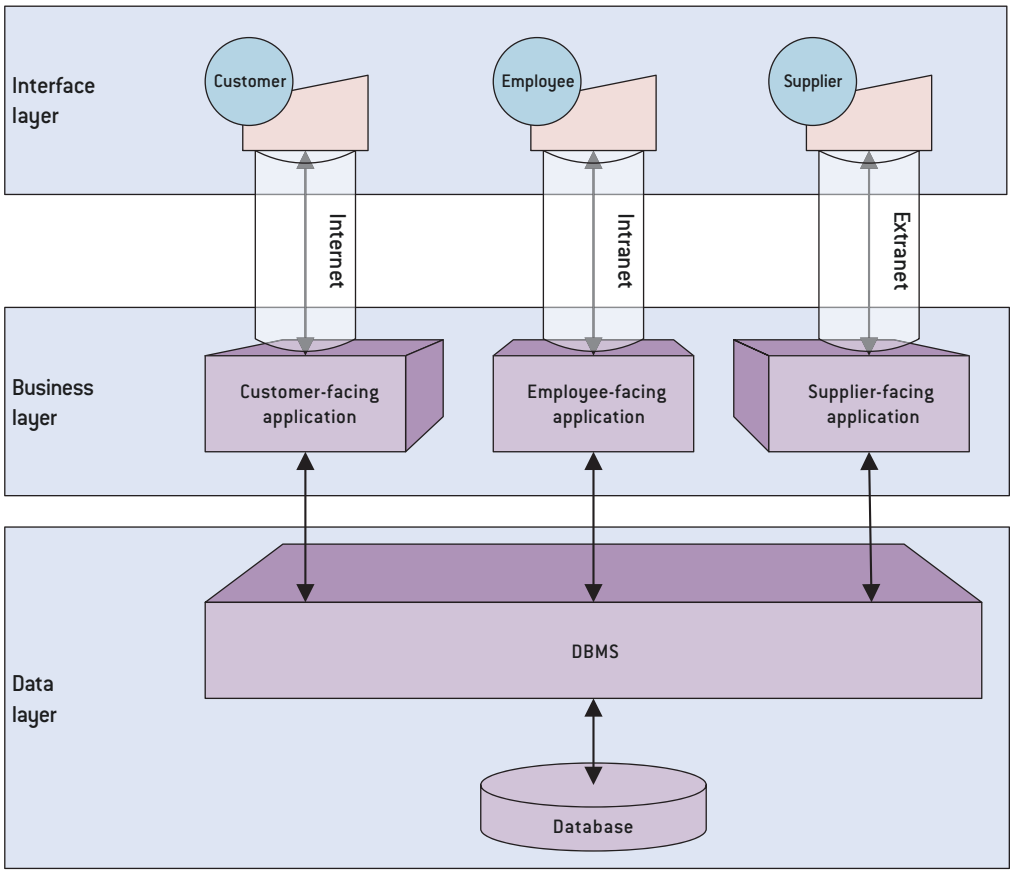


Figure 5.15 Internet, Intranet and Extranet

5.6 THE BENEFITS OF ICT INFRASTRUCTURE

An ICT system is an example of a data system, and data systems (see Chapter 3) have existed for many thousands of years in various different forms. So, what does an ICT system provide to the process of organisation? We can think about this question in three related ways – in terms of functionality, usability and utility.

5.6.1 Functionality, usability and utility

Functionality
What an ICT system is designed to be able to do.

Usability
How easy a system is to use for the purpose for which it has been constructed.

Functionality is what you can do with an ICT system, which is largely a concern of how the system helps actors articulate data structures within a data system. **Usability** is how easy it is to use the functions of some ICT system to do things, to use articulation of data structures to communicate things. **Utility** is an assessment of how the enhanced communication provided by ICT improves the coordination of activity. Functionality is largely a concern of a data system; usability is a concern of an associated information system; utility is a concern of the surrounding activity system (see Figure 5.16). Use of some data system facilitates the accomplishment of information which in turn impacts upon the coordination of activity.

Utility
The worth of an information system in terms of the contribution it makes to its human activity system and to the organisation as a whole.

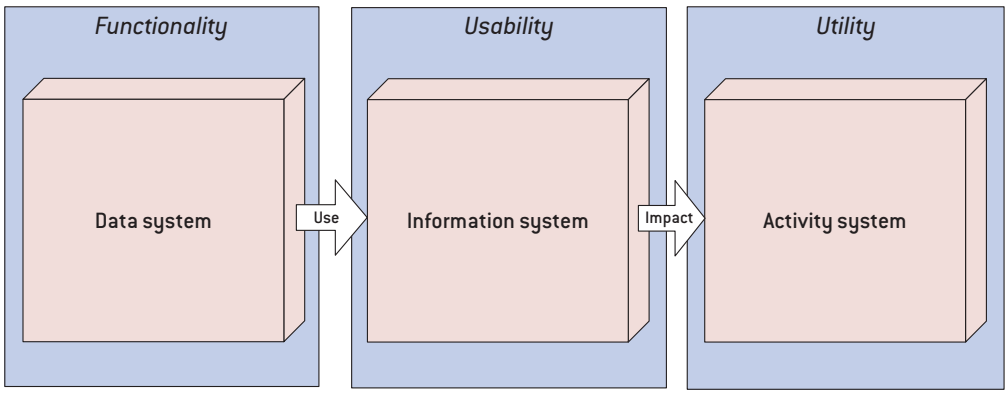


Figure 5.16 Functionality, usability and utility

5.6.2 Improvements in data articulation

We shall consider usability and utility in Chapters 10 and 11. Here, we focus upon functionality – how does ICT improve the articulation of data structures? Here are some improvements in functionality:

- Data can be entered more easily by multiple means – such as through multiple access devices.
- Data can be entered once and used many times, reducing the potential for errors to creep into data.
- Data structures can be shared more easily between multiple actors working in different locations, through telecommunication.
- The same data can be used for multiple purposes by different actors more readily.
- Data can be transformed from one form to another relatively easily and seamlessly.
- Data can be analysed and assembled into aggregate structures such as reports automatically (Figure 5.17).

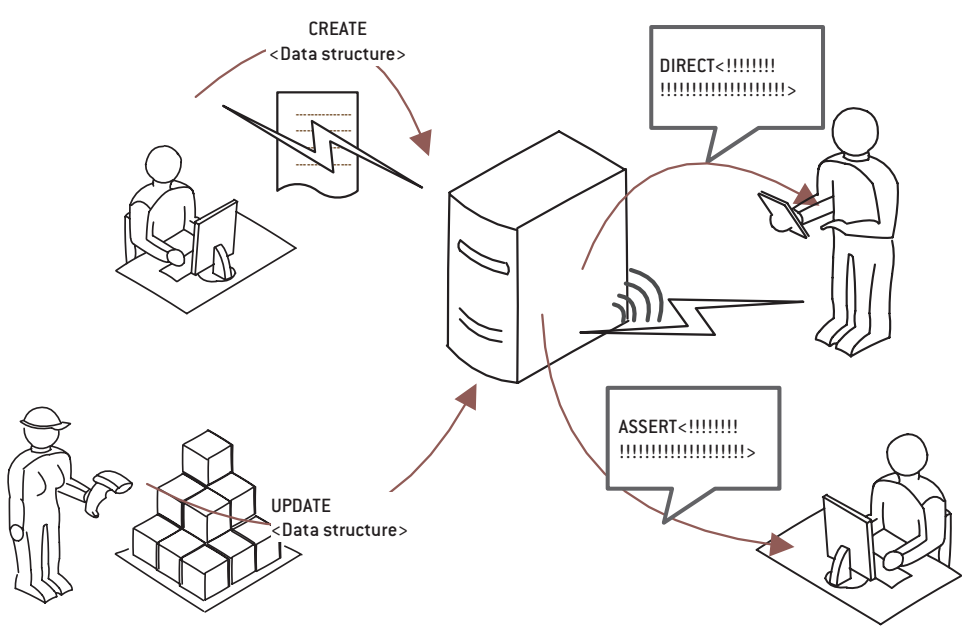


Figure 5.17 The worth of ICT

Consider the case of the ICT system that was introduced by Goronwy Galvanising:

- Data can be entered into this system by production clerks using a fixed PC and by production operators using handheld devices.
- Data about a certain production job can be entered once but read and updated many times, by many different actors.
- Data structures such as job records can be shared more easily between multiple actors working in inbound logistics, production, outbound logistics and administration.
- The same data about jobs can be used for production purposes as well as for managerial purposes.
- Data about jobs can be aggregated to provide an ongoing snapshot of production over a working day, week and month.

RECAP

An ICT system is an instance of a data system. The functionality of an ICT system is what you can do with it. Nowadays, ICT systems in whole or in part can be accessed through the Internet, through an Intranet and through an Extranet. The benefits of ICT systems lie in the improved articulation of data structures by diverse actors working in different places.

5.7 WEB 2.0 AND THE COMMERCIAL WEB

Web 2.0
A collection of web-based communities and hosted services which facilitate collaboration.

Commercial Web
A corporate infrastructure built upon the Web but using closed, proprietary standards.

In this part of the chapter we examine several digital innovations that build upon the ICT infrastructure described and which are affecting the ways in which business is done. Innovation involves doing things differently. Digital innovation involves doing things differently through the application of ICT (see Chapter 11). Many of the technology trends we shall highlight here have either already caused disruption in major industries or have the potential to disrupt such industries in the near future.

One way of viewing the development of the Internet and Web is as a continually layered communication infrastructure. The lower levels of this infrastructure rely upon open standards; the upper levels rely upon proprietary standards. Open standards are published and freely available. Proprietary standards are relatively closed to anyone outside the organisation that produces them.

Some of the first institutions to adopt the Internet standard and use it within communication technologies were universities around the globe. These institutions started to develop applications to run on the Internet, such as email, and these applications were initially distributed free to all potential users. Not surprisingly, many of the early users of the Internet saw it as an egalitarian infrastructure which would have a profound effect on world politics. The Web was also established as an intellectual trust rather than a commercial enterprise, with the aim of helping people around the globe to become better connected.

In 2004, Tim O'Reilly coined the term Web 2.0 to refer to a series of applications that developed on the infrastructure of the Web and the Internet. Many such applications were created to facilitate greater collaboration among dispersed actors using the Web. These applications include wikis, weblogs, folksonomies and rich site summary. Wikis are effectively tools for creating web pages quickly and without recourse to HTML. Weblogs or blogs are websites or web pages that are regularly updated by an individual and typically amount to an online personal journal. Folksonomies are user-generated systems for tagging online content. The photo-sharing site Flickr is an often-cited example. Rich site summary is a format for delivering regularly changing Web content to a group of subscribers.

On top of Web 1.0 and Web 2.0 there is a growing range of applications which almost constitute a Web 3.0. Web 3.0 is the corporate web built using a range of closed, proprietary standards. Most of us experience the web and the Internet through the 'lens' provided by the infrastructure created by three technology giants – Google, Amazon and Facebook. This has caused some to wonder whether the principles originally established for the Internet and the web are being subsumed and potentially corrupted by large corporates (Figure 5.18).

Internet governance
The development and application of shared viewpoints by governments, private sector corporations and civil society as to the further evolution and use of the Internet.

The area of **Internet governance** is developing the debate about how this infrastructure should evolve in the near and distant future. One key principle is *net neutrality* which has come under attack in various ways. This is the principle that ISPs must treat all data travelling over the Internet as the same, and not discriminate data by user, content, delivery platform or method of communication. According to this principle, ISPs must not charge money to give certain Internet users preferential treatment or block, slow down or in some other way discriminate against the data produced and received by users.

Darknet
A term used to refer to any communication network that uses protocols different from the Internet.

Darkweb
Websites accessible through the Darknet.

As more and more activity moves online, it is not surprising to find that deviant activity follows. Such deviant activity is frequently discussed in terms of the **Darknet** and the Darkweb. Darknet is a term used to refer to any network which can only be accessed using specific configurations of software and communication protocols, different from those used in the Internet. The related term, the **Darkweb**, refers to running the web within the confines of a Darknet. The technologies themselves are not malignant and are used by some to attempt to reinstate some of the founding egalitarian principles of the Internet and the web. However, this adjunct communication infrastructure has undoubtedly been used to conduct activity such as drug dealing, arms trafficking, money laundering, human trafficking and pornography. The Darknet has particularly become associated with trade conducted through Bitcoin (see Section 6.2.8).

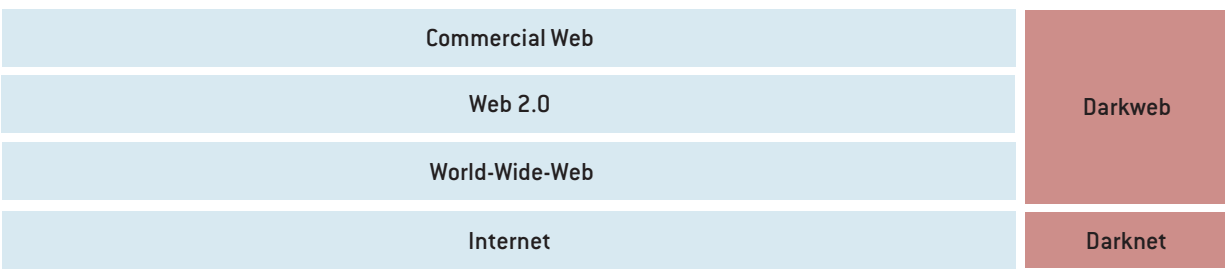


Figure 5.18 Layers of the Internet and the Web

5.8 CLOUD COMPUTING

Cloud computing
A term used to refer to a number of technologies that support remote computing such as SOA, data centres and virtualisation.

In the 1960s the computer scientist John McCarthy made the prediction that '*computation may someday be organised as a public utility*'. This is the aim of the Cloud or **cloud computing** in which computing power is delivered to the user in much the same way as electricity or water is delivered as a utility, over the Internet. The user of a cloud application does not require knowledge of the location or configuration of the application to use it: he/she merely connects to it over the Internet. Therefore the term derives from the common representation of the Internet on diagrams, such as the ones used in this book, as a cloud. But cloud computing is not one technology but a series of technologies including: tiered computing, software as a service, data centres and virtualisation.

As we have discussed in an earlier section, ICT systems as applications are typically divided up into layers or tiers such as interface, rules, transaction and data. Each of these layers may be distributed on different machines, perhaps at different sites but connected through communication across some network (Figure 5.19). The most extreme version of this technical architecture is when a client machine runs little more than the user interface, probably through a browser. Most other parts of application are run on remote data servers. Clients communicate with such servers through open software standards such as the Internet protocol and application programming interfaces.

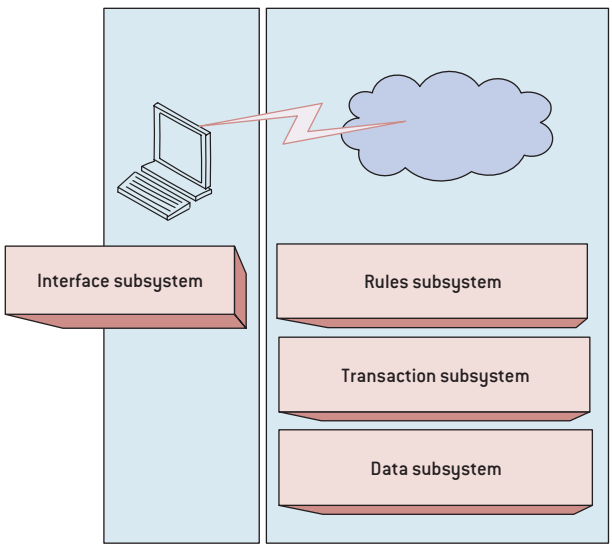


Figure 5.19 A tiered architecture for an ICT system

Service-oriented architecture
SOA represents a way of designing ICT infrastructure in which the functionality of some ICT system is decomposed into small, distinct units known as services, which can be distributed over a network and can be combined together and reused to create business applications.

Web standards support interoperable systems across computer networks through the idea of a **service-oriented architecture** (SOA) and the related idea of a web service. SOA represents a way of designing ICT infrastructure in which the functionality of some ICT system is decomposed into small, distinct units known as services, which can be distributed over a network and can be combined together and reused to create business applications. These services communicate by passing data from one service to another, or by coordinating an activity between one or more services.

Web services typically implement software functionality that most humans would recognise as a service, such as filling out an online application for a bank account, viewing an online bank statement, or placing an order for an airline ticket online. Instead of web services communicating by making calls to each other, protocols are defined which describe how one or more services talk to each other. This architecture then relies on a business process expert linking services in a process known as orchestration, to meet a new or existing requirement for some ICT systems functionality.

Each element of an SOA can play one or more of three roles: service provider, service broker and service requestor. The service provider creates a web service and possibly publishes its interface and access information to a service registry or broker. The service broker is responsible for making the web service interface and implementation access information available to any potential service requestor. The service requestor or web service client locates entries in the broker registry using various find operations, then 'binds' to the service provider in order to invoke one of its web services.

Hence the architecture associated with cloud computing assumes a massive network of 'cloud servers' interconnected as if in a grid. The servers run applications in parallel and sometimes use a technique known as data virtualisation to maximise computing power per server. This involves making multiple physical resources, such as storage devices or servers, appear as a single virtual resource to the user.

CASE

Google is said to operate a global network of approximately 36 data centres needed to run just its search engine. The Environmental Protection Agency in the United States estimates that the 7,000 or so data centres situated in the country consume as much as 1.5% of the country's total electricity consumption.

Data centre
A data centre is a purpose-built facility which runs multiple computing servers, usually with associated infrastructure such as telecommunications, backup power supply and both physical and digital security. Consumers of the resources provided by the data centre are not concerned with the underlying infrastructure as services such as web applications or data storage are available on demand to the consumer.

Some of the claimed benefits of cloud computing include device and location independence, improved scalability, improved reliability and reduced cost. Cloud applications can be accessed from different access devices from any Internet-enabled location. The dynamic provisioning of computing resources means that a user's needs for computing power can scale upwards without significant new investment. The application itself in terms of software and data can be separated from physical resources such as hardware. Hence, if more computing power is required to handle peak loads, additional cloud servers can be applied to the task on an as-needed basis. Well-designed cloud applications can ensure business continuity and reliability of ICT use. Finally, it is claimed that the pricing structure of cloud computing, typically offered as a subscriber or metred service, offers a more cost-effective means of operating ICT infrastructure than in-house computing.

However, there are a number of concerns expressed in relation to cloud computing. Cloud computing is a form of outsourcing, and as such has to be closely controlled by the client company to ensure that the service provided meets changing needs. Given the increased value placed on data, detailed attention needs to be paid to the security of business data (Section 5.10) held on remote data servers and that records of personal data held on such servers meet data protection standards. A European organisation's data, for instance, might be held in a **data centre** situated in the United States, which has generally lower levels of data protection than countries in the European Union.

5.8.1 SaaS, PaaS and IaaS

SaaS
Software as a Service – a form of SOA in which clients request software components from the Cloud.

PaaS
Platform as a service – a form of SOA in which a platform is provided in the Cloud, typically for the development of software.

The Cloud, as we have seen, is a very broad concept built around the idea of providing computing as a service delivered over the Internet, much like a utility such as electricity or water to organisations. Generally, people distinguish between three major forms of cloud service: **Software as a Service (SaaS)**, **Platform as a Service (PaaS)** and Infrastructure as a Service (IaaS).

SaaS is similar to what used to be referred to as a thin client architecture for computing, described above. Client computers run little more than a web browser which requests software components from a cloud service, which in turn delivers these components on demand. SaaS can be used to reduce the total cost of ownership problem (see Section 12.6.2) by removing the need to manage the installation and upgrade of software across an organisation's base of computers. Because of this, SaaS has become a popular delivery model for not only office software but also business applications such as customer relationship management (CRM) and payroll processing.

Platform as a Service (PaaS) is particularly used by software developers to provide a platform on which software (such as apps) can be developed and deployed. The developers do not need to worry about things such as the operating system and server hardware, and can concentrate on building the functionality of their software. PaaS has become a popular way in which developers can construct, run and test the code associated with mobile apps before release.

IaaS
Infrastructure as a service – a form of SOA in which key elements of ICT infrastructure are supplied through the Cloud.

Infrastructure as a service (IaaS) is generally used to refer to the provision of key ICT infrastructure elements such as computational resource, storage and network capability. This allows organisations to scale their requirements for computing resources as their organisation grows. It offers organisations one way of outsourcing particular elements of their ICT infrastructure (Section 12.5) and managing the costs of such infrastructure on an on-demand basis much as an organisation would pay for its electricity supply.

5.9 BIG DATA

Big data
Data applications characterised by volume, variety and velocity.

Data volume
An important attribute of big data applications. The size of the data sets used are very large.

Data variety
An important attribute of big data applications. The sources of data are diverse.

Data velocity
An important attribute of big data applications. The speed with which data are captured, processed and output is rapid.

Data resolution
An important attribute of big data applications. Data handled are fine-grained.

Data flexibility
Both the structure and size of data can expand easily and rapidly within big data applications.

Data indexicality
Data are uniquely identifiable to designated people or things

Big data is a difficult term to pin down precisely as it involves a lot of things. However, the core features of applications using big data are **data volume**, **data variety** and **data velocity**. A number of tangential features are also sometimes seen as important to big data such as **data resolution**, data relatability, **data flexibility**, **data indexicality** and **data exhaustivity** (Kitchin, 2014). Not all examples of big data display these features. And, big data clearly builds upon small data, if only by using conventional databases as data sources. Some also include within definitions of big data features associated with the analysis and presentation of data. Data analytics is the activity in which data sets are examined using complex algorithms to reveal patterns in the data. Sometimes people include the capacity to visualise such patterns in various ways (data visualisation) within definitions of big data. Some even have formulated a coherent subset of Computer Science called Data Science, devoted to building better analytics and visualisation on the back of big data.

In terms of core features, the size of the data sets used within big data applications is very large (data volume), frequently tera-bytes or peta-bytes of data. The sources of data are diverse (data variety), frequently meaning that big data applications must handle multiple structures for data. The speed with which data are captured, processed and output in some form has rapidly increased (data velocity), leading to data experienced almost in real time.

In terms of other features which some think important, data can now be handled in fine-grained detail (data resolution). Data are also uniquely identifiable to designated people or things (data indexicality). Whole populations rather than samples of data are collected and stored (data exhaustivity). Data in one data set are relatable to those in other data sets (data relatability). Both the structure and size of data can expand easily and rapidly (data flexibility).

So, take the example of a company which collects data about the purchases people make with them through their smartphones. You, as a consumer, leave a myriad of digital traces in this manner – what you purchased and at what price, from where and also from which location. These data are captured and held about you on a minute by minute basis (data velocity) and must be identifiable to you (data indexicality), typically by using identifiers to refer to you. Data such as this are collected and stored, typically in the Cloud. They may then be related to perhaps other data collected about you from other data sources, such your age, gender, occupation, place of residence and marital status (data relatability). These data might be held in different formats (data variety) and may need to be 'cleaned', perhaps to make them relatable back to you. These data may also be longitudinal, meaning that they have been collected for some time about

Data exhaustivity
Whole populations rather than samples of data are collected and stored within big data applications.

you. All these data about you then become part of an entire population of data held about customers of this company and may be expanded periodically with other data referring to your activities such as membership of particular company loyalty schemes (data expandability). All this might comprise tera-bytes of data (data volume) which in the past would have been extremely difficult to store. The company may also want to analyse the entire population (data exhaustivity) of such data for business insight.

5.9.1 Big data technologies

Big data relies upon many other aspects of digital infrastructure, such as communication networks, cloud computing and the growing range of sensors within many aspects of contemporary activity that capture data about such activity, such as social media applications. However, the data structures used in conventional databases (see Section 5.4.4) are not normally used to run big data applications, but they may act as key data sources for such applications. In conventional databases data are typically stored within relational databases and articulated using languages such as SQL. In contrast, big data applications are likely to use NoSQL data management in which data tend to be stored in a distributed and much more unstructured manner than in a relational database. In this sense, NoSQL data management sacrifices aspects of data relatability for other properties such as exhaustivity and expandability of data.

For example, companies might use a framework such as Hadoop which can manage the distribution of large amounts of data on a number of data management devices connected together through a communications network. These data might then be analysed by using a toolkit such as MapReduce. MapReduce is a programming model that can be run in association with distributed data management frameworks such as Hadoop. A MapReduce program consists of a map function which performs filtering and sorting of data, and a reduce function which performs a summary operation. For instance, a map function might sort customer purchasing data into queues by product name, one queue for each product name. A reduce function would then do some summary work on these data such as counting the number of product names in each queue, yielding a purchasing total for each product.

5.9.2 Data analytics

Data analytics
Data analytics broadly refers to a number of techniques for identifying and analysing patterns in business data. The aim is to use such intelligence for better business decision-making, particularly strategic decision-making.

Data analytics is sometimes called business analytics and also business intelligence. Subsets of data analytics refer to its application within particular business function, such as marketing (marketing analytics) and B2C eCommerce (web analytics). Data analytics broadly refers to a number of techniques for identifying and analysing patterns in business data. The aim is to use such intelligence for better business decision-making, particularly strategic decision-making.

The idea of analysing organisation data for business insight has been around for many decades. Frederick Winslow Taylor (Section 2.5.3) first had the idea of collecting data about activities and using these data to conduct scientific analyses of performance for management purposes. The area of management-facing information systems (Section 4.6.1), which developed from these ideas, assumes that data can be created as transactions which describe the major activities of the business, such as orders, production operations, sales and payments. These data are then analysed in aggregate and probably visualised in terms of graphs to provide operational managers with an understanding of the performance of key activity systems. For instance, the number of customer orders for particular products made over the last month will indicate to such managers not only how much to manufacture in the near future but also the likely cash

flow. Sharing data internally through an integrated data systems infrastructure (Section 4.7.1) will provide operational managers with a much more complete picture of current organisational performance and allow them to make better decisions about the control of activity systems. Some data scientists now class such an approach to data analytics as data reporting services.

The introduction of a growing range of employee-facing information systems (Section 4.6.2), customer relationship management information systems (Section 4.6.3) and supplier relationship management information systems (Section 4.6.4) clearly increases the volume of data created by the organisation. Aspects of such data systems' infrastructure may also be outsourced to cloud applications (Section 4.8.1). Finally, the organisation may be engaging with developments such as mobile commerce and social media. All of this makes for volumes of data more suitable for big data rather than conventional database technologies. But such data can be used in two different ways, which data scientists refer to as descriptive analytics and predictive analytics. Descriptive data analytics provides insight as to what has happened or is happening in the organisation. Predictive data analytics is more complex and involves extrapolating from current data as to likely trends of importance to managerial decision-making.

RECAP

Cloud computing and big data are offshoots of contemporary ICT infrastructure. Cloud computing is built upon the tiered architecture of contemporary ICT systems to allow both data and software to be delivered as a service to the interface upon some access device. Big data refers to large volumes of data being accumulated from numerous different sources and analysed for business intelligence.

5.10 CYBER-SECURITY

Data security
The process of ensuring the security of stored and transmitted data.

Cyber-security is more accurately referred to as data security. **Data security** is a critical issue in modern societies and economies because of the increasing use of remote communication – communication at a distance. Among the problems this creates are the need to authenticate users, and the risks of unauthorised access to systems. Electronic commerce (see Chapter 7) cannot occur without the transfer of transactional data and the storage of data in ICT systems.

Data form the lifeblood of much modern business and commerce. There is an increasing level of computer-related crime, and an increasing number of measures, many of them technological, that organisations take in response. Data security is becoming a critical issue for most businesses and involves a vast range of technical and non-technical solutions.

This section considers three major technological dimensions to the issue of data security:

- ensuring effective personal identity management
- securing stored data
- securing transactional data.

Personal identity management consists of three interrelated processes – authentication, identification and enrolment – that serve to connect people, identifiers and identity in the information society. The data in an organisation's ICT systems are a valuable resource and must be protected. We consider both computer-based and non-computer-based ways of achieving this. Data privacy needs to be maintained too, keeping

sensitive data from both internal and external unauthorised users. We also consider some technologies for achieving this.

REFLECT

Can you think of three identifiers that are used to identify you to various organisations with which you interact?

5.10.1 Dimensions of data security

To provide a secure environment for the conduct of digital business (see Chapter 7) three conditions must be satisfied:

- Privacy of data should be ensured. In other words, only authorised people should have access to stored data. In data transmission, only the parties to an electronic transaction should have access to the data about it.
- Users of ICT systems need to be authenticated, as do parties to an electronic transaction. In general, messages should only be exchanged between parties whose identity has been confirmed in some way.
- Users of an ICT system should not be able to deny that they have used it, and the sender of a message cannot deny that they have sent it. This is known as non-repudiability.

Some of the major components of the technical infrastructure for ensuring data security are illustrated in Figure 5.20.

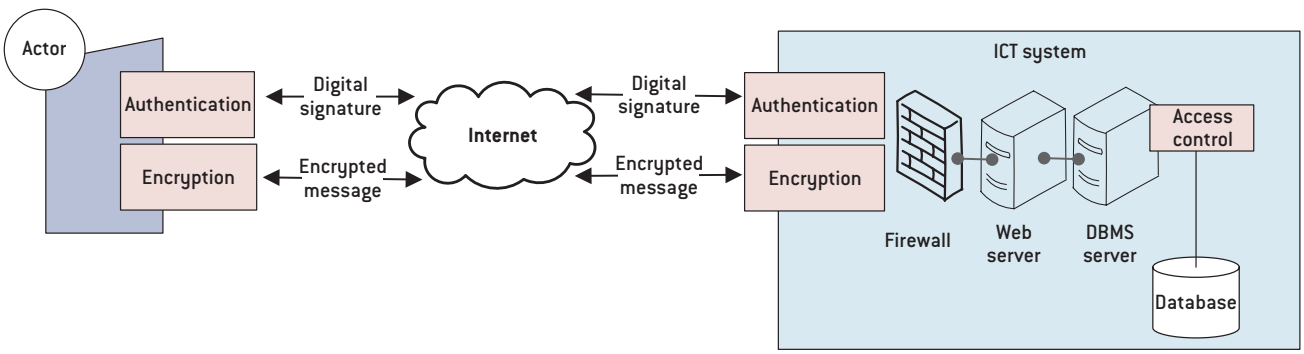


Figure 5.20 Dimensions of data security

Consider someone who wants to move money from one bank account to another. Let us say they use a PC to access their bank's online banking facility. They will be asked to authenticate themselves to the system by entering data such as a username and password, which are checked against an access control list. If the authentication is successful, they are given a secure connection to the bank's web server. Depending on the activity, messages from the access device will then be encrypted and bundled with a form of identification known as a digital signature. The message will be sent over the Internet using its inherent communication protocols, decrypted and unbundled at the organisation end, and examined by a firewall. This validates the message in various ways and only allows access to designated web servers once security rules are satisfied. The personal bank account details are likely to be held in the data management layer of the bank's ICT system.

DID YOU KNOW?

Cyber-security is a matter not only for organisations but also for nation-states. Cyber-warfare involves activities undertaken by some actor (such as the agencies of some nation-state) to attack and attempt to damage another nation's digital infrastructure, through technological devices such as computer viruses or denial-of-service attacks. In a sense, the existence of cyber-warfare is a direct result of the embeddedness of ICT within systems of economic, social and political action within modern nation-states. Because so much of modern-day activity is reliant upon digital infrastructure, attacks upon such infrastructure can cripple nation-states and wider systems of action. For such reasons, governments around the world are investing heavily in both offensive and defensive cyber-warfare facilities (see cyber-warfare case in the Case Studies section.).

5.10.2 Personal identity management

Personal identity management
A term used to encompass all those issues involved with authenticating, identifying and enrolling individuals.

In face-to-face communication between business actors personal identity is signified through natural signs such as appearance (how a person looks), behaviour (for instance, how a person speaks), or names (e.g., personal names and nicknames). Within forms of mediated communication, such as when a person emails a company, such forms of natural identifier are not available. In substitute, mediated communication tends to use surrogate or artificial identifiers. Examples of surrogate identifiers are codes (such as customer numbers), tokens (such as credit cards) or knowledge (such as PINs and passwords). More recently, there has been increasing interest in biometric identifiers. A biometric is a machine-readable measurement or more readily a series of measurements of some bodily characteristic or behaviour such as an iris scan, a fingerprint, a voice pattern or a DNA pattern. These measurements can be used to build a unique profile of an individual; this profile can serve as a strong identifier in situations of remote communication.

Hence, when using an online banking website, a customer is likely to be required to enter a range of identifiers to access the services of the website, such as a customer number, a password and possibly even aspects of personal knowledge such as the name of a person's father. Some banks issue card readers to their online customers. This requires the customer to swipe an identity token such as a debit or credit card through the reader to gain access to the services provided by the website. It is possible for such readers and tokens to store and manipulate biometric data held about the individual.

Authentication
The process of identifying some actor to a system.

The banking customer in our example is engaged in a process of authentication. **Authentication** involves validating the association between some identifier and the person it stands for. An identifier, as we have seen, is a symbol or set of symbols that can be used to authenticate an object such as a person. Authentication is a process that involves answering the question: Am I who I claim to be? It involves validating the association between the identifier and the person, and is a critical aspect of data systems that handle personal data.

Identification
The process of using an identifier to connect to a stream of data constituting a person's identity.

Authentication is a prior activity to identification (see Figure 5.21). **Identification** is the process of using an identifier to connect to a stream of data constituting a person's identity. Personal identification in the large involves answering the question: Who am I? This question is normally answered in terms of attributes of the person such as age, gender, occupation and so on, as well as events in which the person has participated, such as having gained a qualification, made an order with a company or submitted a tax return. In this manner, personal identifiers are used to assign organisational identities to individuals within given information systems. For example, a country's public sector agencies frequently have to legitimate somebody as a legal resident or a

taxpayer. Within the private sector, financial institutions must validate the credit-worthiness of a customer before offering a loan.

Organisations authenticate and identify people because these determine which persons are entitled to participate in some activity system provided by the organisation. Therefore, a validated identity serves to enrol the individual in some defined activity system. **Enrolment** in this sense involves answering the question: What am I expected to do and to receive? Hence a validated identity such as that of a taxpayer will enrol the individual in a whole range of rights, responsibilities and expected actions in the government activity systems associated with fiscal matters. In some countries it will also entitle the individual to access services provided by the state authorities, such as healthcare.

Enrolment
Enrolment refers to the process by which identified individuals gain access to the systems of a particular organisation or institution.

A personal identity in the modern age is entangled with the operation of a multitude of business or organisational systems. Individuals in the information society use a complex web of identity for existence and action. In our information society an individual may take on a number of different identities; one for each electronic service in the public, private and voluntary sectors with which the individual engages. As a consequence, an individual may accumulate a vast array of personal identifiers for such 'services' and is also likely to accrue a range of physical representations or tokens of such multiple identification: credit card, debit card, driving licence, passport, library card, parking permit etc.

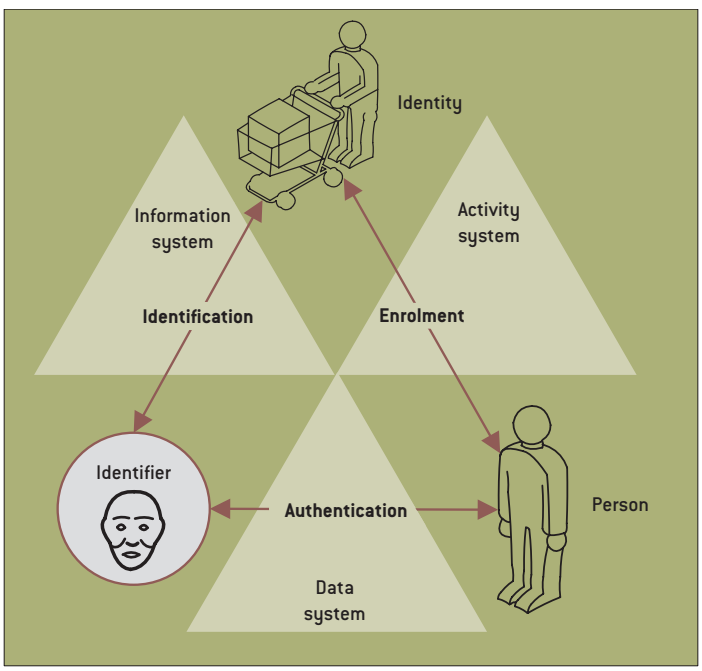


Figure 5.21 Authentication, identification and enrolment

CASE

In the UK, the issue of personal identity management came to the fore in 2002 when the then Home Secretary David Blunkett resurrected the idea of introducing a national identity card, as had been done during the First and Second World Wars. There was consultation for two years on draft legislation to create a national identity management infrastructure for the UK, consisting of a large central registry of personal identity data, and the issuing of biometric tokens to all UK citizens by 2013. Controversy surrounding this issue led to the scrapping of the idea in 2010. (See the full case description on p. 343.)

5.10.3 Securing stored data

Effective digital business demands the storage of much personal data, so it is very important to protect these stored data from external threats (for example, hacking of customer databases). But most organisational data (for instance, financial details of company performance) are also sensitive and must be protected.

The threats include:

- Electronic theft and fraud: for example, someone falsely updating corporate data with the aim of defrauding their employer, or a hacker making an illegal entry into a database system and extracting corporate data without permission.
- Loss of confidentiality: such as an unauthorised person viewing information on confidential corporate policies and disclosing it to outside agencies.
- Loss of availability: for instance, a database system becoming unavailable because of a natural disaster such as fire and flood, or a human-generated disaster such as a bomb attack.
- Loss of personal privacy, when an unauthorised person views personal data someone wished to be kept private.
- Loss of integrity: when data are corrupted, by a software virus or a software or hardware failure.

Any organisation needs to take both computer-based and non-computer-based measures to counter threats such as these.

Computer-based measures include an authorisation strategy for operating systems, ICT systems and database systems. This normally involves system administrators assigning usernames and passwords to individuals and groups. As mentioned above, it can also include physical tokens such as a card with an electromagnetic strip or a smart card with an embedded chip, which is read by a specialised input device, or a biometrics reader.

Non-computer-based measures include establishing a security policy and plan and enforcing it; establishing a policy on access to data (which can involve rethinking people's roles); positioning computer hardware in secure environments through physical access controls; and securing copies of data and software in off-site, fireproof storage.

REFLECT

How important is personal identity data to the operation of the average company?
What happens to business if outsiders gain unauthorised access to personal data?

5.10.4 Securing transactions

Encryption
The process of securing data through application of some security algorithm.

The increasing use of electronic transfer of data structures leads to a need for security and privacy. In this section we provide an overview of some key technologies designed to address this which include **encryption**, digital signatures and certificates, firewalls and tunnelling technology.

As we saw in the station X case (see Section 3.4.8), encryption and decryption have been carried out for thousands of years. Two types of algorithm employed in commercial data transmission are symmetric and asymmetric key encryption.

In symmetric key encryption, sometimes known as private key encryption, the same key is applied at both ends of the encryption process. The key is agreed in advance between the sender and receiver, as in the case of the configuration of the Enigma machine in the station X case. The main problem is that messages can only be transmitted between parties known to each other and trusted to hold the private key.

Asymmetric key encryption, sometimes known as public key encryption, uses a pair of keys, one private and one public. A user with a private key can give a corresponding public key to anyone they wish. This then allows the user to send a message encrypted with the private key, safe in the knowledge that only users with the corresponding public key can decrypt it. There is no requirement for the sender to agree the keys in advance of sending a message since the user can place the public key in a register of selected users via encrypted messages.

Public key infrastructure
An infrastructure for ensuring the security of electronic transactions that includes ensuring that digital keys are used only by legitimate holders and procedures for managing the assignment and storage of digital keys.

Secure socket layer
Secure socket layer (SSL) is Netscape's attempt to offer a secure channel of communication. It is a framework for transmitting sensitive information such as credit card details over the Internet.

Firewall
A collection of hardware and software placed between an organisation's internal network and an external network such as the Internet.

Public key encryption provides the foundation for digital signatures. These are important in authenticating the senders of messages and for ensuring a degree of non-repudiability. The sender transmits a message using a private key. If the receiver of the message is able to decrypt the message successfully using the public key, this automatically acts as a way of authenticating the sender.

The management of encryption and digital signatures requires an infrastructure that includes ensuring that keys are used only by legitimate holders, and procedures for managing the assignment and storage of keys. This is referred to as the **public key infrastructure** (PKI), and is provided by a trusted certification authority (CA). All legitimate users are required to register with the CA to use public key encryption. The CA issues a digital certificate, sometimes called a digital passport, to users. This consists of an electronic document that keeps a record of users and their public keys.

Public key encryption is also important to securing data transmission over the Internet. **Secure socket layer** (SSL) is an attempt to offer a secure channel of communication. It is a framework for transmitting sensitive information such as credit card details. It involves using a sophisticated protocol between client and server systems that is transparent to the user and provides a secure connection. It exchanges a digital signature between a client (such as an individual using an Internet-enabled PC) and a server (an organisation's front-end ICT system).

A **firewall** is a system that attempts to protect a private network from hackers, software viruses, data corruption or unauthorised access. Effectively it restricts access to the private network by external users, and may also be used to prohibit internal users from accessing selected parts of the private network. For example, it is used to prevent public Internet users from accessing an organisation's private Intranet.

Firewalls can be implemented in both or either of hardware and software. They typically comprise a proxy server, which examines all messages entering or leaving the private network, and blocks those that do not match particular security criteria. In a web environment a proxy server sits between a web browser and a web server. It runs routers, other communications software and special programs known as proxies. One proxy is normally assigned for each Internet service such as HTTP and FTP. When data packets from the external environment reach the firewall it checks the packets for details of their source and destination. It then makes a decision to accept or reject the packet depending on an inspection of an access control list and a set of associated security controls.

Tunnelling technology involves the transmission of data over the Internet using leased lines to the local ISP. With the use of encryption, authentication and other security technologies, this can be used to produce a virtual private network (VPN) over a WAN. Data packets are encrypted and encapsulated into IP packets, then transmitted over the Internet using routers. At the receiver end the packet is decrypted and authenticity checks are made. This creates secure data tunnels between an organisation's

systems and key external stakeholders such as suppliers and partners. This approach offers an inexpensive way for an organisation to extend the reach of its information systems, and is the key technology underlying Extranets.

RECAP

Data security is increasingly important to modern organisations both in terms of securing the messages travelling over communication networks and in data stored within databases. Authorisation schemes, such as usernames and passwords, are typically used to secure stored data, while technologies for securing messages include encryption, digital signatures and certificates, firewalls and tunnelling technology.

5.11 CONCLUSION

This chapter has considered the typical ICT infrastructure of organisations to consist of access devices, communication channels, front-end and back-end ICT systems, and core data management.

As we shall see, much contemporary digital business (Chapter 7) involves people accessing services or products through channels of access which consist of an access device and associated communication channel. Access devices such as smartphones and personal computers are used to formulate, transmit, receive and display messages. Communication channels rely upon the infrastructure of the Internet and the Web. The Internet relies upon the technologies of packet-switched networks, TCP/IP, HTTP, email protocols and FTP, IP addresses, universal resource locators (URLs) and domain names. The Web as an application that runs on the Internet relies upon the concept of hypertext/hypermedia, its implementation in HTML and the use of web browsers.

It is conventional to consider ICT systems in terms of what they do – their key functionality. In this sense, an ICT system can be seen as being made up of a number of interacting subsystems or layers: the interface subsystem, business rules subsystem, transaction subsystem and data management subsystem. Such layers are likely to be distributed around various hardware devices connected through an organisation's communication network. Recently, the idea of cloud computing proposes running major parts of the functionality of an ICT system on large data centres accessed as a service run over the Internet.

Various front-end ICT systems interface with internal and external stakeholders through access channels and typically involve a website accessible via the Internet or through an Intranet or Extranet. The business tier of a typical business ICT application consists of three interrelated elements: update functions, business rules and transactions. Back-end ICT systems include the core systems in the business, and tend to be located around databases storing important corporate data. The integration of back-end ICT infrastructure is now frequently achieved through enterprise-wide ICT systems.

To provide a secure environment for the conduct of business communication over the Internet, three conditions must be satisfied: authentication, privacy and non-repudiability. Key approaches to ensuring the security of stored data include authorisation schemes such as usernames and passwords. Key technologies for ensuring privacy and authentication of transactional data include encryption, digital signatures and certificates, firewalls and tunnelling technology.

This chapter has considered the technical infrastructure for digital business. In the next chapter we start to examine some of the component elements of the digital environment which help us understand the place of ICT within business infrastructure. We also examine the effect of increasing digital infrastructure upon activities within the wider society and polity.

5.12 REVIEW TEST

5.1 Access devices include:

Select all that apply by placing an X in the box.

- ☐ Personal computer
- ☐ Satellite communications
- ☐ Smartphone
- ☐ Tablet
- ☐ Interactive digital television

4 marks

ICT infrastructure

5.2 The ICT infrastructure can be divided into the following elements.

Select all that apply by placing an X in the box.

- ☐ Back-end ICT
- ☐ Management information systems
- ☐ Front-end ICT
- ☐ Access devices
- ☐ Communication channels
- ☐ Data management

5 marks

5.3 An ICT system can be considered to have four major layers or subsystems plus a communications subsystem.

Place in order (1–4), with the layer closest to the user first (1).

- ☐ Rules subsystem
- ☐ Interface subsystem
- ☐ Data management subsystem
- ☐ Transaction subsystem

4 marks

5.4 There are several different types of digital innovation

Match the type of digital innovation with the appropriate business implication by placing the number next to the letter.

Mobile commerce (A)	Being able to locate and manage much of the functionality of an ICT application in a remote data centre (1)	A. ☐
Cloud computing (B)	Being able to offer goods and services to customers anywhere (2)	B. ☐
Big data (C)	Being able to communicate and control remote domestic devices over the Internet (3)	C. ☐
Internet of Things (D)	Being able to 'mine' large data sets accumulated from numerous sources for business insight (4)	D. ☐
The blockchain (E)	Being able to manage transactions indistributed electronic ledgers (5)	E. ☐

5 marks

5.13 EXERCISES

- In face-to-face communication, what are the access device and channel?
- Does a company known to you use any mobile devices to access ICT systems? What types of system are accessed through them?
- When you use a computer on some communication network, try to determine the IP address of the computer.
- Choose an organisation and determine its use of the Internet. Does it have an Intranet and Extranet?
- Try to determine the volume of monetary transactions occurring within a nation such as the UK in any one day.
- Find an ICT system, and analyse it in terms of the four-layer model described in this chapter.
- Try to find an organisation that maintains both an Internet and Intranet website and determine how they differ.
- Determine whether an organisation known to you uses an Extranet. Attempt to determine its functionality.
- When you have made any payments online, determine how sites inform you that they are secure. Determine the confidence you place in the security of such sites.
- Identify core database systems in an organisation known to you.
- Determine how privacy is handled in a system known to you.
- Determine how authentication is handled in a system known to you.
- Determine the sort of access controls used in an ICT system known to you.
- Consider an ICT system known to you. Attempt to estimate the volume of data stored in the system.
- Find an organisation that has adopted a mega-package. Why did the organisation decide to implement the package? What experience have they had of using it for their infrastructure?

5.14 PROJECTS

- Choose an organisation and a remote access channel that it uses, and investigate the key costs of maintaining the channel. For instance, what access devices are supported? How much does the communication channel cost to run and maintain?
- Attempt to determine the current penetration of a chosen access device, such as 5G mobile phones or tablet computers. Also investigate the degree to which such access channels are being used to conduct interaction with businesses.
- The Internet and the Web have created what is sometimes called a global marketplace. Define precisely what globalisation means in relation to communication technology. What consequences does communication technology have in relation to globalisation? Would globalisation happen without communication technology?
- Technology does not stand still. Investigate likely changes to the technology of the Internet over the next decade. What are the likely trends and what effect will such trends have on global business?
- Investigate the effect of Web 2.0 on business organisations. For instance, business organisations are grappling with both the potential and the pitfalls associated with online social networking sites. Some businesses are using them as means of enhancing collaboration among organisational members. Other businesses see social networking as a large security risk.
- Investigate the use of blogs for business purposes. Do they offer a distinctive new channel of communication with customers? How are blogs managed within the

overall communication strategy of a company? Are blogs considered part of the content management process or are they managed separately?

- Gather data on a limited range of ICT systems within a specific organisation. Analyse their functionality in terms of the layered model discussed in this chapter. How easy is it to assign aspects of their functionality to a three-tiered model? Is an n-tiered model more appropriate?
- Build a high-level description of the functionality of a mega-package such as SAP. How much of a core information systems infrastructure as described does it provide for organisations? Investigate the penetration of ERP systems, such as the one chosen, into a particular industrial sector such as manufacturing and retail.
- ERP systems are frequently introduced into organisations in an attempt to import integration of data and processes. However, many organisations have experienced problems in implementing such large-scale package solutions. Investigate the problems and pitfalls of ERP implementation.

5.15 FURTHER READING

The free textbook produced by the Open University (2016) provides a good review of some of the component elements of the ICT infrastructure covered in this chapter. The short book by Holmes (2017) is a good introduction to the central idea of big data. A vast range of material, both offline and online, has been published on the technologies of the Internet and the Web. Berners-Lee (1999) provides the definitive account of the creation of the Web. The review by Meeuwisse (2017) provides a high-level account of cyber-security. My paper on personal identity management (Beynon-Davies, 2006) raises some issues of concern for ICT infrastructure.

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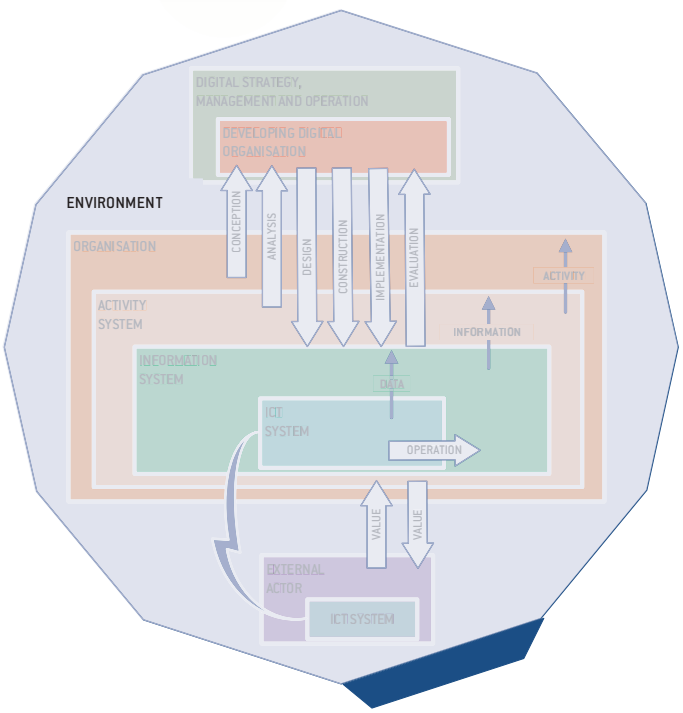
6 THE DIGITAL ENVIRONMENT

'All programmers are playwrights and all computers are lousy actors.'
– Anonymous

LEARNING OUTCOMES	PRINCIPLES
Understand the increasing embeddedness of ICT within the wider economy, society and polity.	The increasing embeddedness of ICT into all aspects of activity provides evidence that modern economies, societies and polities are digital environments.
Define the concept of value and distinguish between digital and non-digital value.	Goods and services can be digital and non-digital. Non-digital goods and services have a physical form. Digital goods and services have a form amenable to representation as data.
Describe organisations as value-creating systems.	Organisations can be considered systems for producing value. Primary activity systems contribute directly to value-production, while secondary activities systems support primary activity systems.
Explain the wider environment of the organisation as a value-network.	The internal value-chain of the organisation interacts with a wider value-network consisting of supply chains, customer chains, partnership chains and community chains.
Understand how the wider society is impacted by ICT.	One way of thinking about social systems as compared to economic systems is in terms of social networks. Social networks provide social capital for their members.
Understand how the wider polity is impacted by ICT.	ICT is impacting upon the ways in which government is enacted and democracy is realized. This we refer to as the digital polity.

CHAPTER OUTLINE

6.1 Introduction
6.2 Value
6.3 The value chain
6.4 The value network
6.5 Digital society
6.6 Digital polity
6.7 Conclusion
6.8 Review test
6.9 Exercises
6.10 Projects
6.11 Further reading
6.12 Bibliography



6.1 INTRODUCTION

For well over a century people have been arguing about which has more effect on children's development: their environment or their genetic inheritance. The notable British geneticist and evolutionary biologist J. B. S. Haldane commented, '*We do not know, in most cases, how far social failure and success are due to heredity, and how far to environment. But environment is the easier of the two to improve*'. In a sense the same is true for organisations. Organisational success cannot be guaranteed solely by improving internal operations: their prior history and 'inherited' competitive position have a great influence too. In the long term organisational sustainability definitely relies on effective interaction with the wider environment.

To emphasise again, this book takes a system view of the organisation. In this sense, organisations are viewed as complex systems of action that create value. Organisations are not isolated entities, they are open systems. This means that organisations are necessarily adaptive systems. The entire complex system of organisation is affected by its environment – anything outside the organisation with which the organisation interacts. The success (i.e., both current viability and future sustainability) of any organisation will depend on how well it integrates with and reacts to aspects of its environment.

This chapter focuses on the wider environment. It first considers it as three major environmental systems: an economic system (economy), political system (polity) and societal system (society). The chapter describes important aspects of each of these environmental systems that provide foundation for digital business, as it is described in Chapters 7, 8 and 9.

The chapter begins by explaining how organisations can be considered as systems creating value that travels along an internal value chain. But value also travels between economic actors in the wider value network – and between organisations – in customer, supply and partnership chains. The wider value network also includes the community chain as a social network. The value it produces (social capital) is an increasingly important platform for business (see Chapter 8).

The increasing embeddedness of ICT into all aspects of business provides part of the evidence that modern Western societies are information societies. However, at its heart, the idea of an information society relies on a critical mass of the populace using remote access channels as their preferred method of accessing the services and products of public and private sector organisations.

Although organisations are producing strategies to encourage external actors, such as customers to use remote modes of access to their services and products, a number of preconditions exist for the successful uptake of such access channels. These preconditions represent the interaction of a range of social factors likely to affect take-up of remote access devices and channels, and the use of such channels to interact with organisational actors.

ICT is impacting upon the ways in which government is enacted and democracy is realised. This we refer to as the digital polity. In terms of government, many services provided by government to its citizenry are now 'digital by default'. In terms of democracy, our means of selecting our political representatives and voting for them is changing through ICT. We consider the issue of electronic or digital government in more detail in Chapter 8. Here, we focus upon some key issues of digital democracy.

6.1.1 The external environment of the organisation

Environment is the general term for anything outside of the organisation with which it interacts. The environment of most organisations can be seen as three major interdependent systems: an economic system, social system and political system. In this

sense, it is made up of a complex network of activities and relationships between the organisation and other actors. Each of these environmental systems has an impact on digital business and the operation of digital business in turn is likely to impact on the social, economic and political spheres.

An economic system is concerned with the way in which groups of humans arrange their material provisioning, and essentially involves the coordination of activities concerned with this. An organisation's economic environment is defined by its activities and relationships with economic actors. It is particularly concerned with national and international commerce and trade, and is influenced by such factors as levels of taxation, inflation rates and economic growth. Information systems are critical to organisational performance in economic markets. Recently, there has been a lot of growth in the specialised markets focused around the use of electronic networks. Not surprisingly, eBusiness and eCommerce have become significant strategies for modern organisations to improve their performance (see Chapter 7).

The social environment of an organisation concerns its position in the cultural life of a grouping such as a nation-state. We can think of it as a series of social networks consisting of activities and relationships that serve to bind various social groupings together. In Chapter 9 we are particularly interested in the ways in which people relate to organisational activity through communities of consumption.

The political environment or system concerns issues of power. Political systems consist of sets of activities and relationships concerned with power and its exercise. This deals especially with government and legal frameworks, which are a major constraining force on organisational behaviour. Among the issues we can consider here is the influence of ICT on electronic government (Chapter 9) and electronic democracy.

6.1.2 The embeddedness of ICT within the environment

Digital native
Persons who have not known of a time when digital technology has not been around.

As a person reading this book you are more than likely to be a **digital native**, meaning that you have not known of a time when ICT was not around. You have grown up with ICT, such that you treat it as a mundane and accepted background to your everyday life. But this acceptance of the embeddedness of ICT comes at a cost – the basis of ICT as a series of designed technologies goes relatively unquestioned.

We can demonstrate the embeddedness of ICT within the modern economy, society and polity in a number of different ways, at the level of organisations or at an individual level. Increasingly, your activity as an economic actor is driven through ICT. Organisations of all forms are increasingly dependent upon their ICT to produce value. As much as 70% of the value produced by advanced economies is in intangible goods and services, many of which are amenable to digitisation. As a member of a modern nation-state you cannot function effectively as a citizen without access to ICT. Likewise, the functioning of modern democracies is increasingly performed through and impacted by ICT.

6.2 VALUE

In Section 2.5 we asked the question: What is organisation for? And we came to the conclusion that the goal of most human organisation is the creation of value, and that such value comes usually in two major forms – as products or as services. In this section we consider the issue of value in more detail and argue that ICT is impacting upon the very nature of value itself within the modern digital economy.

6.2.1 Value

Value
A general term used to describe the worth of something such as the output from some system of organisation.

Axiology
The study of value.

The term **value** is used much within business to refer to any 'thing' of worth to someone. But this raises the question of what people find to be of worth and **axiology** is the study of this subject. In a purely materialist sense we could equate value with the satisfaction of human needs such as the need for food, water and shelter. For the psychologist Abraham Maslow these constitute basic human needs which must be satisfied before other human needs – such as the need for safety, love and belonging, esteem and self-actualisation – are achievable. In this manner, a hierarchy of needs is specified that translate into forms of value. Some of this value is material in nature such as food, while other forms of value are non-material in nature such as a sense of esteem or personal status. In this sense the concept of value, just like the concept of a sign we considered in Chapter 3, is an arbitrary concept: it depends on what is considered of worth by some community of people.

There is also an overlap between what we find of worth and our personal values, which guide us in the decisions and actions we take. Hence the study of value (axiology) overlaps with the study of living a good life (ethics). There is also a clear relationship between what we value and what we regard as beautiful or desirable. Therefore, axiology and aesthetics – the study of beauty – are clearly related.

REFLECT

Marketing people clearly understand something of this relationship between axiology, ethics and aesthetics. You may be a vegetarian, for instance, which probably reflects certain personal values you hold and reflects something of what you regard as desirable. Being vegetarian clearly influences your purchasing of certain goods. Can you think of any other examples of the relationship between axiology, ethics and aesthetics like this?

Commerce
That process which deals with the exchange of goods and services between actors.

The term **commerce** is generally used to refer to the exchange of value within economic systems. Economic systems are seen as concerned with the production, distribution and consumption of value (Figure 6.1). Value is created by a producer. Value is passed from creator to user by a distributor. Value is used in some way by a consumer.

In terms of systems of organisation value is traditionally thought of in terms of goods and services. A good (product or commodity) is some 'thing' created as a result of some activity. As such, goods are not dependent on any particular location or time for their existence. As outputs from some activity they can also be inspected and stored. For instance, a can of baked beans as a commodity can be sold in numerous different stores at different times. A service is an activity typically performed by somebody or something on someone or something else. As an activity a service is time- and location-dependent. It takes place at some time in some place on or for somebody. Likewise, as activities, services cannot be distributed or stored. For example, a haircut is performed at a given time, in a given location, on a specific person and by a specific person.

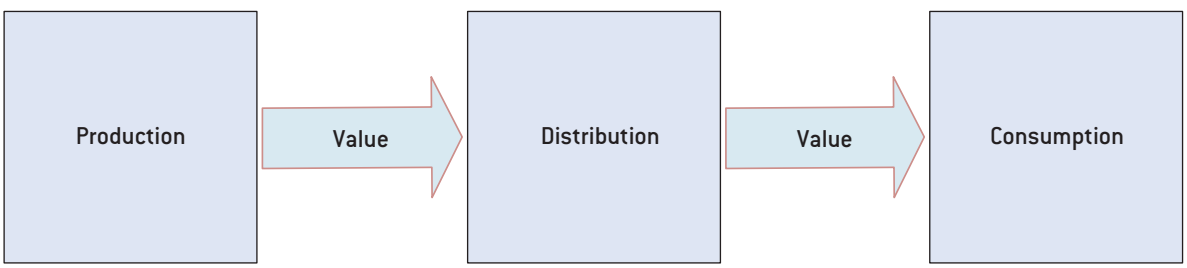


Figure 6.1 Production, distribution and consumption

REFLECT

In terms of the following list of activities of value creation which could be said to involve producing a good and which providing a service?

Manufacturing a table; caring for the elderly; educating children; transporting passengers; growing foodstuffs.

6.2.2 Data and value

Traditionally, data are seen as something separate from the value. But in the modern digital economy data are not only crucial accompaniments to value, they can be value in and of themselves.

Economic activity fundamentally relies upon the exchange of value. Somebody creates something of value to somebody else and exchanges this for something. As a system of activity, an economy, just like a unit of the economy, for example a business organisation, must be reliant on effective communication through information systems and effective representation through data systems. This explains why any flow of value within the wider economy is inherently accompanied with a flow of data (Figure 6.2). This data flow records who is involved in the exchange, when the exchange happened, what was exchanged and how the exchange was valued, among other things.

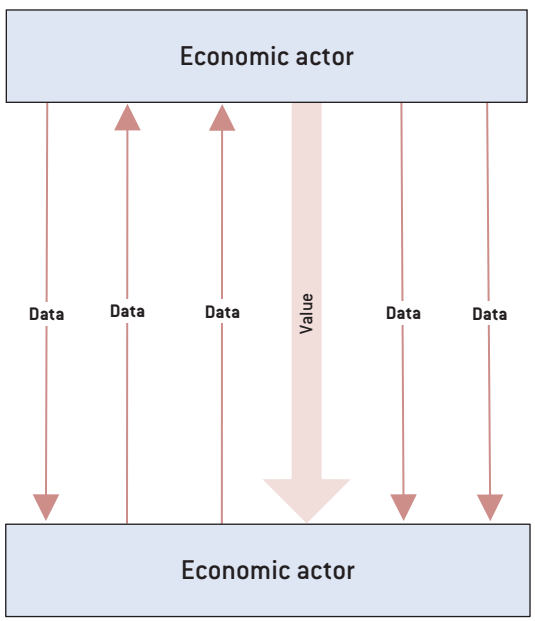


Figure 6.2 Data and value

6.2.3 Commerce

The key activity of any economic system is commerce or trade. Commerce of whatever form can be seen at a high level to consist of four main activities or activity systems – pre-sale, sale execution, sale settlement and aftersale activity (Figure 6.3). Each activity, as we shall see, necessarily needs to be supported by key information systems and data systems.

As we shall see in Chapter 7 this high-level pattern is evident in all forms of commerce, not only in physical or offline business, but also within online or digital business. It therefore can be considered a high-level template for the design of any

Digital good
A good that can be delivered over a digital access channel.

Digital service
A service that can be delivered over a digital access channel.

information systems infrastructure that supports commercial activity, including an increasing range of **digital goods** and **services**.

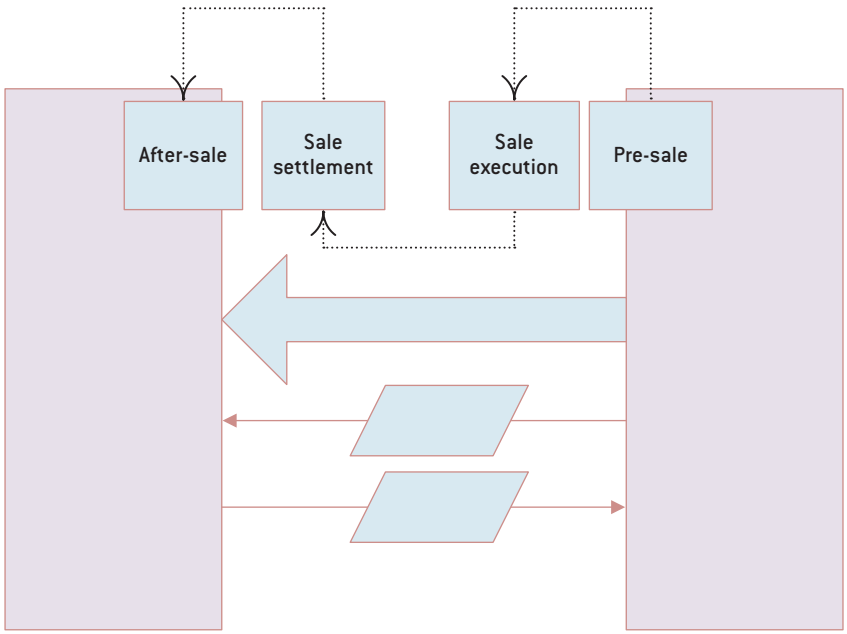


Figure 6.3 The activity systems of commerce

6.2.4 The changing nature of value

The nature of value is impacted upon by the application of ICT through processes of digitisation. Digitisation is the way in which certain goods and services are turned into data.

Certain goods and services are not amenable to digitisation, to be turned into data, and are never likely to be so (see Figure 6.4). We do not yet have a *Star Trek* transporter that can dematerialise certain physical things in the sense of turning them into data, sending them as a signal and then rematerialising them at some other distant location. In such situations ICT is used, as we shall see, primarily as a way of managing the flow of value, by reducing what we shall refer to as the coordination costs associated with the exchange of goods such as automobiles and services such as healthcare.

	Goods	Services
Non-digital	Automobiles Foodstuffs	Health care Waste disposal

Figure 6.4 Non-digital goods and services

Certain other goods and services are amenable to digitisation, to be turned into data, distributed via communication channels and consumed at a distance using access devices (see Figure 6.5). Once a musical track is digitised it costs next to nothing to copy or to distribute the track via streaming services.

	Goods	Services
Digital	Music Movies	Legal advice Monetary transfers

Figure 6.5 Digital goods and services

If advanced economies such as the United States and those within the European Union produce as much as 70% of their value as intangible goods and services, then many of these goods and services are either currently digitised or are amenable to digitisation. This distinction between digital and non-digital value helps explain how certain industries have been disrupted through ICT. Many of the so-called content industries have been disrupted in this manner – newspapers, books, music and movies.

DID YOU KNOW?

In his famous book *Argonauts of the Western Pacific* the eminent anthropologist Bronislaw Malinowski (1922) described a curious case of axiology. This involved the Kula exchange, sometimes known as the Kula ring: a system of goods exchange conducted among 18 island communities, including the Trobriand Islands, in the South Pacific. Participants in this exchange system travel hundreds of miles by canoe in order to exchange Kula, which consists of two types of goods: disc necklaces formed from a red seashell and armbands formed from a white seashell. Kula goods have no value as useful objects but are traded purely for the purposes of raising social status. The act of giving a necklace or armband is used as a sign of the greatness of the giver. This exchange network is known as a ring because Kula necklaces are traded to the north in a clockwise direction and Kula armbands are traded to the south in an anti-clockwise direction. In this way, Kula valuables never remain in the hands of recipients for long. Instead, they must be passed on to other partners in the Kula exchange system within a certain amount of time and thus constantly are circling around the exchange network. However, even temporary possession of Kula by a participant brings prestige and status for the temporary owner.

A similar system was conducted on the Pacific Northwest Coast of North America in terms of what was known as Potlatch. Potlatch is a festival ceremony which was practised by indigenous peoples of this area, the word coming from the Chinook meaning 'to give away' or 'a gift'. At Potlatch gatherings, a family or hereditary leader hosted a feast for guests. The main purpose of the Potlatch was the redistribution of wealth. Within it, hierarchical relations within and between clans, villages and nations, were observed and reinforced through the distribution or sometimes destruction of wealth. The status of any given family was raised not by who had the most resources, but by who distributed the most resources.

6.2.5 Movies as value

CASE

The term 'content', in a digital context, used to refer solely to documents held on websites. Nowadays, the term is used to refer to all forms of goods and services that can be represented in digital form as data. Movies are a good example of such digital value – digital content. They can now be created as data, distributed as data and consumed as

CASE
continued…

data. Figure 6.6 lists some of the technological innovations that have impacted upon the movie industry since its inception.

Movies are digital goods because a modern movie is captured and edited as a data structure – a video file. A movie once edited can be stored on the data management tier of some ICT system and consumed as a data stream by somebody on some access device.

1880s	Motion picture camera and projector
1920s	Motion picture soundtracks
1930s	Colour movies
1990s	Digital cinematography
2000s	Computer generated imagery (CGI)

Figure 6.6 Technological developments in the movie industry

REFLECT

Consider an industry known to you – perhaps the banking, insurance or publishing industry. Consider how these industries have changed over the last 20 years. Attempt to use the concepts of the value chain, and value network discussed in this chapter to explain what has been happening to such industries.

Is it possible to consider the effect of ICT upon such industrial change purely in relation to coordination costs as compared to 'production' costs?

6.2.6 Production and coordination costs

Production cost
The cost of producing something.

Coordination cost
A cost incurred in making an economic exchange. Also known as a transaction cost.

We can also understand the growing embeddedness of ICT within the global economic system in terms of the distinction between **production costs** and **coordination costs** (Coase, 1937).

The costs associated with creating and distributing some value are production costs. The costs of coordinating the activity of multiple actors, such as in the exchange of goods and services within commerce or trade, is a coordination cost. For non-digital goods, ICT can be used to help reduce coordination costs within economic activity such as those costs associated with participation in markets. ICT can also help reduce certain production costs for certain types of value – goods and services amenable to digitisation.

Take physical books as an example of a type of value, a good. The costs associated with authoring, printing and distributing a physical book are production costs. The costs associated with communicating with customers about books through various marketing channels, as well as the costs of selling these books to customers are coordination costs. The coordination costs associated with the marketing and sale of physical books to customers can be reduced through ICT infrastructure such as digital communication channels and electronic payments systems. The same applies to

electronic books or eBooks. But eBooks also reduce the costs associated with the 'printing' and distribution of books – these are production costs.

6.2.7 Money and value

There is a tendency to confuse money with value. Money is not value, but a convenient measure of value that is useful within economic exchange. We can demonstrate the difference between money and value quite easily with a simple thought experiment. Imagine you are alone on a desert island and sitting on a wooden chest. Within the chest there are one million pounds sterling in banknotes. What is the value of the banknotes to you? The answer is of course that it is worthless as money, but might have some worth as fuel to put on a fire and to keep you warm at night.

Economists argue that money serves three major and interdependent functions. As a unit of account, money serves as a measure of the worth associated with value – goods and services. As a medium of exchange, money must be able to facilitate the exchange of value – goods and services between economic actors. As a store of wealth, the units of money must be consistently valuable in the sense of being able to be exchanged for goods and services.

Each of these functions is sufficiently abstract to allow us to think of money as essentially data. Money these days is essentially a set of data structures held in the ICT systems of financial intermediaries such as banks and building societies. Monetary exchange is essentially just the articulation of certain data structures accompanying the flow of goods and service between buyers and sellers (Figure 6.7). On completion of a sale, the bank account of the seller is updated by writing a new data element to it which increases the monetary balance of this data structure. Likewise, the bank account of the buyer is updated with a data element and its balance decreased.

Digital currency
Currency stored and processed as digital data.

Bitcoin
A digital currency that uses the blockchain.

This also helps us understand the growth in the cashless society and the rise of so-called **digital currency**. Money traditionally has been given physical form as tokens of value – banknotes and coins. But, in many economies worldwide such as the UK, the number of economic exchanges performed using physical banknotes and coins (cash) is declining as more and more people use tokens, such as credit and debit cards, to electronically withdraw monies from their bank or credit account in payment for something. Companies such as Apple have also introduced means by which people can use their smartphones to pay for things. **Bitcoin**, as a digital and cryptocurrency, consists solely of records held within digital wallets held on computing devices.

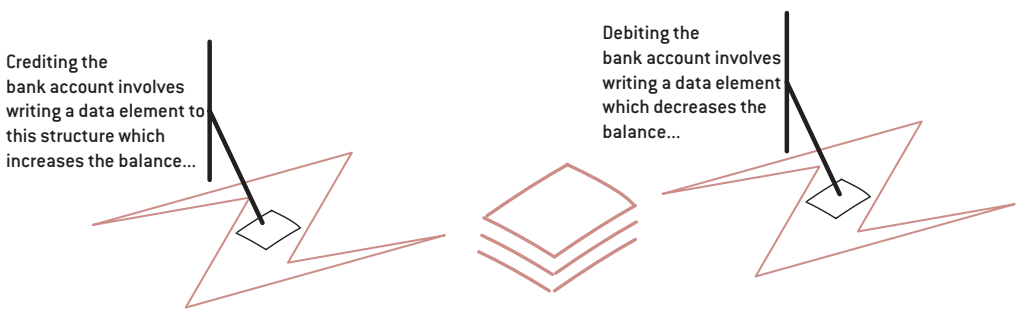


Figure 6.7 Money as data

6.2.8 Bitcoin and the blockchain

CASE

Examples of payments through use of a debit card or a smartphone are not truly cash payments because the enactment of a financial transaction by these means requires the participation of a financial intermediary to store and transfer funds for you. And, as a direct result, data are gathered about the payments you make by such intermediaries. True cash transactions can be undertaken without the need for a financial intermediary and without any data being recorded about the transaction. This explains why in most countries there is a hidden economy which is still driven by cash transactions. It also explains why governments worldwide are very keen to reduce the number of such cash transactions as their continued use makes it extremely difficult to track things like a person's income, and consequently how much income tax they should pay.

This is where the notion of digital currency or digital cash comes in, of which the most prominent example is Bitcoin. The invention of Bitcoin is attributed to a character who calls himself Satoshi Nakomoto, but who has never actually been identified. His idea was to create a digital currency (sometimes referred to as a cryptocurrency because the process of creating bitcoins involves cryptography) that was not backed by national governments and not administered by any financial intermediaries. In 2009 the first Bitcoin network came into existence, when the first open source Bitcoin client was issued and the first block of bitcoins 'mined'.

Bitcoins are stored in digital wallets held on access devices such as personal computers, tablets and smartphones. A digital wallet is just a data structure, which records the number of bitcoins held. When bitcoins are used in economic transactions, the transactions are checked by a network of 'miners', who effectively validate transactions and add them to a distributed ledger known as the blockchain. The 'miners' are rewarded for their computational work with the potential for earning new bitcoins. So new money is generated as a natural by-product of using digital currency in the system of exchange.

Blockchain
A distributed digital ledger used to support application such as Bitcoin.

The **blockchain** as a technology relies on the following elements (Figure 6.8). First, a set of declared participants must situate themselves upon some communication network and share some common communication protocol such as Transmission Communication Protocol/Internet Protocol (TCP/IP). Each node on the Bitcoin network stores a common data structure known as the blockchain. A common consensus function is used to verify transactions and preserves the immutability of the blockchain – transactions cannot be changed once entered on the blockchain.

A blockchain is so-called because as a data structure it is made up of many data elements known as blocks, which are chained together in chronological order. A new transaction forms a data item that is added to a designated block within the blockchain. The block is then broadcast to the nodes of the blockchain network. These nodes either all approve the transaction as valid or one or more nodes reject the block as invalid. Only a validated block can be added to the blockchain, which is updated across all the nodes within the network.

Bitcoin relies on using the blockchain as a registry of money and transactions. Bitcoins are held in digital wallets and these form part of the blockchain. A block within the blockchain is equivalent in size to a text message, held on your access device. There are different forms of blockchain. Bitcoin implements a permission-less blockchain, meaning that anyone can participate and contribute. Each blockchain is unique to each participant in the blockchain network, but personal details of the 'owner' of a designated blockchain are not recorded in it.

When bitcoins are used in a transaction, then the digital signature of the user is attached to the blockchain as confirmation and to prevent duplication of transactions and 'forgery'.

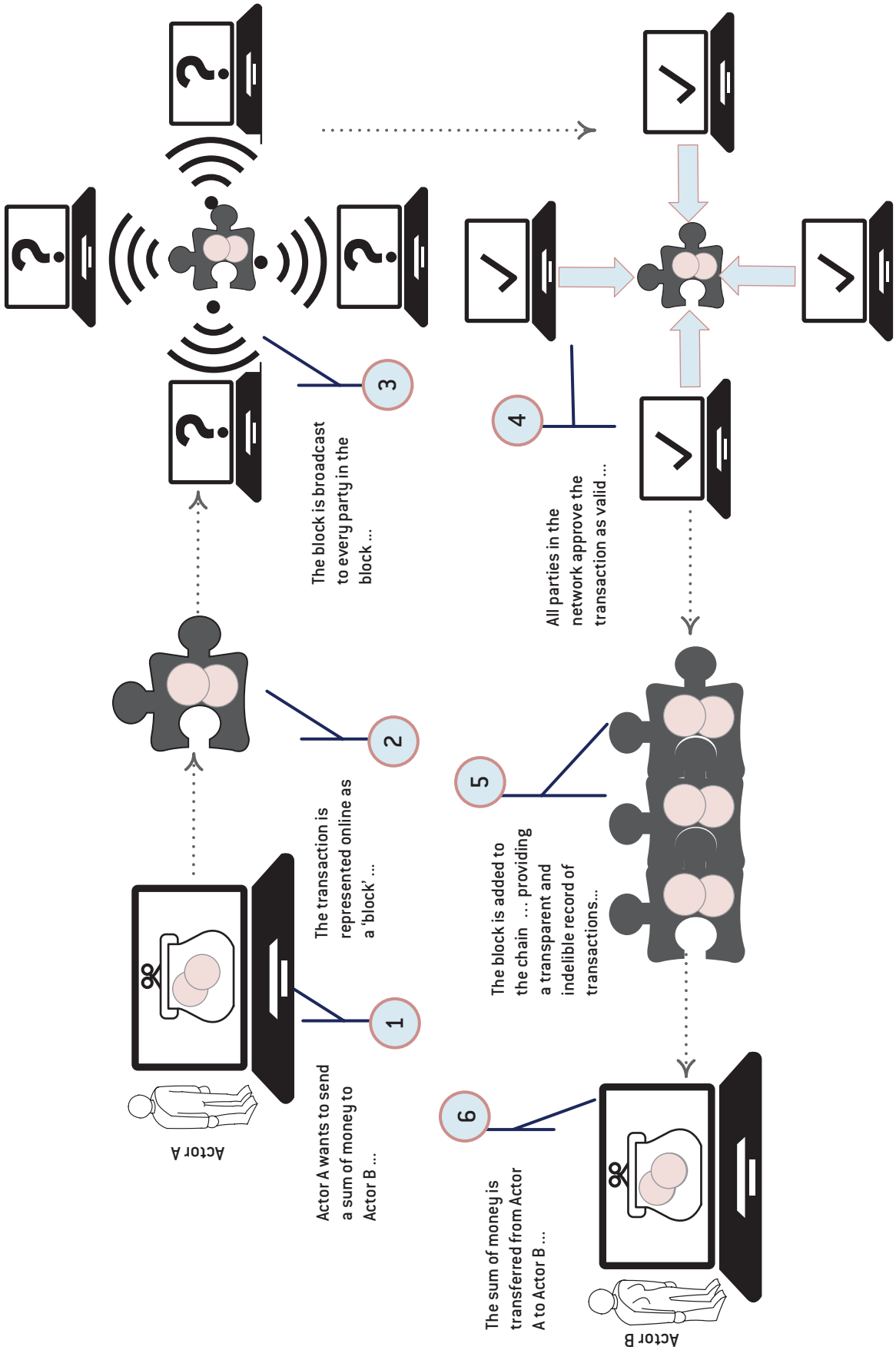


Figure 6.8 How Bitcoin works

CASE
continued…

But these digital signatures are also not stored in the blockchain. So the blockchain provides to Bitcoin some interesting properties. No central government banks are required to issue bitcoins. No financial intermediaries are required to manage monetary transactions using Bitcoin. The parties to economic transactions conducted in Bitcoin cannot be identified.

The blockchain as a technological infrastructure is not limited to Bitcoin. It is being proposed as a way of implementing distributed registries for different communicative purposes in the sense of supporting different types of coordinated activity. As a data structure, a registry is a list of things held as being important by some institution or group of institutions. Consider the nation-state as an institution. Such institutions maintain registries of events affecting people – births, deaths and marriages, for instance. They also maintain registries of relationships, such as land registries, which record which person owns which parcel of land or vehicle licencing registries which record which persons own which vehicles.

Within current practice, registries are maintained by registration authorities. If actors wish to undertake many activities they inherently engage with registries of various forms. An entry on such a registry either prescribes certain activities or proscribes certain activities. Hence, to be able to drive a car, you need to be recorded on a driver licence registry, while if you are on a sexual offenders register you are prevented from working in certain areas, such as with children or vulnerable adults. The blockchain has been proposed as a form of disintermediation (see Section 6.4.7) (removing intermediaries in the value network) in the sense that registration intermediaries may no longer be necessary for such domains of organisation.

RECAP

Economic systems are concerned with the production, distribution and consumption of value. Value is any 'thing' of worth to someone. In terms of systems of organisation value is traditionally thought of in terms of goods and services. The nature of value has and is impacted upon by the application of ICT through processes of digitisation – the way in which certain goods and services are turned into data. Digitisation affects not just coordination costs but also production costs. The costs associated with creating some value are production costs. The costs of coordinating the activity of multiple actors, such as in the exchange of goods and services within commerce or trade, is a coordination cost.

DID YOU KNOW?

Certain societies have functioned perfectly adequately without the concept of money. The Inka empire, for instance, managed the distribution of goods between many millions of its members without the need for money.

6.3 THE VALUE CHAIN

Value chain
A defined set of activities that deliver value to the customer.

As we have argued in previous chapters, the purpose of organisation is to produce or create value. Value is produced within value-creating systems. Michael Porter thinks value creation involves a chain of activities all focused on delivering value to the customer – what he calls the **value chain**. Operations management talks in the same way of the manufacturing or service organisation as a value stream – a set of internal activities that transform or add value.

6.3.1 Primary and secondary activities

Primary activity
Activities that constitute the core competencies of some organisation.

Secondary activity
Activities that are critical to supporting primary activities.

In terms of our conception of an organisation as a complex, adaptive system we can view the value chain as consisting of a series of core or primary activity systems that transform or add value. For Porter, primary activities include inbound logistics, operations, outbound logistics, marketing and sales, and aftersales service. Porter models his idea of the value chain on the typical manufacturing organisation. The primary activities will differ in other types of organisation, such as movie production.

Primary activity systems are supported through core back-end information systems and ICT systems. Hence, along with the flow of value through the value chain, there is a corresponding flow of data structures. The coordination of activity across the organisation is therefore reliant upon shared data such as sales, customers, stock and payments.

The value chain also includes a series of secondary activity systems that do not transform or add value directly but support the primary activity systems. The coordination of activity within secondary activities is typically enabled through front-end information systems and ICT – such as management-facing, employee-facing and supplier-facing information systems.

6.3.2 The movies value chain

CASE

We can think of making movies as an activity system or more likely a series of activity systems that create the eventual value of the movie itself. It is evident from this that the production and coordination costs associated with making movies have decreased with a digitally enabled value chain.

The conventional approach to making movies involves three key activity systems in sequence (Figure 6.9). Pre-production involves activities such as establishing production schedules, establishing budgets, obtaining shooting permits, hiring staff and purchasing equipment. Shooting involves the capture of pictures and audio onto storage media both on and off set. Post-production involves the editing of movie content, including adding effects and soundtrack to the movie.

ICT has reduced the coordination costs associated with pre-production, enabling dispersed resources to be managed effectively, sometimes across the globe. In terms of shooting, the cost of movie capture equipment has fallen drastically, and such equipment can now be taken to pretty much anywhere easily. At the time of writing, a movie has been captured simply by using an Apple iPhone. Finally, post-production costs have decreased as software for the editing of movies is readily available for low cost. Computer-generated imagery has also enabled the production of stunt scenes and special effects much more cheaply.

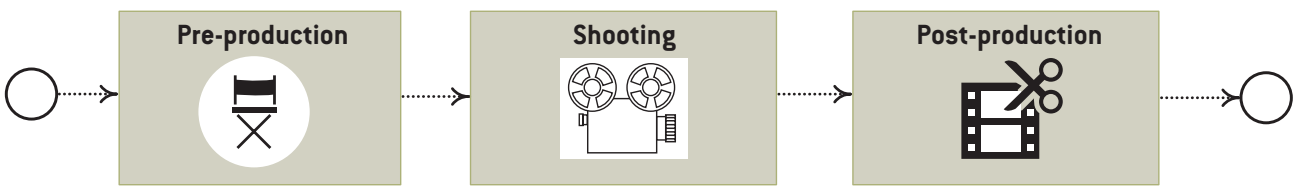


Figure 6.9 The movie value chain

RECAP

An organisation is a complex, adaptive system which we can view as a value chain consisting of a series of core or primary activity systems that transform or add value focused on delivering value to the customer. It also consists of a series of secondary activity systems that do not transform or add value directly but support the primary activity systems.

6.4 THE VALUE NETWORK

Value network
The network of actors within which an organisation sits and with which the organisation exchanges value.

The organisation as a value-creating system exists within a wider environment of competition and cooperation, which we refer to as the value network. We shall see in later chapters how much recent digital innovation has taken place in parts of this value network. The key parts of the value network are illustrated in Figure 6.10.

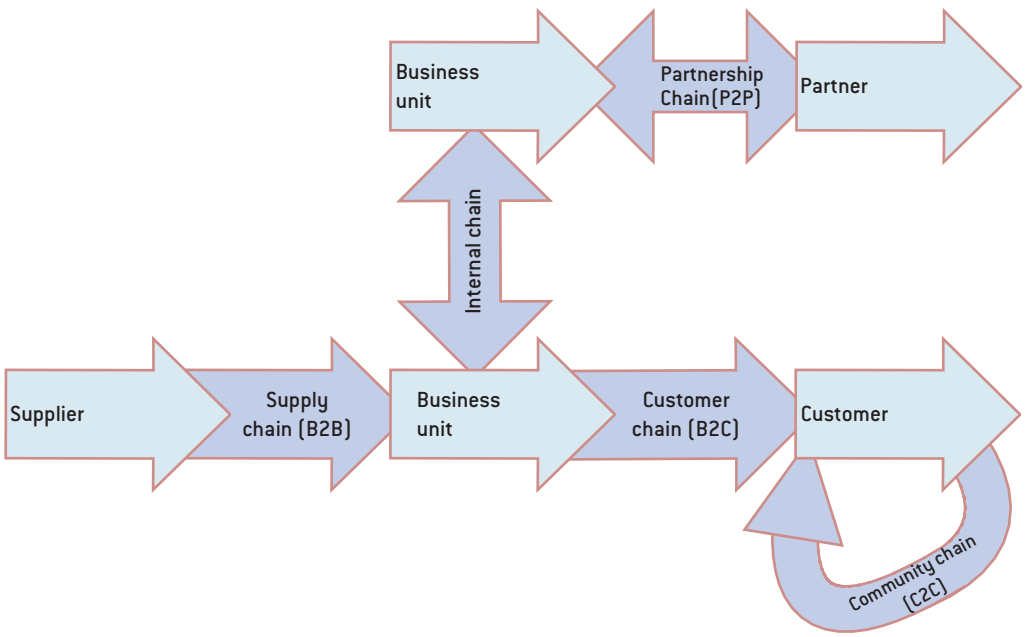


Figure 6.10 The value network

6.4.1 The customer chain

Customer chain
The set of activities that are involved in the delivery of value to the customer of the organisation.

The **customer chain** consists of a series of activity systems which provide customers with goods and/or services (Figure 6.11). The customer chain involves business-to-customer commerce; sometimes referred to as sell-side commerce. Value is rarely delivered directly to customers, but through intermediaries. The customer chain involves both local customers, perhaps in the same country, and global customers, situated around the world.

6.4.2 The supply chain

Supply chain
The set of activities an organisation takes in relation to its suppliers.

The **supply chain** consists of one or more activity systems involved with ensuring the effective and efficient supply of goods and/or services into the organisation from its suppliers (Figure 6.12). The supply chain involves business-to-business commerce; sometimes referred to as buy-side commerce. The supply chain is the mirror image of

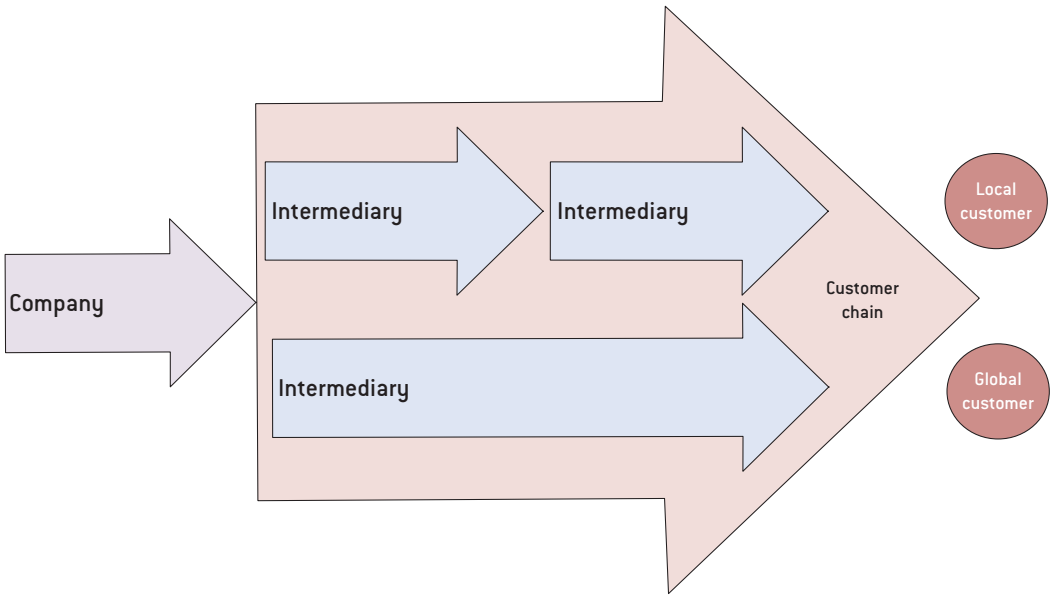


Figure 6.11 The customer chain

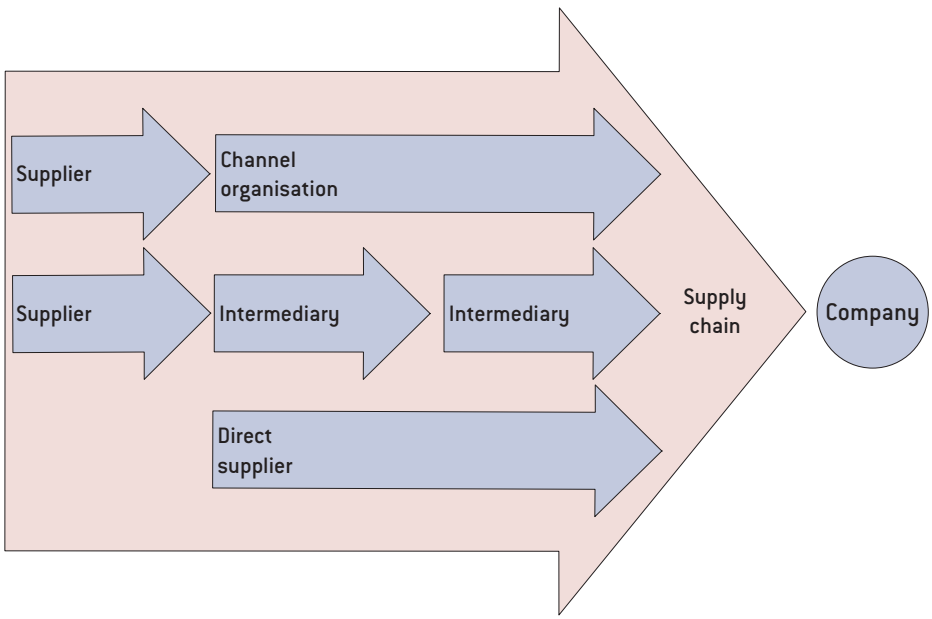


Figure 6.12 The supply chain

the customer chain – an organisation consumes value from its suppliers. The supply chain is likely to consist of both direct suppliers and intermediary organisations such as distributors and dealers.

6.4.3 The partnership chain

Partnership chain
The chain of activities conducted with partners in delivering value to a common customer.

The **partnership chain** involves activity systems performed jointly with partner organisations in relation to a common customer. The partnership chain involves business-to-business commerce, but through cooperation rather than competition. Hotel chains, car-hire companies and airlines frequently form partnership chains and use shared data about a common customer to help coordinate their activity.

6.4.4 The community chain

Community chain
The chain of social networks within which the organisation sits.

The **community chain** consists of activity systems undertaken by a network of individual customers of the organisation and which influence their relationship with the organisation. As we shall see, communities are best viewed as networks of social actors – social networks. The growth of online infrastructure to facilitate social networks is a significant force in the community chain. Facebook is a case in point.

6.4.5 Change in the value network

Figure 6.13 illustrates some high-level value networks that have been appropriate to different sectors of the economy for many decades. But each of these value networks has been 'disrupted' through ICT application. Automobiles can now be purchased direct from manufacturers from their websites. Online grocery has grown substantially in countries such as the UK, particularly in major cities. Most consumers in the UK now purchase their insurance online rather than through high-street brokers.

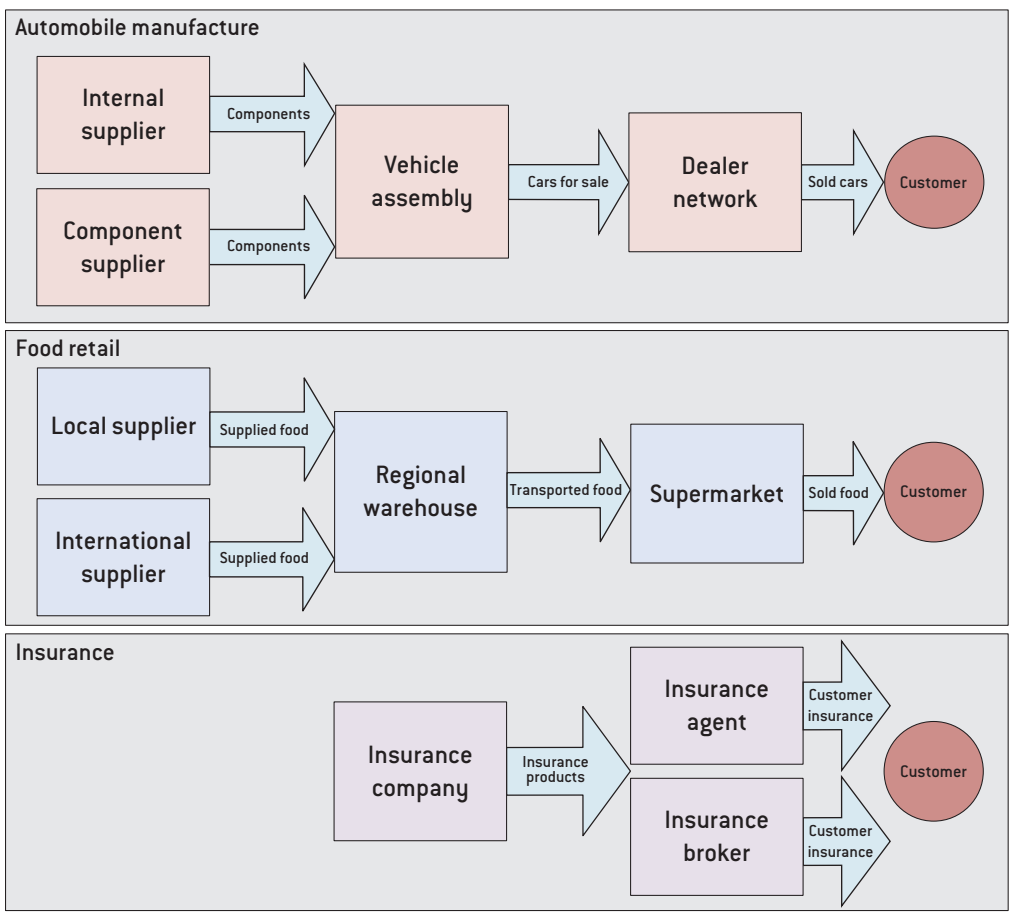


Figure 6.13 Three value networks

REFLECT

How relevant is the idea of a value chain for understanding the dynamics of public or voluntary sector organisations? What would constitute the supply and customer chains of a higher education institution such as a university? Would you say there is any disintermediation in the higher education sector?

6.4.6 The movie value network

CASE

ICT has impacted upon all elements of the movie value network (Figure 6.14). Movie production has been traditionally dominated by large companies based in the United States. The declining costs of movie production have enabled smaller production companies to thrive. They have also enabled regional cinema to survive in certain parts of the world such as in Scandinavia and India. Distribution to cinemas worldwide used to involve the transport of bulky physical film. The introduction of digital projection equipment into cinemas means that movie files can be downloaded though electronic distribution. A large back catalogue is also opened up for distribution. The only way to view a movie in the past was through the cinema chains or more recently on DVD. Consumers can now view a movie pretty much anywhere and at any time using various access devices.

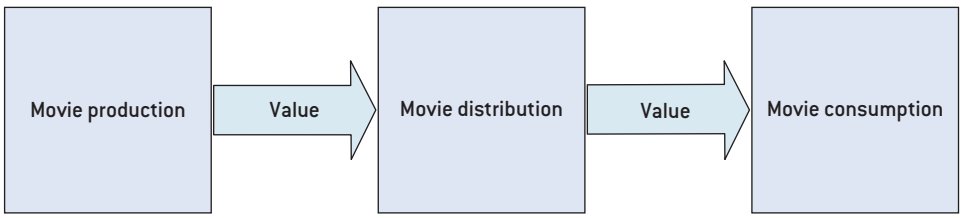


Figure 6.14 The movie value network

6.4.7 Disintermediation and reintermediation in the value network

Disintermediation
The process by which intermediaries are removed from parts of the value network.

Reintermediation
The process in electronic markets of new intermediaries developing between buyers and sellers.

One way in which the value network is impacted by the application of ICT, is through removal of intermediaries in key parts of the value network – a process known as disintermediation (Figure 6.15). When ICT first started to be introduced in parts of the customer chain then analysts thought that mass disintermediation would occur. In practice, both **disintermediation** and **reintermediation** (the introduction of new intermediaries) has happened through ICT application within areas such as commerce.

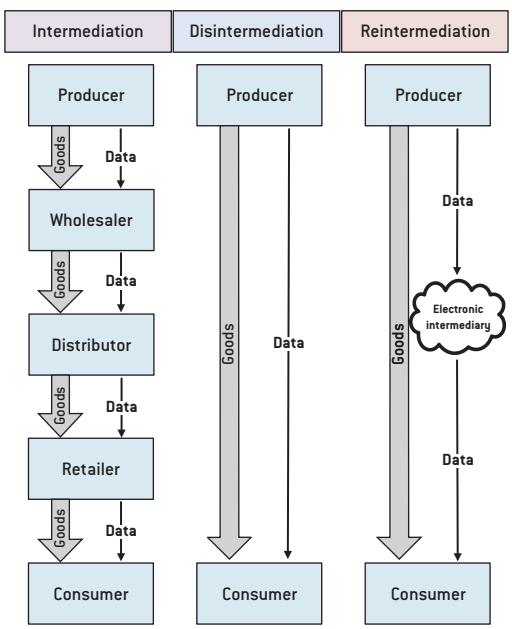


Figure 6.15 Intermediation, disintermediation and reintermediation

Within food retail a key example of disintermediation is the growth of small, specialist food producers who sell their products directly to customers through their websites. A key example of reintermediation is the growth in online comparison websites in areas such as insurance, loans, and electricity and gas supply.

6.4.8 Disintermediation in the movie industry

CASE

Disintermediation and reintermediation has been a significant force within the movie customer chain (Figure 6.16). Movies can now be consumed through a variety of different access channels, provided by a range of different intermediaries in the customer chain. Traditionally, and to ensure maximum sales, movies were released in a strict sequence to various access channels – first to cinemas, then to DVD and finally to streaming. But as consumption patterns have changed certain new entrants in the market have reversed this sequence, releasing first to streaming, then to DVD and potentially to cinema at a later date.

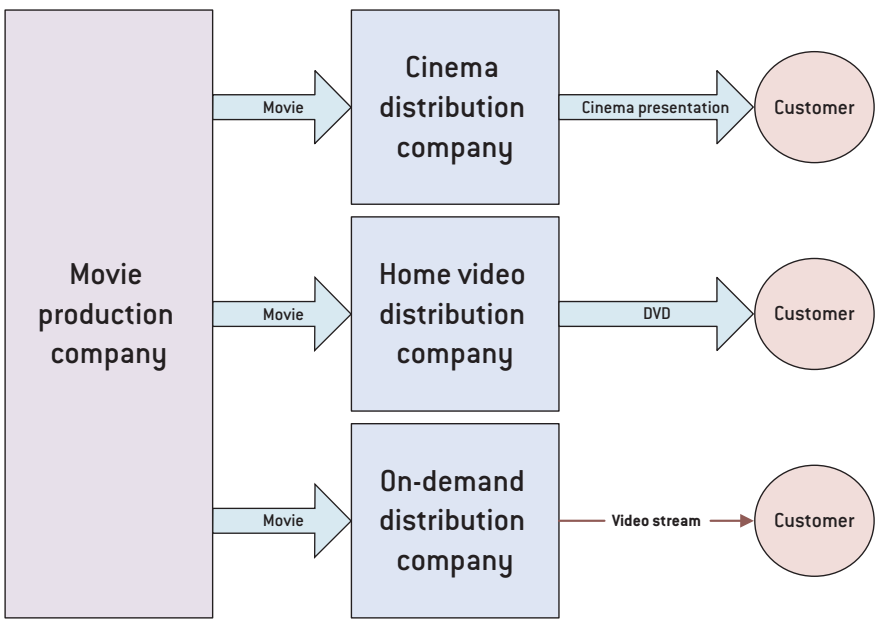


Figure 6.16 Disintermediation in the movie customer chain

RECAP

An organisation also interacts with its environment consisting of a wider value network, consisting of a customer chain, supply chain, partnership chain and community chain. The application of ICT within parts of the value network has facilitated both processes of disintermediation and reintermediation. The organisation as a value-creating system exists within a wider environment of competition and cooperation – the value network.

6.5 DIGITAL SOCIETY

ICT is of course not just used for economic matters. The sociologist Norbert Elias published a fascinating and accessible book some time ago (1978) entitled, *What is sociology*? As part of his answer to this question he considered the related question of *What is society?* and came fundamentally to the conclusion that society is much more

than a mere aggregation or collection of individual actors. Instead, society is a system consisting of a multitude of individual actors, relationships and actions. Such actors through their relationships and actions produce and reproduce patterns (Elias refers to them as figurations), which in turn serve to constitute society. In such terms, society is considered an emergent phenomenon of a complex system of activity. This, of course, sounds very similar to the conception of organisation we have been proposing throughout this book.

Many areas of life are now digitally enabled for individuals and citizens of the modern nation-state. Education and learning is enabled through ICT infrastructure. People rely upon social media for their understanding of what is happening in the world. People pay taxes of various forms online. They also access many state benefits through digital channels. Effective healthcare increasingly relies upon data stored about patients. Deployment of police resources increasingly relies upon data gathered about criminal activity.

In this section we look at some crucial societal issues and the positioning of ICT within current debates. In the following section we look at the related role that ICT plays within modern political systems.

6.5.1 Social networks

In earlier sections of this chapter we considered economic systems as comprised of various activity systems involved with the production, distribution and consumption of value through value chains and value networks. So what makes social systems different from economic systems?

Social network
A network of people joined together with social relations.

One way of thinking about social systems as compared to economic systems is in terms of **social networks**. A social network has nodes which are actors, and the relationships are social bonds of various kinds such as kinship (family) and friendship. Within Figure 6.17 three different social networks are illustrated. Six social actors are labelled A through F and friendship relations are plotted, indicating that A is a friend of B and vice versa. What varies between network 1 and network 3 is the number of relationships evident in each network – its density. The density of a social network refers to the number of links in the network. Hence network 2 has a greater density than network 1, and network 3 has more density than network 2. The density of a social network is one determinant of the value of the network to its members – something which some people refer to as *social capital* and such social capital is generated through social networks, bound together with phatic communication.

6.5.2 Phatic communication

We mentioned in Chapter 3 that we are interested primarily in this book in instrumental communication – communication that gets things done. This is the essence of communication evident in information systems and is the basis of the five types of purpose important to instrumental communication. Social networks, like economic networks of exchange can be a source for instrumental communication, such as directing people to view some indicated content or making commitments to attend some political protest. However, much of the communication conducted within social networks serves a much more social function and is referred to as **phatic communication**. Commonly referred to as 'small talk' this form of communication helps to bind people together in social networks. In other words, phatic communication has more of a social function than an informative function.

Phatic communication
Communication used to bind people together in social networks.

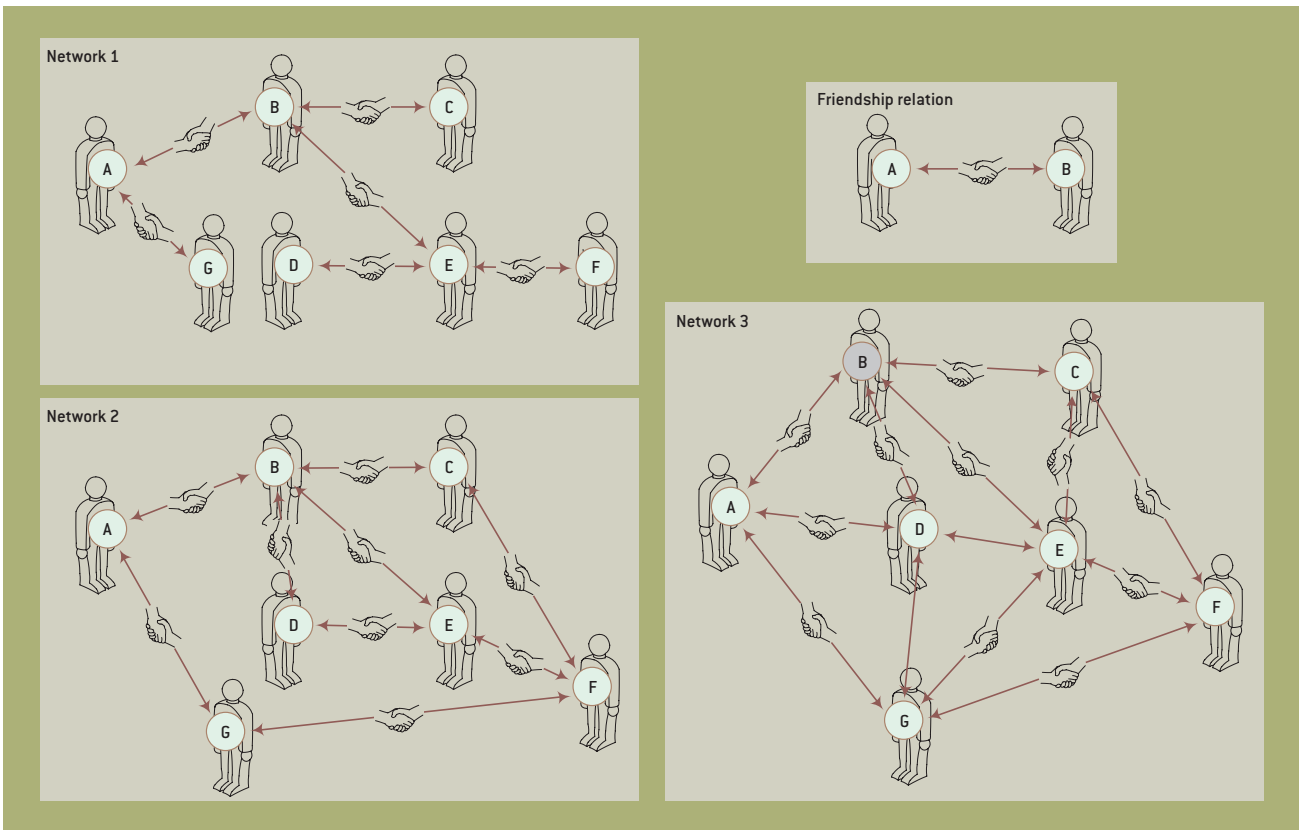


Figure 6.17 Social networks and density

REFLECT

[How are you?] as a question along with an appropriate response such as [I'm fine thank you, and you?] is an example of phatic communication. Can you think of any other examples of conversation which does not achieve anything except to make people feel good in each other's company and sustains personal relationships?

6.5.3 Social capital

Social capital
A feature of social networks that facilitates coordination and cooperation among actors.

The US sociologist Robert Putnam (2000) wrote an influential book which described what he referred to as the decline in social capital among the population of the mid-West in the United States. **Social capital** is the set of resources available to individuals that participate in dense networks of social relationships. One of the most important of such resources is *reciprocity*, the notion that if you do something for me then you can call on me to do something for you in the future. Note that this is different from economic exchange in which I will give you something or do something for you only in return for some financial capital.

Another important resource of social capital is *trust*. Generally speaking, you are more likely to trust your relatives or friends rather than strangers. This also means that you are more likely to believe what other members of your social network say about something than what strangers say. But trust is also transitive, meaning that if you (C) trust what member B tells you and B trusts what member A tells him then you are likely to trust what member A says (Figure 6.18). As we shall see, this is a critical reason why marketing people are so interested in online social networks.

But social capital is not evenly distributed among social networks. It varies depending upon the size, density and types of links present in the parts of the wider social network.

DID YOU KNOW?

In the classic movie *Witness* we see evidence of social capital among the Amish community in the United States. In a key scene from the movie, members of this community come together and raise a wooden barn in one day for some newly-weds. The people conducting this activity receive no monetary payment for their work. Instead, they gain social capital – the commitment that the newly-weds will contribute to future activity involving the community in some way in the future.

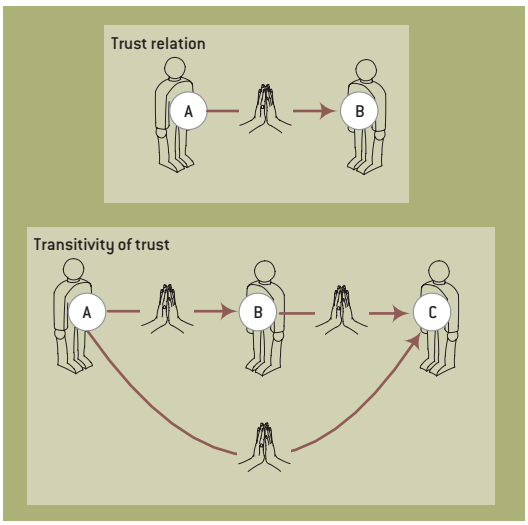


Figure 6.18 Transitivity of trust

6.5.4 The network effect

Metcalfe's law
A 'law' which states that the worth of a communication network to a user is proportional to the square of the number of users or members of the network.

The usefulness of a social network as a resource for its members is a function of something known as **Metcalfe's law**, sometimes referred to as the *network effect*. Robert Metcalfe, as a communication engineer, originally proposed this law in relation to communication networks. The law states that the worth of a communication network to a user is proportional to the square of the number of users or members of the network. We might argue that the same principle applies in relation to a social network. What this is suggesting is that the worth of participating in a network for a given member grows exponentially with the number of the members of the network. Another way of putting this is that the denser the social network then the more social capital is potentially available to its members.

6.5.5 Strong and weak links

Strong link
A relationship between two actors that are in regular contact with each other.

Weak link
A relationship between two actors that are in irregular contact.

However, the usefulness of a social network does not directly correspond to the number of its members or the density of its links. This is because there are usually differences in the 'quality' of links in a social network (Granovetter, 1973). **Strong links** exist between close friends and family because these people are regularly in touch with one another. **Weak links** exist between acquaintances, people who know of one another but do not regularly communicate with each other. Strong links and weak links are both important but serve different purposes within social networks. And this helps explain some of the different ways in which social media is used within modern society (Figure 6.19).

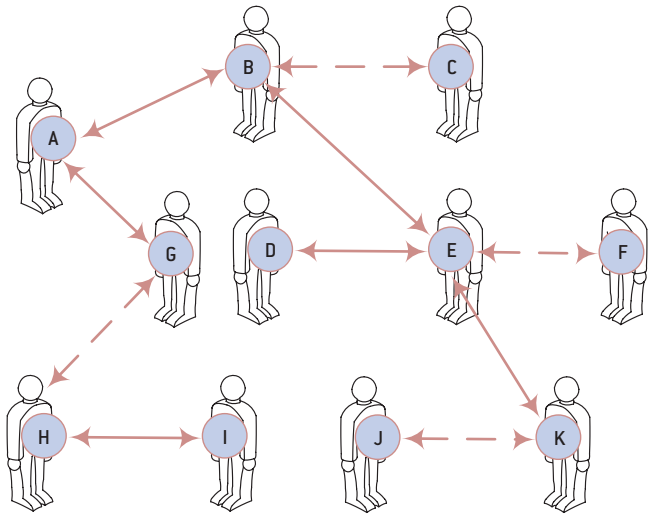


Figure 6.19 Strong and weak links

6.5.6 Social media

Social media
The attempt to build and support social networks through the application of ICT.

Social media (see Chapter 9) is the attempt to build and support social networks through the application of ICT. Social media is particularly used as a means of creating and sharing digital content, but it is also now used as an infrastructure for communication, particularly phatic communication, through various forms of electronic message. This helps explain why organisations from the private sector to the voluntary sector are interested in social networks and the social capital they generate. It also helps explain why social media, which is founded on the idea of social networks, is such a fruitful bedrock for much recent organisation activity.

You would tend to infer both from the network effect and the distinction between strong and weak links that social media is important to maintaining strong links – particularly as more and more people are geographically dispersed and use social media to communicate on a regular basis with each other. However, the anthropologist Robin Dunbar reckons that humans have a cognitive limit to the number of people with whom one can maintain stable social relationships – strong links. This has led some to propose that the number of strong links in someone's social network cannot exceed 150 – so-called Dunbar's number. This suggests an upper limit to the density of one's core social network – both online and offline.

But social media may also be important to developing weak links as well, because weak links are important to social and economic opportunities. Interestingly, the higher you climb the career ladder the more important weak links become. This explains why high-ranking business people spend so much of their time 'networking'; because they know that job opportunities are not usually communicated via strong links but through weak links – by acquaintances.

REFLECT

Try to draw the core of your own social network in a similar way to the diagrams in Figure 6.18 or 6.19. Does Dunbar's number hold for your social network?

6.5.7 Digital exclusion

Digital exclusion
The way in which certain sectors in society are excluded from access to digital infrastructure.

The very notion of the digital society relies on a presumption that all members of a particular society have access to ICT infrastructure. But this should not be taken as a given in many countries around the world. To engage with the digital economy and the digital society, certain preconditions must be in place for all individual actors within the economy and society – awareness, interest, access, skills, use, impact (Figure 6.20). People must be aware of and have an interest in using ICT. There is no such thing as free access to ICT infrastructure. Some groups may not be able to afford a suitable access device and Internet connection. Acquiring the requisite skills to use various forms of ICT is a costly and continuing exercise for individuals. Some people may worry about the impact of using ICT, such as identity theft and fraud. Finally, the use of ICT must be 'domesticated' – in the sense of being part of the habits or conventions that people follow in their everyday lives.

Different groups of actors in society may not meet one or more of the preconditions essential for engaging with the digital society and economy and hence suffer a form of social exclusion known as digital exclusion. Excluded groups may include the elderly, the disabled, the infirm and the poor.

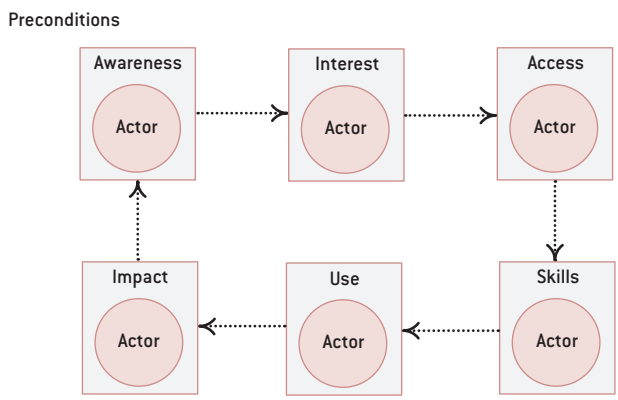


Figure 6.20 Preconditions for digital inclusion

Digital exclusion is particularly stark if you compare different regions of the world (Figure 6.21). In North America 88% of the population are digitally enabled in some form by having access to the Internet at the time of writing. In the continent of Africa only 28% have access to the Internet. This is important because the very ideas of both the digital economy and digital society rely upon the entire population of nation-states having access to and using Internet applications on a regular basis.

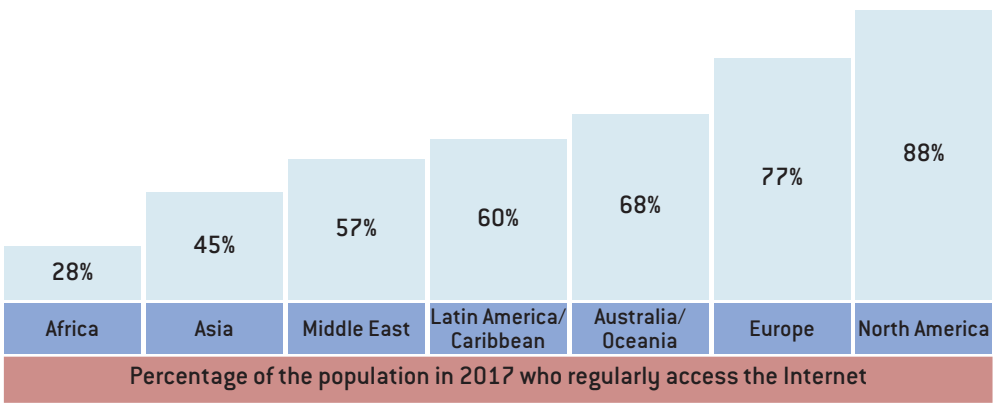


Figure 6.21 Digital exclusion across the globe

DID YOU KNOW?

The film, *I, Daniel Blake* dramatises the effects of aspects of digital exclusion. The main character is a middle-aged, unemployed carpenter who suffers from a serious heart condition. Daniel Blake has never used a computer and is seriously disadvantaged because his attempts to access state benefits require a base level of computer literacy which he does not have.

6.5.8 Data privacy and protection

Data privacy
Ensuring the privacy of personal data.

Data protection
The activity of ensuring data privacy.

The digital society is particularly evident in the growth in personal data held on ICT systems. As more and more of individual activity is reliant upon access to ICT infrastructure, more and more of what it means to be members of society is held in data structures about members. The rise in so-called personal data and the management of personal identity through such data is therefore of crucial concern. The key question is who owns these personal data and who is responsible for them? A related question is how should these personal data be protected and how should the privacy of such data be ensured?

Whenever you do something online, data are captured about your activity. Of critical importance is the metadata associated with any electronic communication. Metadata is data about data. Whenever a data structure is created as a message or a record, metadata is also created and captured. For instance, the metadata associated with a telephone call includes who is called, who is calling, the date and time of the call, the duration of the call, and, if you use a mobile phone, the location from where the call is made.

Countries such as the UK, Sweden and Eire have had a certain level of data protection in place since the late 1980s. This legislation typically establishes certain principles for using personal data by organisations, such as the following: that data should be collected for a specific and declared purpose by organisations; the collection and processing of data collected about individuals should be relevant to the declared purpose; organisations should maintain accurate and current data on people; personal data should be identifiable only for a period and for the purposes for which the data are declared; finally, organisations must ensure that personal data are secured from unauthorised access.

The UK's data protection laws have been similar to, but also different from, the data protection laws operated in the 27 other countries of the EU. As of May 2018, a set of common data protection laws became applicable for all organisations operating within the European Union, wherever they are based. This is known as the General Data Protection Regulation (GDPR) and enshrines the notion that protection of personal data is now a fundamental right of all citizens of the European Union.

RECAP

One way of thinking about social systems as compared to economic systems is in terms of social networks. A social has nodes which are actors and the relationships are social bonds of various kinds such as kinship (family) and friendship. Social networks provide *social capital* for their members through both strong and weak links. Access to ICT infrastructure such as social media is not equally distributed across the population. There is also much concern in relation to the privacy and protection concerns associated with personal data.

6.6 DIGITAL POLITY

Digital polity
The interaction of ICT with political systems.

There is an instance of the embeddedness of ICT that is occurring somewhat 'under the radar'. ICT is impacting upon the ways in which government is enacted and democracy is realised. This we refer to as the **digital polity**. In terms of government,

various agencies of government now frequently share data through ICT infrastructure. Government agencies procure goods and services from business by electronic means. Many of the services provided by government to its citizenry are now 'digital by default'. In terms of democracy, our means of selecting our political representatives and voting for them is changing through ICT. Social media is a major means by which political protest is organised. Many of our political opinions are 'informed' nowadays more by social than by broadcast media. We consider the issue of electronic or digital government in more detail in Chapter 8. Here, we focus upon some key issues of digital democracy.

6.6.1 Digital democracy

Digital democracy
The use of ICT to support informed deliberation among citizens and help them to participate in decision-making.

Definitions of electronic government (eGovernment) should include conceptions of electronic or **digital democracy** (eDemocracy) – the use of ICT to support informed deliberation among citizens and help them to participate in decision-making. Hence eDemocracy can be seen to be a component part of eGovernment along with eAdministration – the use of ICT to enable the internal and external activities of government.

In narrow terms, eDemocracy can be used to refer solely to the enablement of democratic processes between members of some political grouping and their governmental representatives. This is clearly a form of external eDemocracy. For instance, government representatives may establish their own websites and communicate with citizens by electronic means such as email or tweets.

On the other hand, eDemocracy can serve to refer to the way in which ICT can be used to improve internal democratic processes within government. This is a form of internal eDemocracy. For example, the Welsh Assembly Senedd (debating chamber) is set up in a radical, different arrangement from the debating chamber employed in the Westminster parliament. Each Assembly member is given a permanent kiosk within the chamber, where they can not only listen to the ongoing live debate but also access internal ICT systems and the wider Internet.

There is also the notion of local eDemocracy. Local eDemocracy occurs where local groups use ICT to create democratic forms, forums and processes to facilitate political interaction within the community itself. One key example here is the way in which social media were used to organise political protest in support of a number of uprisings such as those in Libya and Egypt.

DID YOU KNOW?

The right to free speech is seen by many as a fundamental principle of any democratic system. This is the principle that any actor within some democratic system has a right to express any opinions without censorship or restraint. But this principle has clashed with the way in which the Web and the Internet allow actors worldwide to express extreme views on various issues, causing governments to react by imposing certain criminal offences for the expression of such views on any communication channels.

6.6.2 Voting as an activity system of democracy

CASE

In many respects our modern democratic systems have not kept apace with the infrastructure of the digital age. The way in which we exercise our democratic right to vote is a key case in point. In this case we consider the UK as a modern parliamentary democracy and what voting currently involves as an activity system. We then have a look at how digital innovation might be applicable to this activity system.

CASE
continued…

The UK is a parliamentary democracy and hence is reliant upon an effective electoral system. General elections are held after parliament has been dissolved either by royal proclamation or because the maximum term of office of five years for a government has been reached. The decision as to when a general election is to be held is taken by the Prime Minister.

For parliamentary elections to the Westminster parliament the UK is divided into 650 constituencies. Candidates stand for election in each constituency and each eligible voter in the constituency uses a single polling card to cast a single ballot for one candidate.

The UK employs a first-past-the-post system. This means that the candidate with the most ballots cast in each constituency is elected and the political party with most elected members of parliament generally forms the next government of the country.

Figure 6.22 provides a high-level visualisation of this system of action. The key inputs into the electoral system are ballot polling cards and ballot papers provided by the key agents, voters. The key outputs are a set of election results provided for each constituency. The key control process is one of electoral monitoring which establishes guidance on expected electoral practice and monitors the actual election to determine any deviation from such practice. The environment of the electoral system is the overall political system of the UK.

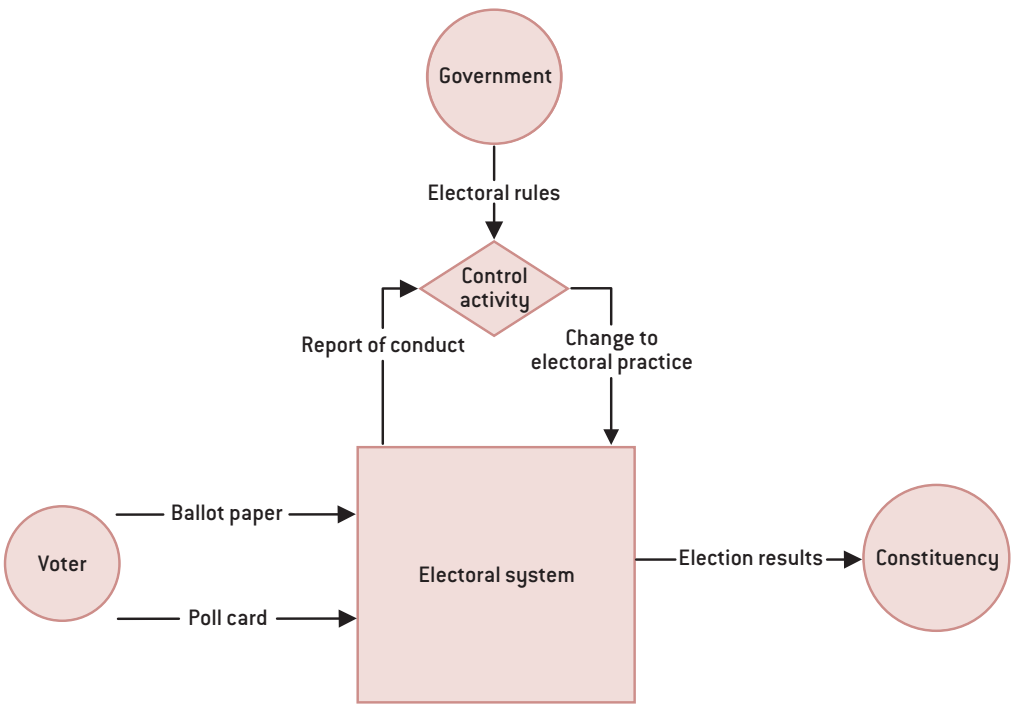


Figure 6.22 Electoral activity considered as a system

The central purpose of this system of activity is to enable citizens of the UK to vote for a person (in the case of elections) or for some policy option (in the case of referenda). Certain input activities feed into this central transformation and certain output activities lead from it. In practice, the activity system consists of a larger range of coordinated activities as illustrated in Figure 6.23.

Candidates and voters need to be registered. Candidates in a UK general election must be over 21 and must register for election for a given constituency. Voter registration

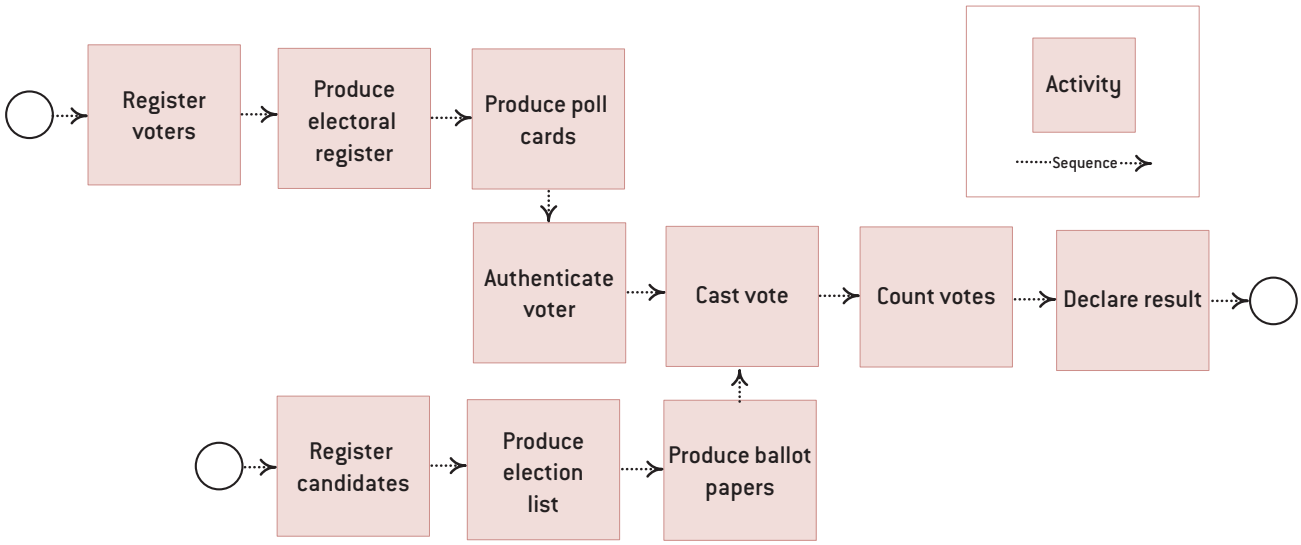


Figure 6.23 The activity system of voting

CASE
continued…

used to be done only at set times during the year. Nowadays a person can register to vote at any time prior to the conduct of an election. To vote in a UK general election a person must be a citizen of the UK, be over the age of 18 and not excluded on grounds such as being detained in a psychiatric hospital or a member of the House of Lords. Normally voters would be expected to attend in person at a specified polling booth to vote. If they are able to supply a valid reason a person may be entitled to appoint a proxy (some other person) to attend for them. Postal voting can also be used by voters unable to attend polling stations and in 2001 some 1.4 million people out of a total electorate of 44 million voted in this manner. This more than doubled in the 2010 general election.

An electoral list needs to be produced and ballot cards issued to voters. Each Local Authority in the UK is tasked with maintaining an electoral register. From this register each Authority needs to produce an electoral list for each of the designated polling stations in its area. Electors receive various items of documentation through the post, the main item being a polling card detailing the name and address of the voter plus the date of the election and address of the designated polling station. Interestingly the polling card also contains a serial number, which can be used to track voters against electoral lists.

Voters need to be authenticated and to cast their votes. Voters typically turn up at their indicated polling station. They produce their polling card for inspection and this is checked against the electoral list. If the elector is correctly authenticated in this manner, he/she is handed a ballot paper on which the list of candidates for the constituency is listed. To indicate that it has been issued appropriately a member of polling staff stamps each ballot paper. The elector enters a polling booth and chooses one entry against the list of candidates by placing an 'X' in an appropriate box. The ballot paper is then folded and posted in a sealed ballot box.

Votes are counted and results declared. Most elections in the UK are held during a weekday (typically a Thursday) and voters are only allowed to vote during the set period of 0700 to 2200 hours on that day. At the end of the voting period all ballot boxes are collected and taken to a central counting centre. A team of workers then count the ballots by hand into piles of 50 by candidate. Recounts are normally only ordered if candidate totals are close. Then only the bundles are normally counted unless candidates request that bundles be checked.

Voting must be validated and results declared. Before announcing a result, a constituency officer must confirm a true and proper election. To ensure this, the total number of

CASE
continued…

persons crossed off against the electoral list is usually cross-checked against the total number of ballots cast for each ballot box/polling station. Assuming satisfactory validation, results are announced at each constituency counting centre and communicated to national electoral headquarters.

There are a number of issues with this activity system which make it a problem situation (see Section 10.3) for some. It is possible to categorise these problems as issues of performance (see Section 2.5.4): of efficacy, efficiency and effectiveness.

If we take the key transformation of the electoral system to be the processing of votes, a number of problems exist with the efficacy of the current system. Ensuring that a person is registered on one and only one register is a difficult process given social mobility. Ensuring that all persons are registered is even more difficult. It is estimated that as much as 9% of the UK population (3 million people) were not registered for the 2001 election. Frequently people are allowed to vote without an appropriate polling card. Supplying a valid name and address is frequently used as the only form of authentication. There is hence potential for fraudulent activity. The requirement to visit a polling station during a set period frequently disadvantages certain groups such as the elderly, disabled and shift workers.

If we take the efficiency to be concerned with the balance of inputs to outputs, then the efficiency of the system can be seen to be problematic in a number of ways. Currently voting only occurs on a weekdays between 0700 and 2200. This can lead to queuing at peak periods at polling booths. During the 2010 election a number of people who queued to vote were denied their vote because the polling booths closed at the scheduled 2200. Because of the manual nature of processing it can also take an inordinate time to process votes in a general election – 36 hours is typical. Spoiled papers are a regular occurrence – 0.26% of papers in the 2001 election were spoiled. Such errors can be due to lack of validation at point of entry. Errors are also frequent in the processing of votes leading to a need for recounts. The current electoral system involves employing many staff in polling booths and counting centres. The estimated cost of the 1997 general election was £52 million, which represents £1.19 for each elector. Such costs mean that polling of citizen opinion is not normally conducted outside of periodical elections.

If we take the super system for the electoral process as being representative democracy, then a number of problems exist with the effectiveness of the current system. Generally, there is a declining trend of citizen participation in the electoral process. Turnout in the 2001 UK general election was 59%, a fall of 12% on the 1997 figure and the lowest level of participation since 1918. Approximately 60% of 18–24-year-olds did not vote in the 2001 election. Throughout Western Europe turnouts at elections have been declining. The current time-consuming and costly nature of the electoral process makes it difficult to hold referenda on various important issues on a regular basis. This makes it difficult to increase levels of participation in democracy between elections. The UK is one of the most ICT-enabled of Western societies. In this context, in many people's eyes the manual nature of the current electoral process appears arcane.

6.6.3 Digital voting

CASE

There are clearly many different ways digital innovation might be used in the redesign of this critical system of democracy. Figure 6.24 illustrates some of the possibilities. The development of a voter registration site together with a national rather than local electoral register would make it easier for citizens to register their change of constituency when they move. Providing identity tokens such as usernames and passwords could provide a stronger means of authentication prior to voting than the current polling card and could be

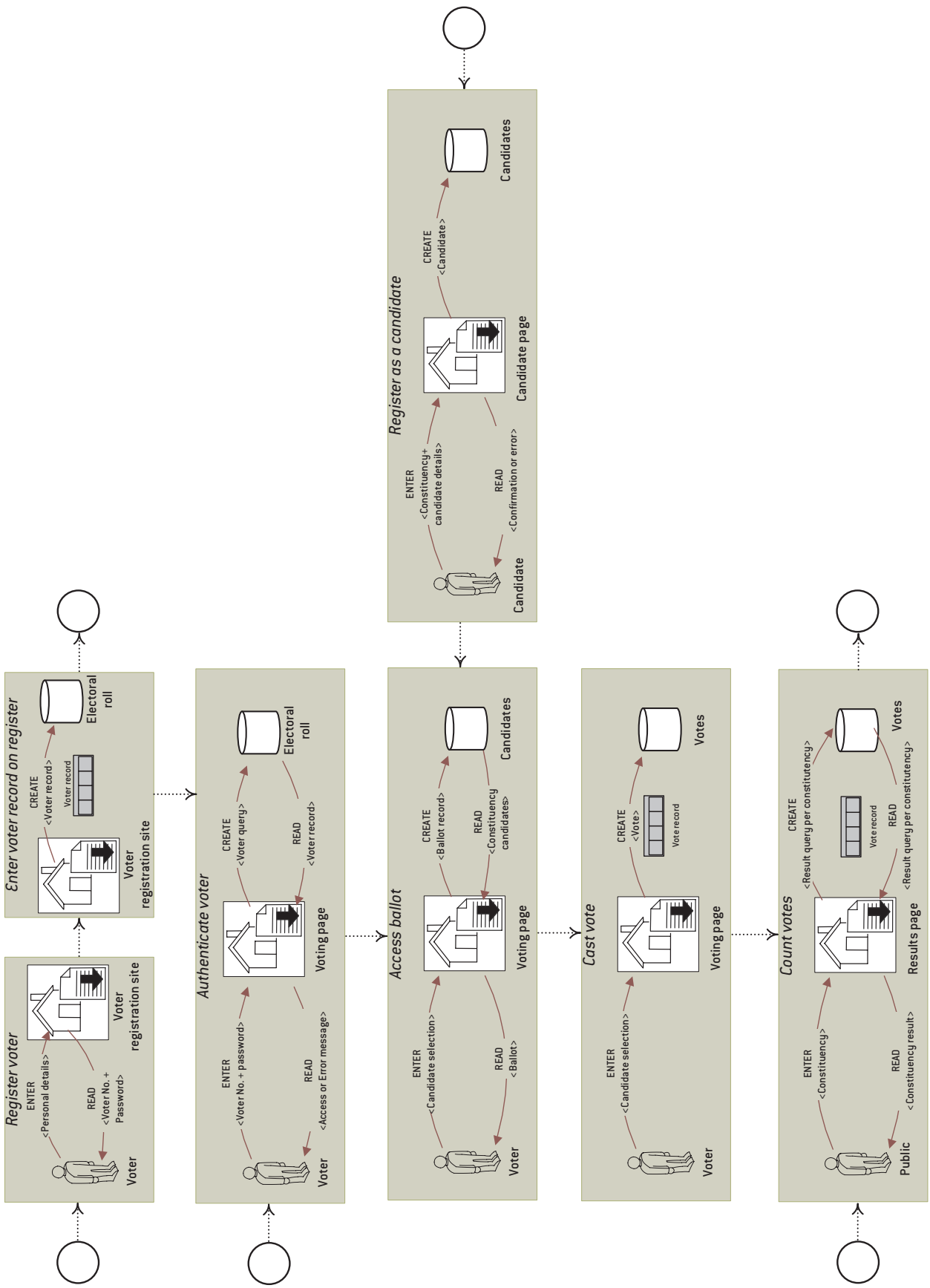


Figure 6.24 Some digital innovation as applied to the problem situation of voting

CASE
continued…

used to prevent electoral fraud. Voting could potentially take place at any time and in any place prior to an election deadline. Counting of ballots cast could be achieved in a matter of minutes rather than many hours. Once the infrastructure is built and in place then the cost of running an election or referenda would be minimal.

Of course, any digital innovation must be assessed in terms of whether the advantages of such change outweigh possible disadvantages of change. Running electoral voting as digital by default (see Section 8.6.5) would not be feasible in a country such as the UK because digitally excluded voters would have to be given the opportunity to vote by other non-digital means. People worry about hackers (perhaps employed by foreign governments) gaining access to such a system and potentially influencing elections. Such a system makes it easier for government to potentially know how their citizens have voted, making surveillance and control of their citizenry easier. A considerable upfront investment in technical infrastructure is needed to get electronic voting established.

Some countries, such as Estonia, have already introduced a full electronic voting system. The task of building and using such infrastructure is made easier by the existence of a national identity register in which details of each Estonian citizen are held centrally.

6.7 CONCLUSION

This chapter has introduced the concept of value, its production and its distribution, and considered organisations as value-creating systems that interact with a wider value network.

The primary environment of any commercial organisation is the economy, which can be considered a system for coordinating the production, distribution and consumption of value. Value traditionally comes in two forms: goods and services, which can be seen as the end points of activity systems performed in business organisations.

A crucial point about the modern economy is that value can be digital or non-digital. Whereas non-digital value has a physical form, digital value is amenable to representation as data. The flow of both digital and non-digital goods and services has a corresponding flow of data or transactions that record a coherent unit of activity within economic exchange.

Activity between economic actors is typically controlled in one of three ways: hierarchies, markets or networks. Markets are systems of competition, while managerial hierarchies are systems of cooperation. More recently, a third form of economic control has been proposed. Networks are intermediate forms of economic control in which both cooperation and competition are evident.

It is convenient to label the activity systems of the typical business as the internal value chain and consisting of a defined set of primary and secondary activities. But two other chains of value are also seen as critical to economic activity: the supply chain and the customer chain. These three value chains overlap with another frequently ignored chain of value of increasing significance to organisations: the community chain, founded on social networks of individuals which generates social capital.

The concepts of the internal value chain and the wider value network provide the business analyst with ways of considering potential changes to business systems. The next chapter uses the material in this chapter as a platform to consider the rise of digital business – electronic business and electronic commerce. Various forms of digital innovation are defined in terms of the value chain and the value network, and we consider the place of technological innovation in this mix. The role of ICT in reducing transaction or coordination costs is one crucial aspect of business change.

6.8 REVIEW TEST

6.1 A digital good is …

Select the statement that best applies by placing an X in the box.

- [ ] … a good amenable to digitisation … to be turned into data
- [ ] … a component part of an ICT system
- [ ] … something believed to be worthy by technologists

1 mark

6.2 A _____ cost is a cost associated with coordinating activity.

Fill in the blank term below.

1 mark

6.3 A production cost is a cost associated with the creation of value.

True or false? (Select only one by placing an X in the box)

- [ ] True
- [ ] False

1 mark

6.4 Match the most appropriate definition to the relevant part of the value network

Match the part of the value network with the appropriate definition by placing the number next to the letter.

Customer chain (A)	Relationships and activities performed between fellow customers (1)	A. ☐
Supply chain (B)	Relationships and activities performed with the customer (2)	B. ☐
Community chain (C)	Relationships and activities performed with suppliers (3)	C. ☐
Partnership chain (D)	Relationships and activities performed with partner organisations (4)	D. ☐

4 marks

6.5 The community chain is founded on social networks.

True or false? (Select only one by placing an X in the box)

- [ ] True
- [ ] False

1 mark

6.6 Social capital is a resource generated by dense networks of social relationships.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

6.7 A service is …

Select the best three statements that apply by placing an X in the box.

- ☐ An activity performed by somebody on someone else
- ☐ An activity that is time- and location-dependent
- ☐ Something served to something
- ☐ Something that cannot be distributed and stored

3 marks

6.8 The UK Data Protection Act enforces that data can only be held about people for a declared purpose.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

6.9 EXERCISES

- Identify one non-digital good, over and above those considered in this chapter, and consider how ICT is used in managing the production, distribution and consumption of such goods.
- Identify one non-digital service, over and above those considered in this chapter, and consider how ICT is used in managing the production, distribution and consumption of such non-digital services.
- Identify one digital good, over and above those considered in this chapter, and consider how ICT is used in managing the production, distribution and consumption of such digital goods.
- Identify one digital service, over and above those considered in this chapter, and consider how ICT is used in managing the production, distribution and consumption of such digital services.
- Identify the internal and external value chains relevant to a company or organisation known to you.
- Consider what goes into the coordination costs associated with some good or service known to you.

- Consider what goes into the production costs associated with some good or service known to you.
- Find one other digital currency that is available besides Bitcoin.
- Try to produce a high-level model of a public sector organisation in terms of activities of the internal value chain.
- Identify elements of the customer chain of an organisation known to you.
- Identify elements of the supply chain of an organisation known to you.
- When you purchase a product through mail order, attempt to identify the flow of data transactions that accompanies the purchase.
- If you live in what you would class as a community, investigate how much social capital exists in it. Determine the evidence for this.
- List a number of the social networks in which you participate. How are you linked to other members? Would you describe the ties as strong or weak?

6.10 PROJECTS

- Investigate ways of measuring social capital in a community. For instance, develop some ways in which you might map the social network underlying a virtual community. What types of bonds or links exist in this network? Are they strong or weak links, and what level of mutual support is provided to members of the social network through such links?
- Investigate the relationship between coordination costs and consumer behaviour. For instance, what coordination costs are involved in consumers changing their utility (gas, electricity, water, broadband) suppliers? Has the Web reduced these coordination costs?
- Investigate the degree to which music now constitutes a digital good and the consequences this has had for the music industry.
- Investigate the impact that social media is having on the news industries globally.
- After some investigation come to some conclusion about the fate of physical cash in future economies.
- Determine how ICT is helping shape the activities of democracy, over and above digital voting.
- Determine the level of digital exclusion that still exists in a country such as the UK by searching through government statistics on the subject.
- Look at the issue of ownership of digital data and come to some conclusion about future policy needed in this area.

6.11 FURTHER READING

Porter's original conceptions of the value chain and his model of the competitive environment of the organisation are reconsidered for the Internet age in Porter (2001). Sawhney and Parikh (2001) consider the issue of value and ways in which value changes in a connected world. Paolini (1999) introduces the idea of the organisation as a value-creating system. Coase's (1937) work on transaction costs forms the basis for Tapscott and Williams' consideration of new collaborative forms of working supported through ICT (2006). The theory of social networks has been around for some time – particularly in the work of Granovetter and others. The book by Christakis and Fowler (2010) popularised the issue.

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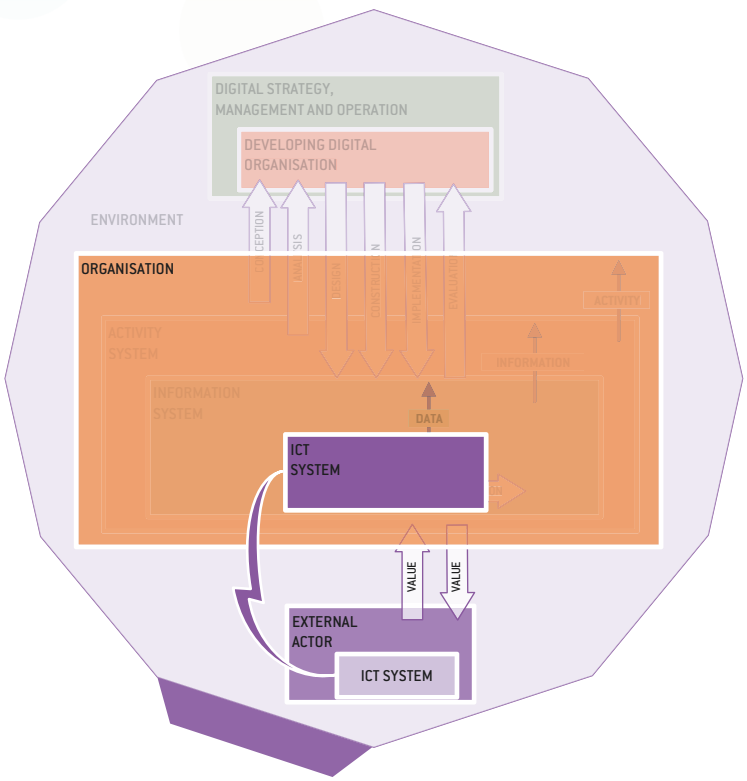
7 DIGITAL BUSINESS

'There can be no economy where there is no efficiency.'
– Benjamin Disraeli (1804–1881)

LEARNING OUTCOMES	PRINCIPLES
Describe the activity system of commerce and the various types of commerce.	Commerce is a pattern of activity having four key activities – pre-sale activity, sale execution, sale settlement and aftersale activity.
Understand what electronic commerce is and how it relates to various parts of the value network.	Electronic commerce refers to the ways in which ICT is used to enable various patterns of commerce within the wider value network of organisations.
Explain the infrastructure of B2C eCommerce.	B2C eCommerce involves ICT enablement of activity systems in the customer chain. An organisation's experience of B2C eCommerce moves through a number of stages of increasing complexity.
Explain the infrastructure of B2B eCommerce.	B2B eCommerce involves ICT enablement of key activity systems in the supply chain. Most B2B eCommerce is directed at supporting repeat commerce in terms of electronic sourcing, purchasing and payment.
Define the nature of C2C eCommerce.	C2C eCommerce refers to ICT enablement of the community chain. The community chain is founded in social networks and the value such networks produce is social capital.

CHAPTER OUTLINE

7.1 Introduction
7.2 Commerce
7.3 Controlling the value network
7.4 Electronic commerce
7.5 B2C eCommerce
7.6 B2B eCommerce
7.7 C2C eCommerce
7.8 Conclusion
7.9 Review test
7.10 Exercises
7.11 Projects
7.12 Further reading
7.13 Bibliography



7.1 INTRODUCTION

The Harvard scholar Michael Davenport highlighted some years ago certain contradictions evident in the ways in which we tend to approach ICT by making an interesting analogy between ICT and plumbing. Imagine a world, he says, obsessed with the technology of plumbing. Only two things are missing in this strange world. The first is an interest in the qualities of the material handled by this technology, namely water. The second is an interest in the uses to which water is put: drinking, washing, cleaning and so on. Substitute ICT for plumbing and data for water, and you get an appreciation of the way in which technology, data/information and action are inevitably intertwined in considerations of the worth of ICT. In other words, the value or the worth of ICT cannot be divorced from the question of what it delivers: that is, data for use in information systems. The worth of ICT is also directly related to the degree to which ICT systems are used and the impact they have on organisations.

Chapters 7, 8 and 9 all cover different aspects of the contemporary phenomenon of digital business. We use the term digital business to refer to any ICT application within business. As such it encompasses two older terms, electronic business and electronic commerce. We also use it to encompass other types of digital innovation such as mobile commerce and social media which we discuss in Chapter 9.

In this chapter we focus upon electronic business and electronic commerce. Electronic business (eBusiness) refers to any ICT enablement of an organisation's internal value chain, as well as its external value network. In contrast, electronic commerce is a subset of eBusiness, and refers to ICT enablement solely of aspects of the external value network of some organisation.

Electronic business is modern business because ICT is so embedded in the data systems of modern business. Electronic commerce is so important because of the way it provides critical infrastructure for trade within the wider global economy.

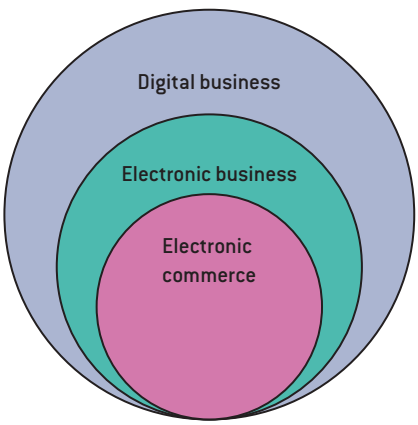


Figure 7.1 Digital business, electronic business and electronic commerce

REFLECT

We tend to feel that any modern business is a digital business to a greater or lesser degree, in the sense that even the smallest of businesses now use ICT in some respect. Consider a business known to you and try to determine the level to which it is reliant nowadays to do what it does.

7.2 COMMERCE

In much recent hype about digital business the fact that ICT has done much to improve the internal activity systems of business, and of public and voluntary sector organisations, is frequently forgotten. Much work has been done, for example, in supporting the internal value chain with enterprise ICT systems – a suite of ICT systems that share data structures across the enterprise (see Section 4.7.1). But over the last decade digital innovation has particularly focused on enabling various activity systems of commerce in the wider value network.

7.2.1 Commerce as a pattern of activity

Commerce is a pattern of activity (an activity system) that itself involves four key activities: pre-sale activity, sale execution, sale settlement and aftersale activity (see Figure 7.2). Pre-sale activities are those occurring before a sale, such as advertising and customer enquiries. Sale execution refers to those activities involved in the actual sale of the product or service, such as ordering or picking the product. Sale settlement refers to those activities involved with the completion of a sale, such as payment. Aftersale activities occur after the customer has bought the product or service, such as handling complaints.

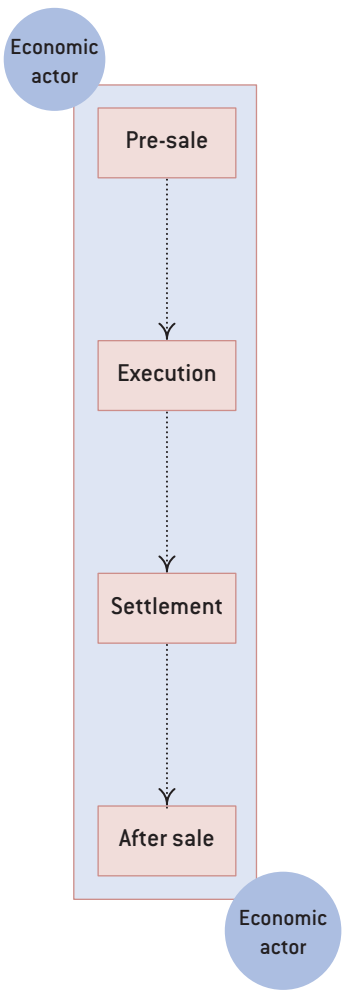


Figure 7.2 Commerce as an activity system

Each part of the value network of an organisation – customer chain, supply chain, partnership chain, community chain – will have one or more distinct patterns of commerce associated with it.

Consider book retail as an activity system undertaken by a company such as Palgrave. Pre-sale activity includes the marketing of books through online and offline catalogues. Sale execution involves the selection of a book by a customer and perhaps placing an order for it. Sale settlement involves the customer paying for the book, while aftersale activity might include discounting further related books of interest to the customer.

Cash commerce
The exchange of low-price goods in irregular exchange between actors.

The fundamental pattern of activity we have just described is what is known as **cash commerce**. This pattern of commerce is normally done on a one-off or irregular basis, and goods are paid for before being received. This is the conventional pattern of commerce evident when customers buy a low-cost product or service. For instance, you engage in cash commerce when you pay for a book from a bookstore or order a book through a website such as Amazon (Figure 7.3). You also engage in cash commerce when you have a haircut.

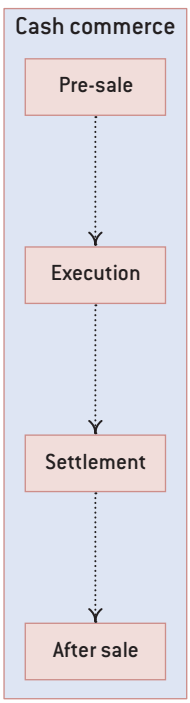


Figure 7.3 Cash commerce

Credit commerce
Credit commerce is where irregular transactions occur between trading partners and the processes of settlement and execution are separated.

Credit commerce is also a pattern of commerce that occurs on an irregular basis (Figure 7.4). However, rather than paying for value delivery up-front, goods or services are invoiced and paid for after delivery. This therefore demands many more activities within the pattern of commerce. Credit commerce is the conventional pattern of activity engaged in when two organisations, rather than individuals, engage in commerce for low- to medium-priced and standardised commodities and services. Hence a public sector agency might search for suppliers of a laptop to a particular specification. It will negotiate a price for a set number of these laptops and place an order for them with the supplier. The supplier will then deliver the laptops and invoice the agency for payment. Some time later payment will be made by the agency.

Repeat commerce
The pattern in which regular, repeat transactions occur between trading partners.

Repeat commerce is similar to credit commerce except that the activities are performed in a regular, repeating cycle with the seller (Figure 7.5). This means that a repeat order is normally placed for an established good or service with a nominated seller. The good or service is often highly priced or it may involve some degree of customisation – meaning it is tailor-made for the particular buyer. For example, consider an automobile manufacturer which needs a new type of front headlamp produced and supplied by a specialist in such lighting. It produces a specification for this part and searches for potential suppliers. In the process it will also negotiate a set price for this part with a selected supplier. The product will be ordered on a repeat basis with this supplier and delivered, invoiced and paid for on a repeat basis.

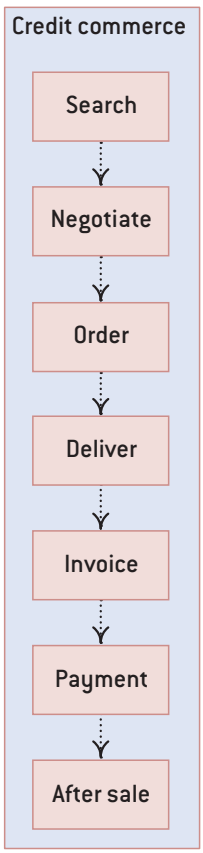


Figure 7.4 Credit commerce

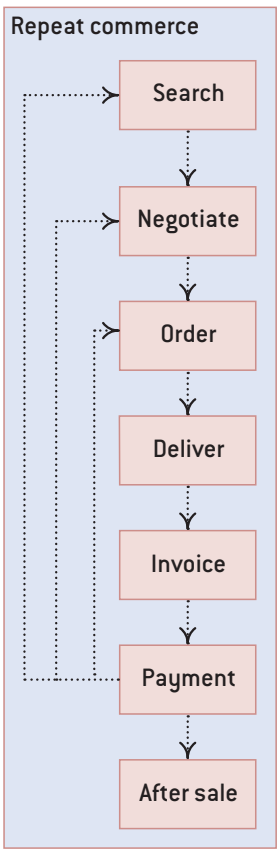


Figure 7.5 Repeat commerce

RECAP

Commerce is a pattern of activity (an activity system) that includes four key activities: pre-sale activity, sale execution, sale settlement and aftersale activity. Cash commerce is normally done on a one-off or irregular basis, and goods are paid for before being received. Credit commerce occurs on an irregular basis and rather than paying for value delivery up-front, goods or services are invoiced and paid for after delivery. Repeat commerce is similar to credit commerce except that the activities are performed in a regular, repeating cycle with the seller.

DID YOU KNOW?

Commerce as a pattern of activity has been in existence for many thousands of years. The first reported evidence of commerce dates back to at least 3,000 BC and involved trade between the ancient Sumerians and peoples in what is now modern-day Pakistan.

7.3 CONTROLLING THE VALUE NETWORK

As we have seen in Chapter 2, every system has control to ensure its viability. As an activity system, commerce performed with external actors is typically controlled in one of two ways within the value network.

Market
A market is a medium for exchanges between buyers and sellers.

In a **market** many buyers and sellers engage in commerce through open competition. The control of commerce in markets is essentially exercised through the price of goods and services. The price of a good or service continually varies depending on the supply and demand of this delivery of value (Figure 7.6).

For instance, one of the crucial markets for financial companies is the stock market. The stock market is a market for the exchange of shares and other forms of securities.

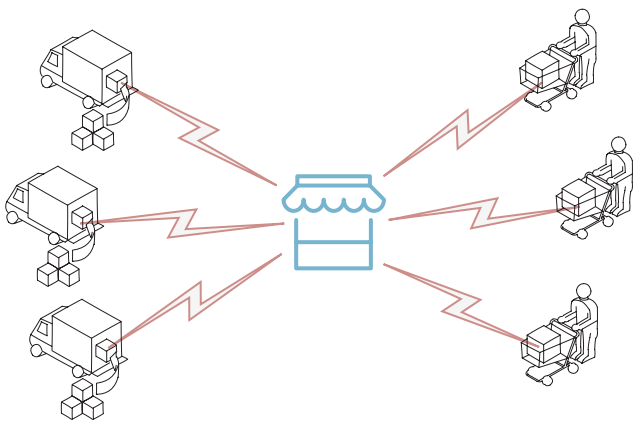


Figure 7.6 A market

Companies trade shares through financial intermediaries to a vast range of financial consumers, many of which will be other companies. The price of a certain share is determined by forces of supply and demand. In other words, the more demand for a particular share, the higher its price.

Because of its many-to-many nature a market is heavily reliant on large volumes of data flow. Buyers and sellers of financial securities, for instance, have to know on a minute by minute basis the current offer price of particular securities. But the buying and selling of securities as an exchange activity generates much data, such as the identities of the buyer and seller, the identity of the share exchanged, the number of shares exchanged and the price paid for the deal. As such, participation in markets traditionally generates what we referred to above as large amounts of transaction or coordination costs for a company.

Managerial hierarchy
Organisations coordinate the flow of value by controlling and directing it at a higher level in management structures.

In a **managerial hierarchy** (Figure 7.7), one buyer engages in commerce with a limited number of sellers, through cooperation. Within managerial hierarchies control is exercised through managerial decision-making about such things as the price to pay

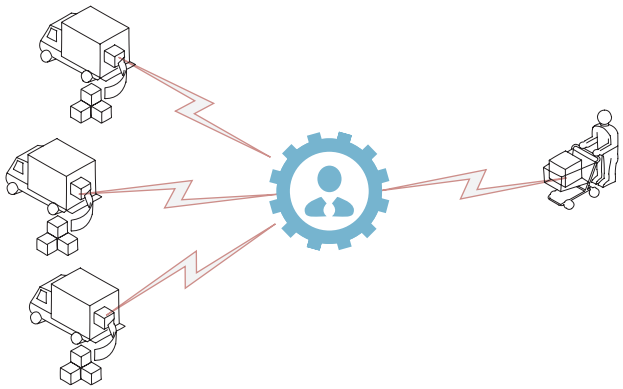


Figure 7.7 A managerial hierarchy

for goods or services. Generally speaking, managerial hierarchies are introduced to help organisations reduce their coordination costs.

In practice, any organisation will engage with some actors in its value network within systems of cooperation (hierarchies), while others will engage in a system of competition (market). So what we typically have is a network of participation in markets and hierarchies. As we shall see, much of the supply chain for the typical organisation has been controlled as a managerial hierarchy, while much of the customer chain is controlled as a market.

Malone et al. argued in the 1980s that the increase of ICT use would stimulate a trend towards electronic markets and electronic hierarchies. They also argued for the dominance of market forms because ICT would decrease the costs of coordination and would enable companies to further personalise goods and services, thus enabling them to better handle issues of product complexity and asset specificity.

More recently, Don Tapscott and Anthony Williams proposed that the Internet and the Web are critically changing the logic of the firm. The presence of such technological infrastructure is forcing a decline not only in transaction costs but also in the costs of 'production' as well. They attribute the latter to the growth in collaborative production facilitated by technologies built upon the global communication infrastructure. So-called open source software production is a case in point. Open source software is produced by a large network of collaborating software developers. They infer from this that network forms of governance and control in economic systems will begin to overtake traditional pure hierarchy and market forms over the first quarter of the twenty-first century.

REFLECT

We discussed control as a systems concept in Chapter 2. In what way do you think feedback works in markets through the price of goods and services?

RECAP

As an activity system, commerce performed with external actors is typically controlled in one of two ways within the value network. In a market many buyers and sellers engage in commerce through open competition. In a managerial hierarchy, one buyer engages in commerce with a limited number of sellers, through cooperation. In practice, any organisation will engage with some actors in its value network within systems of cooperation (hierarchies), while others will engage in a system of competition (market). So, what we typically have is a network of participation in markets and hierarchies.

7.4 ELECTRONIC COMMERCE

Electronic commerce
The conduct of commerce using information technology such as that supporting the Internet.

Electronic commerce refers to the ways in which ICT is used to enable various activity systems of commerce within the wider value network of organisations. We shall focus upon three major types of electronic commerce.

Business-to-customer (B2C) eCommerce refers to the ways in which ICT is used to help enable the customer chain. Business-to-business (B2B) eCommerce tends to be used to refer to ICT enablement of the supply chain. Consumer-to-consumer (C2C) refers to ICT enablement of the community chain.

It is possible to distinguish between major forms of eCommerce in terms of the features illustrated in Table 7.1. Forms of eCommerce relate to different parts of the value network. Electronic commerce can be conducted between organisations and individuals. eCommerce facilitates trade in commoditised and customised goods and for low price and high price items. The control of the activity of commerce typically varies among forms of eCommerce. So B2C eCommerce, for instance, typically involves ICT enablement of the customer chain in which companies sell commoditised goods and services to consumers in a cash or sometimes a credit pattern through markets.

These dimensions establish the parameters for certain so-called business models associated with eCommerce which we shall look at in later chapters.

Table 7.1 Forms of electronic commerce

	B2C	B2B	C2C
Value-chain	Customer chain	Supply chain	Community chain
Economic actors	Company/ consumers	Company/suppliers	Consumers/ consumers
Nature of goods/ services	Standard-priced items	Customised/High-price items	Negotiated/low-price items
Pattern of commerce	Cash/credit	Credit/repeat	Cash
Form of control	Markets	Hierarchies	Networks

7.5 B2C ECOMMERCE

B2C eCommerce
The use of eCommerce in the customer chain.

Within **B2C eCommerce** an infrastructure of information systems and data (ICT) systems facilitate the four major activities of commerce in the customer chain – pre-sales activity, sale execution, sale settlement and aftersale activity. Clearly, the form of such infrastructure and the way in which such infrastructure is established will differ with each organisation. In Chapter 10, for instance, we consider how decisions about particular aspects of infrastructure affect strategy in terms of online grocery. Here, we consider some common aspects of B2C eCommerce infrastructure found in many organisations (Figure 7.8).

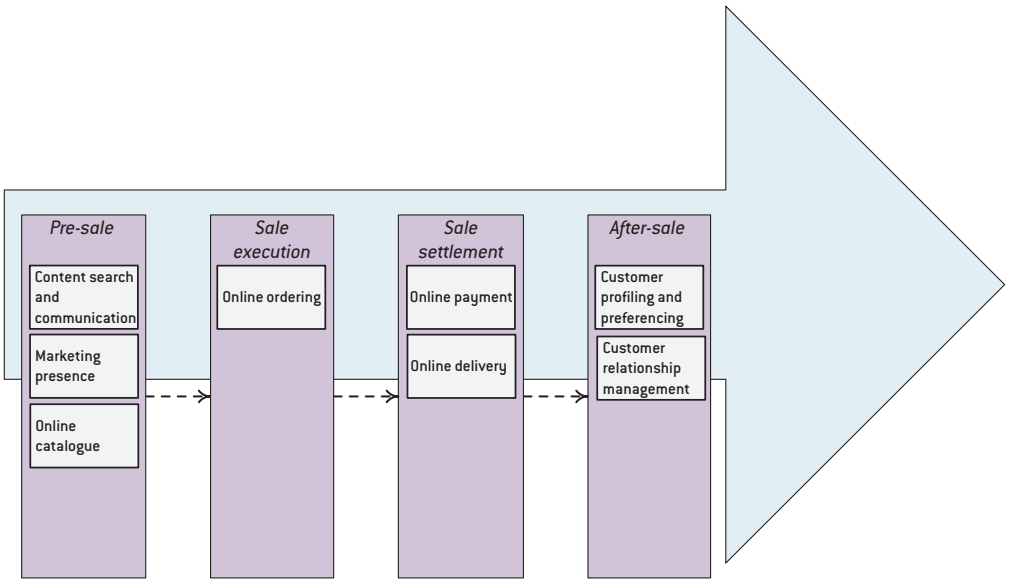


Figure 7.8 Growth in B2C eCommerce infrastructure

7.5.1 B2C eCommerce infrastructure

The simplest application of B2C eCommerce involves a business utilising the Internet and the Web for communication. Even sole traders – companies of one person – are now expected to offer at least some way of contacting them online, such as through an email address. One indicator of the embeddedness of ICT within the modern economy is that now companies of all sizes and types make heavy use of the Internet and Web. Hence a painter and decorator, for instance, might use his smartphone to access a mapping application which enables him to accurately locate the place of his next job. Online messaging such as email is a significant technology for business because it allows asynchronous communication between actors (unlike a phone call, say, both parties do not need to be communicating at the same time). It also enables the easy transfer of electronic files such as photographs. If a company has an email address this makes it easy for customers to make enquiries, book events and place orders (Figure 7.9).

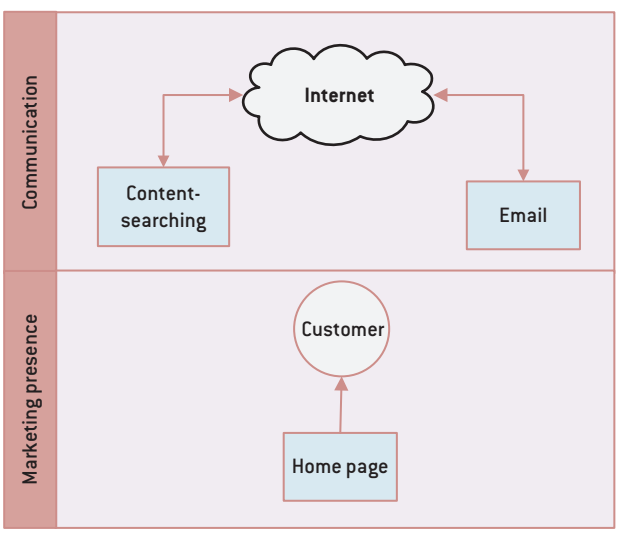


Figure 7.9 Communication and marketing presence

Infrastructure also exists to make it relatively easy to register a domain name, produce some sample web content describing the goods or services offered by a company, and pay for the management and presentation of this content on the Web by a so-called hosting company. Such a website will typically provide a company profile, most likely including a description of the main activities, the location and contact details. A simple website might also allow potential customers to communicate with the company through messaging.

Pre-sale activity can then be enabled further by implementing an online catalogue of its products or services, which could consist of a series of static web pages – or may be dynamic in the sense that it is updated from a database. More sophisticated sites allow dynamic pricing of product information, so that different types of market segment (such as irregular and regular customers) can be given different data. Customers are still likely to place orders through traditional channels such as over the telephone, through the post or potentially through online messaging (Figure 7.10).

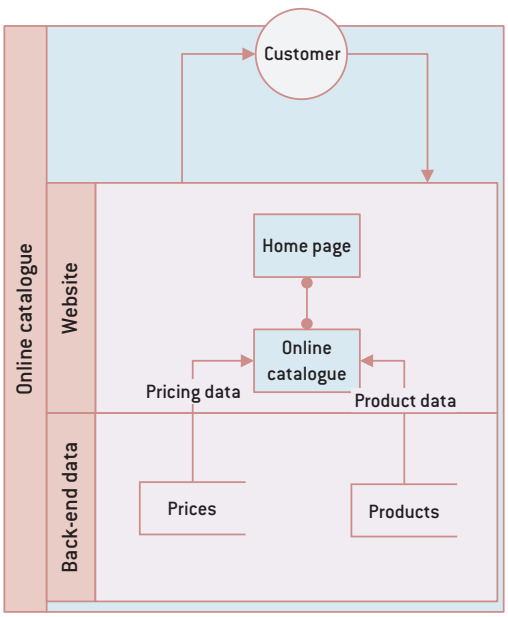


Figure 7.10 Online catalogue

Suppose, for instance, a music publisher produces an online catalogue of its limited range of specialist publications. The catalogue contains a cover image, a short synopsis of the contents of each publication, details of the cost of each publication and delivery charges. To order publications customers still have to ring a telephone line or send an order form through the post with appropriate payment.

7.5.2 Online ordering and payment

The next logical step is to enable customers to place orders online. This is a key transition point for most businesses since it involves the integration of websites with back-end information systems. In forms of credit commerce, the company invoices the customer for payment after delivery. This calls for integration between the website and the sales order processing information system. The sales order information system will trigger

the outbound logistics information system that manages deliveries. Payment details will also ideally be passed to the organisation's finance system, which sends an invoice and receives payment.

For example, a bulk supplier of specialist stationery to the trade might provide an online catalogue of its range of products. This material can be ordered via the Internet site for established customers. The traditional outbound logistics, invoicing and finance systems of the supplier are used to support the B2C process.

The next scenario is where the customer both orders and pays for goods using the website. This is more usual for cash commerce in which the customer is an individual and the goods are standardised and relatively low price, such as foodstuffs or books. This form of B2C eCommerce demands a close integration between an organisation's front-end and back-end information systems.

Figure 7.11 outlines the typical functionality of many sites offering online ordering and payment. (Obviously, individual sites vary, and might not exactly fit this template.) The customer first orders goods using an electronic shopping facility in the sales system. The shopping facility calculates the total cost of the order and includes the delivery charge. The customer enters credit or debit card details, and completes the purchase via a secure payment system.

Payment details are checked with a financial intermediary, such as the customer's bank. Provided sufficient funds are available, the intermediary makes an electronic funds transfer to the company's bank account, and details of the transfer are recorded in the company's finance system (Figure 7.11).

For the company which supplies high-quality art prints, customers can search for prints by theme, period, artist and price. They can look at images of selected prints at various degrees of resolution, and order them in various sizes. They add their selected prints to an online shopping trolley and pay online by credit or debit card. The site automatically confirms orders via email.

7.5.3 Online delivery

As we have seen, there are established digital standards now for data, so an increasing range of goods can be delivered electronically in digital format. This means that the outbound logistics system in Figure 7.11 is replaced by an online delivery system. There is also less likely to be a need for separate inventory and product databases, since one database can hold both product descriptions and the data that comprise the products themselves.

Sometimes digital goods and services are paid for per item, but in other business models there is a subscription system, perhaps with monthly payments. For instance, suppliers of virus protection software sometimes work on a subscription basis, in return for which they provide frequent updates. Music files are sometimes provided on a subscription basis too (either a set limit of downloads per month, or as much as the user requires), although others use a cash-based model, with a payment for each individual download.

7.5.4 Customer relationship management

In the modern business world, where globalisation means that companies face increasing competition, the customer is a key focus. Winning new customers and keeping existing customers satisfied is seen to be critical to organisational success, and electronic systems can help provide the efficient service that contributes to this.

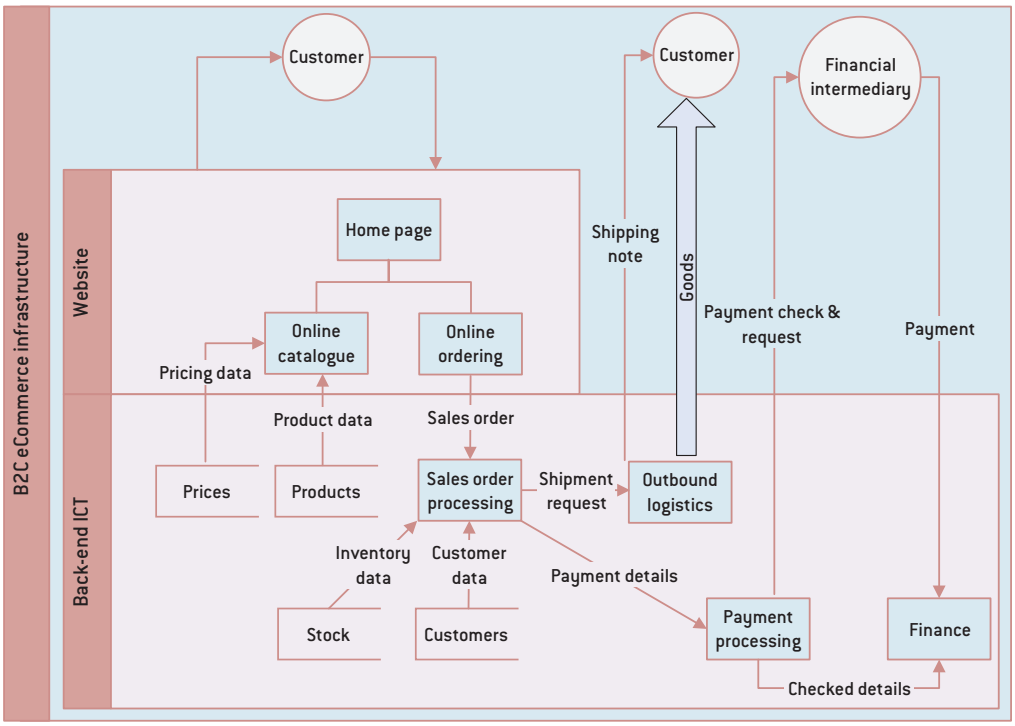


Figure 7.11 Online ordering, payment and delivery

Customer relationship management
The set of activities devoted to managing the customer chain.

Customer relationship management (CRM – sometimes known as customer chain management) comprises a set of activities that support the entire customer chain. In an electronic CRM system, an organisation's information systems track all customer interactions, from initial enquiries through orders to aftersales services. Often for larger companies, the customer-facing systems are integrated with a customer profiling and preferencing system. This information system dynamically builds a profile of each customer, and adjusts it on the basis of new transactions. This profile is then used to offer the customer a targeted range of goods and/or services.

CRM is an attempt to establish long-term relationships with customers and consists of three interrelated activity systems: customer acquisition, customer retention and customer extension.

Customer acquisition is the set of activities and techniques used to gain new customers. For digital business this clearly involves attracting customers to websites, so electronic or digital marketing (see Chapter 8) is a critical part of this aspect. It also involves attempts to persuade the customer to engage in a dialogue with the company, through which its systems can construct a profile of them: the products or services they have shown an interest in, their demographic profile and general purchasing behaviour.

For a high street bank, for instance, customer acquisition means persuading people to open an account or perhaps take up another financial product such as insurance or a loan. Online banking has become an expected part of the services offered, so it plays an important part in attracting new customers.

Customer retention is the set of activities and techniques designed to maintain relationships with existing customers. For eCommerce it has the related goals of retaining customers (repeat customers) and persuading them to keep communicating online (repeat visits). Two factors are critical to retention: customer satisfaction and customer loyalty.

One technique used in customer retention is the personalisation of email content. Customers receive alerts about products or services that their profile has suggested they will find particularly interesting: a new album by a musician whose previous work they have bought, for instance. These alerts may also offer discounts or other added-value services in a bid to persuade customers to return to a B2C website.

For the bank, customer retention activities might include offering multichannel access to accounts and aggregated products such as combined bank accounts, insurance and mortgages. Because online transactions are cheaper for the company, online customers may be provided with inducements to keep on using electronic communications, such as higher interest on balances in savings accounts.

Customer extension activities and techniques encourage existing customers to increase their level of involvement with a company. This is made easier in the online environment as more targeted promotions can be offered to customers.

All these activities depend heavily on good data and how these are used to communicate: knowing who the customers are, what they are purchasing, how satisfied they are with the company and what future services and products they want. Hence there has been an increasing emphasis on information systems to support the CRM process.

It might be argued that B2C eCommerce in general and CRM in particular are a natural consequence of the increasing customer focus. As we have seen, Porter has argued that the value delivered to the customer is the key feature of contemporary business so it is not surprising to find companies attempting to reorient their processes and systems around customers, instead of around business events such as orders and sales.

Take for example an insurance company whose products include life insurance, car insurance and home insurance. If this company structured its information systems around policy types (as most such companies used to do), it would find it hard to work out which customers were purchasing more than one type of insurance. It would also not be able to integrate its communications; if, for instance, a customer's household insurance was renewed the same day as their car insurance, they would get separate communications about each one. With its systems restructured around customers, the company can tell who its most valuable customers are, and which customers for one type of policy have not as yet chosen the company for their other insurance needs. It can then initiate schemes such as discount packages, aimed at retaining and extending its business.

REFLECT

Consider a university which organises its teaching data around courses and modules rather than students. What problems do you think it might find with this way of structuring its data?

7.5.5 Omnichannel retailing

As we have seen, an access channel is a means for an organisation to deliver goods and/or services to its customers (see Chapter 5). Traditional access channels include voice and face-to-face contact. There are also a range of remote access channels, such as telephone contact and more recently Internet access through devices such as the

personal computer or the mobile access device such as the smartphone. Goods and services can either be delivered directly by an organisation or indirectly using intermediaries (Chapter 6).

Many organisations now offer multiple and often tiered access to products and services. Most large-scale private and public sector organisations offer at least three tiers, each of which has different cost and availability implications. The first tier is remote direct access through a subset of the access devices discussed in Chapter 5. The second tier is through a multichannel access centre. Here, contact centre staff manage delivery through computer integrated telephony. The third tier involves direct contact with employees through face-to-face communication or letter. This is illustrated in Figure 7.12.

Omnichannel retailing Retailing conducted through multiple channels of access.

Retailing offers certain challenges in relation to multiple channels of access. Some have talked about the need for organisations to provide **omnichannel retailing** rather than merely retailing through multiple channels of access. This is an attempt to provide integration of data such as pricing across all channels and locations of access – both online and offline. It is directed at certain changes in consumer behaviour evident with the rise of online retail. Showrooming is the phenomenon where customers examine products in an offline, outlet but then purchase the same product often for a lower price online. Likewise, webrooming is the phenomenon where customers research a product on the Web before selecting an offline store to purchase from.

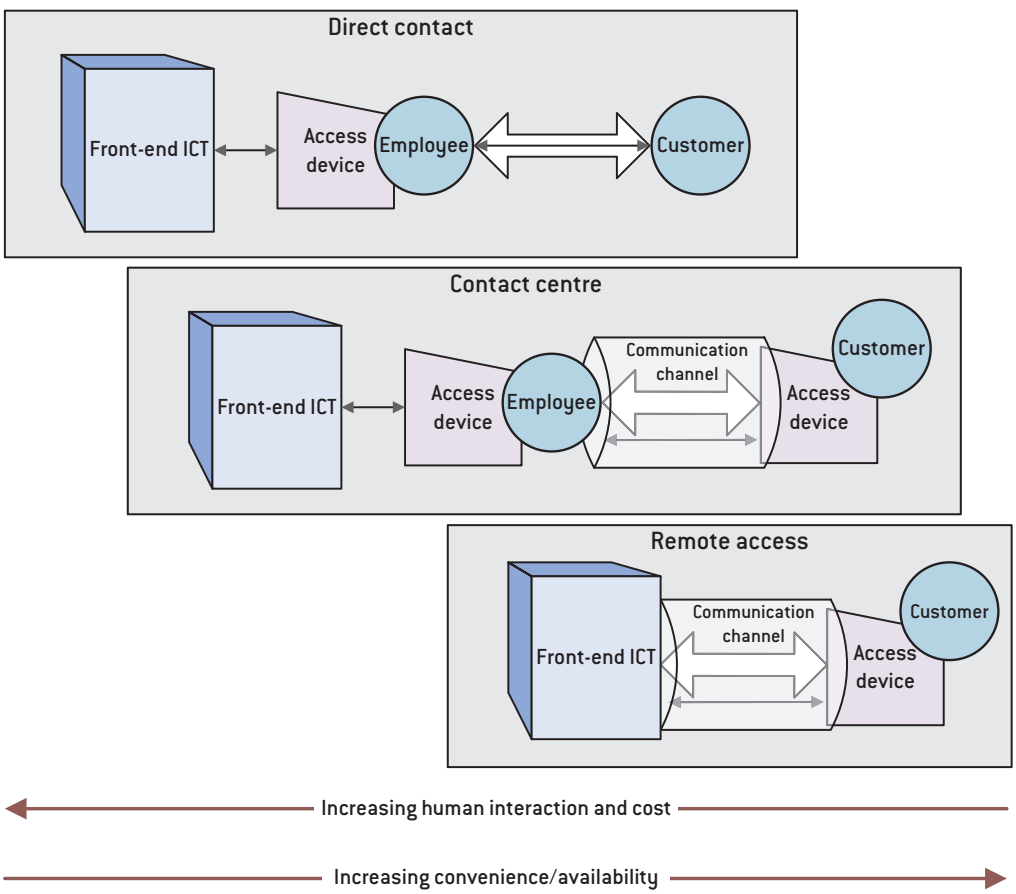


Figure 7.12 Tiered access

DID YOU KNOW?

The concept of online shopping was pioneered by the British engineer Michael Aldrich in 1979 when he connected a domestic television via a telephone line to a multi-user computer. However, true B2C eCommerce had to wait for the infrastructure of the Internet and Web before it could fully emerge. The Internet was only really opened to general access in 1991. Tim Berners-Lee pioneered the Web as a publicly available service on the Internet later that year.

7.5.6 Global or local eCommerce

We tend to think of eCommerce as a phenomenon dominated by global players in the market, such as Amazon, which sell products through their websites in most parts of the world. But many eCommerce companies exist around the world that focus on local rather than global markets. Analysts estimate there to be approximately 3 million eCommerce companies in the world, excluding those present in China. The United States and Canada have an estimated 1.3 million eCommerce companies, so this means that 1.7 million companies are based in and probably focus upon markets in their respective parts of the world. As an example, at the time of writing, Australia is home to companies such as Ozbargain, JB Hi-Fi, Officeworks, Harveynorman, Kogan, Woolworths, EB games, Myer, The Iconic, The Good Guys, BigW, Coles, Catch, Dan Murphy's, Chemist Warehouse, Supercheap Auto, Booktopia, Ozsale, Appliances Online, Dick Smith and Fishpond. Many of these companies are bricks-and-mortar businesses such as Coles, or have converted from offline to online businesses such as Dick Smith, but some have always been clicks-and-mortar businesses that have been around for a substantial period within their marketplace, such as Fishpond.

7.5.7 Amazon and B2C eCommerce

CASE

Amazon.com is an American eCommerce company based in Seattle, Washington State. The company was one of the first major companies to sell goods over the Internet. It was also one of the most prominent traded securities of the late 1990s dot-com 'bubble'. When this bubble burst, many claimed that Amazon's business model was unsustainable. The company made its first annual profit in 2003. Consequently, Amazon.com is probably the most cited example of a company that has succeeded at B2C eCommerce. But interestingly, Amazon sees itself as a technology company first and an eCommerce company second.

Amazon.com was launched on the Web in June 1995 by Jeff Bezos. Bezos obtained the backing of venture capitalists in Silicon Valley to start the operation. He chose to name his site after the world's longest river because Amazon, according to Bezos, was set to become the world's largest bookstore. At the time of Amazon's entry into the market it had no significant rivals – a first entrant into this new market. Within one year the company was recognised as the Web's largest bookstore. Figure 7.13 provides a sensible estimate of the growth in sales by Amazon from 1999 until 2018.

Although we tend to think of Amazon as one website, it has separate websites hosted in Canada, the UK, Germany, France, Italy, China and Japan. Amazon earns more than two thirds of its income in North America.

The company provides a number of levels of functionality through its website such as search features, additional content and personalisation. The site also provides searchable catalogues of books, CDs, DVDs, computer games etc. Customers can search for titles using keyword, title, subject, author, artist, musical instrument, label, actor, director, publication date or ISBN. In terms of added value, the company offers a vast range of additional content over and above its products. For example, cover art, synopses, annotations, reviews by editorial

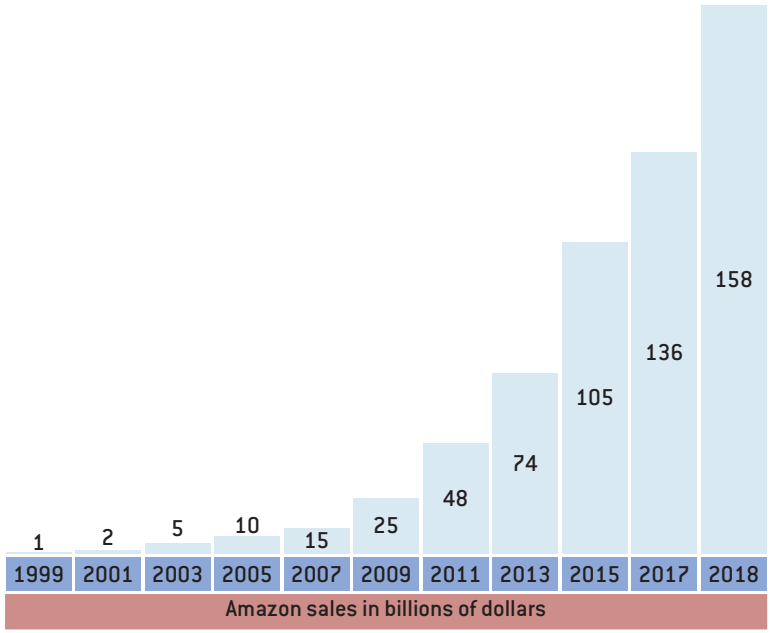


Figure 7.13 The growth in Amazon sales

CASE
continued…

staff and other customers and interviews by authors and artists. The website attempts to personalise the customer experience by greeting customers by name, instant and personalised recommendations, bestseller listings, personal notification services and purchase pattern filtering.

Amazon's service to customers relies on a close integration of its website to back-end information and activity systems. The company uses a streamlined ordering process reliant on previous billing and shipment details captured from the customer. Amazon also utilises secure server software that encrypts payment information throughout its integrated fulfilment process. Most of the company's products are available for shipping within 24 hours.

The primary value stream for Amazon is tangible products such as books and electronic products. As an online retailer the major transformation of its value-creating system is distribution and sales. It offers a vast range of such books for sale to customers and delivers them direct to customers.

At the start, Bezos warned investors that they were unlikely to make a profit in the first five years of operation. However, Amazon has engaged in an aggressive expansion strategy since its inception. Over the last decade, it has attempted to broaden the range of this value by offering a broader range of products including computer software, video games, electronics, clothing, furniture, food and toys. It also provides added-value services such as a personalised notification service. Many such products are not supplied by Amazon itself but through its associate network – a form of P2P eCommerce.

RECAP

B2C eCommerce involves ICT enablement of key activity systems in the customer chain. Customer chain activities include product identification, catalogue search, product comparison and purchase. An organisation's experience of B2C eCommerce moves through a number of stages of increasing complexity, including information seeking and communication, marketing presence, online catalogue, online ordering, online payment and customer relationship management.

7.6 B2B ECOMMERCE

B2B eCommerce
The use of eCommerce in the supply chain.

Up until quite recently it has always been argued that **B2B eCommerce** is even more critical to business activity than B2C eCommerce, and that digital innovation in the area of business-to-business activity has potentially enormous value for organisations. B2B eCommerce involves the use of ICT within the supply chain activity of organisations. Much discussion of B2B eCommerce is directed at supporting the repeat commerce model, discussed in Chapter 6. Here a company sets up an arrangement with a trusted supplier to deliver goods of a certain specification at regular intervals (Figure 7.14). Each of the phases of this repeat commerce model may be impacted upon by B2B eCommerce.

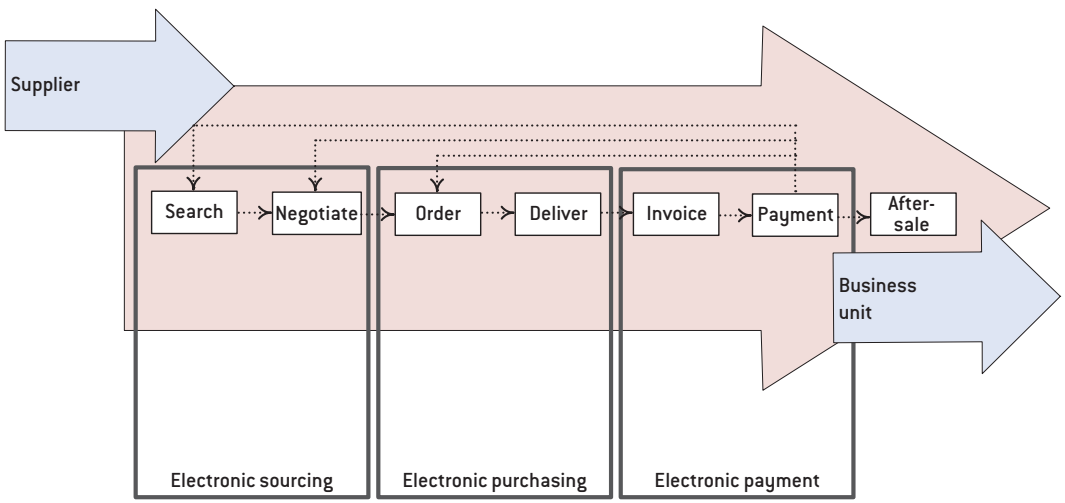


Figure 7.14 B2B eCommerce

The early activities in the supply chain of search and negotiate are sometimes referred to as sourcing. In terms of search, buyers within organisations will be required to detail features of the product or service required from suppliers by completing online forms. Such forms may then be submitted via web interfaces on the corporate Intranet for requisition approval. After requisition approval the purchasing department will issue a request for a quote electronically to potential suppliers. This may be conducted through an online bulletin board or B2B hub that connects businesses online as buyers and sellers. In terms of negotiation, after all bids have been received, a vendor is selected, probably using some software that ranks bids on the basis of chosen key features of the request, for quote.

The middle activities of order and deliver are sometimes referred to as purchasing. Order involves the supplier being notified of a successful bid and a purchase order being electronically transmitted to the chosen supplier.

After delivery of goods, the inventory management system is automatically updated and, following receipt of the invoice from the supplier, the company arranges an electronic funds transfer (payment) with the supplying company. Finally, in terms of aftersale, supplier relationship management systems monitor all interactions with suppliers and can be used to check on the performance of particular suppliers.

This approach to B2B eCommerce is primarily modelled on the economic model of an electronic hierarchy (Section 7.3) and can be considered to be an extension to the supplier-facing information systems described in Chapter 4. In other words, the supply chain is considered an extension of the firm itself and the infrastructure of the company is extended to manage supplier relationships. More recently, forms of market-based trading have infiltrated the B2B sector leading to an overlap of both B2B and B2C business models and ICT infrastructure.

7.6.1 B2B eCommerce infrastructure

Supplier relationship management
The management of supply chain activities. Sometimes referred to as supply chain management.

Supplier relationship management (SRM) is sometimes referred to as supply chain management and involves the coordination of all the supply chain activities of the company (Figure 7.15). Supply chain management is a generalisation of inbound logistics (Chapter 4), the management of material resources supplied to the organisation. It is also sometimes used to encompass outbound logistics, the management of resources supplied by the organisation to its customers. Just as customer relationship management can be seen to include electronic marketing, supplier relationship management can be seen to include electronic procurement (see Section 8.5).

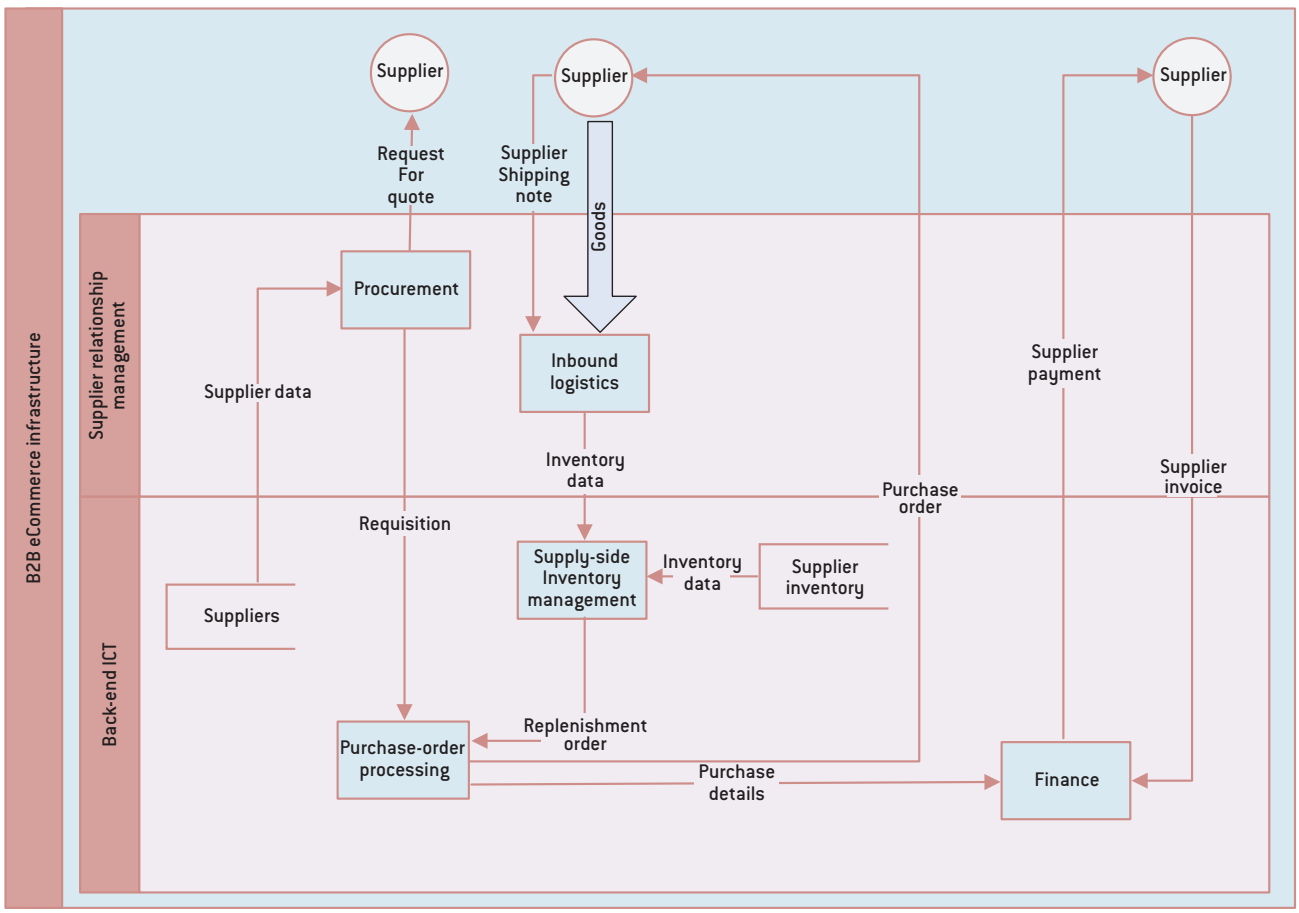


Figure 7.15 B2B eCommerce infrastructure

7.6.2 Amazon and B2B eCommerce

CASE

Although Amazon is frequently seen only as a B2C eCommerce company, much of its success as a company is based upon the efficiency and reach of its B2B eCommerce operations. Two of Amazon's core competencies are clearly to retail books effectively and to deliver such books efficiently to its customers. The latter competency relies upon efficient logistics. Amazon maintains a network of large warehouses or distribution centres which rely on ICT integration to perform effectively. Within these warehouses staff use handheld devices connected to an inventory management system to fulfil customer orders. Inbound

CASE
continued . . .

logistics involves the management of the purchasing of books and the distribution of books to these distribution centres. The process of operations involves unpacking and storing such shipments as well as picking of books to fulfil customer orders. Outbound logistics involves the distribution of books to the customer.

RECAP

B2B eCommerce focuses on ICT enablement of key processes in the supply chain. Most B2B eCommerce is directed at supporting the repeat commerce model in terms of electronic sourcing, purchasing and payment.

7.7 C2C ECOMMERCE

C2C eCommerce
Consumer-to-consumer eCommerce. ICT enablement of aspects of the community chain.

The Internet is a domain not only for business-to-business or business-to-consumer eCommerce; it is also a domain for consumer-to-consumer (C2C) eCommerce (Figure 7.16). We may define **C2C eCommerce** as ICT enablement of aspects of the community chain. In a way it is the most radical form of eCommerce since it overlaps with non-commercial activity in the area of community. Commercial and non-commercial organisations are attempting to incorporate aspects of their community chain into their operations or are attempting to formulate new business models embedded in various social networks external to the organisation.

As a type of exchange, many forms of C2C eCommerce revert to earlier models of markets and trade in which products and services are exchanged between individuals, where the fixed price model of products and services breaks down and where in some instances trade reverts to earlier forms of economic exchange such as barter. In such terms, C2C commerce is a many-to-many commerce model. It typically involves the exchange of low-cost items and monetary transactions. With C2C eCommerce a form of trade that typically survives in local marketplaces is opened up to global access.

In this section we reconsider our definition of a community and use this definition to introduce the idea of an electronic community.

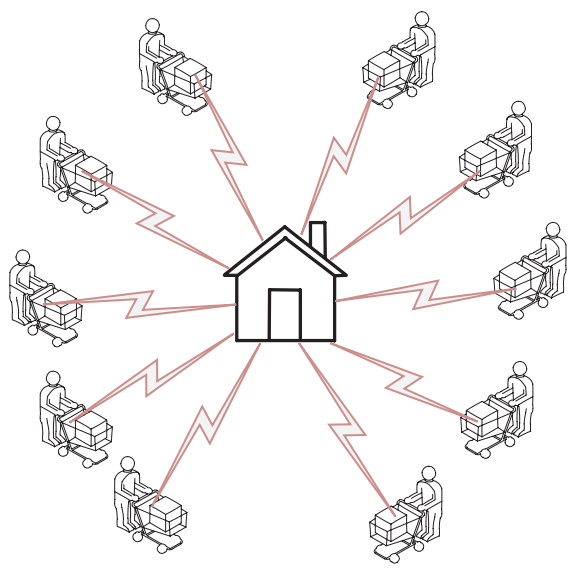


Figure 7.16 C2C eCommerce

7.7.1 Electronic community

Electronic community
A community supported through ICT.

The two concepts of a social network and social capital as defined in Chapter 4 help us understand some of the different forms of **electronic community** (eCommunity). On the one hand, ICT is seen either as an enabler or disabler of traditional forms of community: an eNabled community. On the other hand, ICT is seen as offering potential for newer forms of community based on communication networks: the virtual community. Virtual communities may exist separate from the organisation concerned or be built upon infrastructure provided by the organisation. The latter is the concept of an adjunct community. It is to adjunct communities that many businesses are turning to increase levels of value associated with their products and services.

An eNabled community is a traditional community enhanced with the use of ICT. Community is normally established on the basis of frequent and prolonged interaction between individuals, resident in a clearly defined geographical area. This form of community chain addresses the rise of communication networks and considers whether they are vehicles for recreating community and social capital in local areas. Some argue that communication networks are a threat to existing forms of community; others that they provide a new basis for enhancing social capital.

The Internet and the Web were initially established for free information exchange between dispersed actors around the globe. Some have begun to consider such dispersed networks or individuals and organisations as examples of electronic communities. In such virtual communities, social networks are constructed through electronic rather than face-to-face communication. Social networks based upon communication infrastructure may not only be dispersed geographically, they may also have a much more specific area of focus than traditional communities.

As a generalisation, public sector organisations have particularly been interested in making connections between their activities and initiatives in the area of eNabled community. Such forms of eCommunity are seen as offering the potential for the stimulation of local economies, particularly in disadvantaged areas.

In contrast, private sector organisations have particularly been interested in connecting to the second form of eCommunity, that of a virtual community. The idea is that various forms of value produced by the community chain may support and encourage commerce of various forms. It is only comparatively recently that the Internet and Web have been used as vehicles for commerce and trade/business purposes. C2C eCommerce mediates between pure forms of trade and pure forms of communication exchange.

7.7.2 Virtual communities

Virtual community
A community consisting of a network of actors on some communication network.

It could be argued that one of the first virtual communities was the community of academics that started to use the Internet in the early 1970s to share data, exchange messages and collaborate together on various research programmes. As we have seen, Tim Berners-Lee originally produced the Web as a tool for networks of scientists to share documentation easily, and as such to build community.

In more recent times the idea of virtual communities has become inherently associated with a range of websites collectively known as social networking sites. A social networking site is a website that provides a number of facilities for constructing and maintaining online relationships between members. Prominent examples of such social networking sites are Facebook and LinkedIn. Globally, hundreds of millions of people have become members of these sites.

Virtual communities are founded in social networks and produce social capital just like traditional communities. However, there is still some question as to whether the bonds in the social network of a virtual community are as strong and the social capital produced as great as that produced in traditional communities. This is because there are a number of differences between virtual communities and traditional communities including issues of space, the form of communication used and the general focus of the community.

In terms of space, traditional communities are normally established on the basis of long residence by individuals in a prescribed geographical region. In contrast, virtual communities break geographical boundaries and individuals are effectively nodes in a wide area communication network. In traditional communities the dominant form of communication between community members will be face-to-face conversation. In virtual communities, various forms of remote communication may be employed such as email, chat, telephone conversation, video conferencing etc. Finally, the focus of a traditional community will be diverse, but all located around a particular geographical area. The focus of virtual communities is likely to be much more specific in nature, but span the globe.

It is possible to define various types of virtual communities. For instance, virtual communities can be formed in terms of different types of content provided on websites such as transactions, area of interest, industry or expertise. Many sites are established to facilitate the buying and selling of products and services and to delivering data that are related to the completion of transactions. Many community websites focus on areas such as theatre, sports, science fiction or fantasy. Community websites frequently locate around key industrial areas such as accounting or manufacturing. Also, occupational groups may focus around key areas of expertise such as waste management and software engineering.

7.7.3 Social networking sites

Social networking site
A website that facilitates social networking.

There has been much interest in the growth over the last decade or so of so-called **social networking sites**; sometimes referred to as social networking media, social media or digital media (which we shall discuss in more detail in Chapter 8). All of these are somewhat bad names for this phenomenon, because most social networks, as we have explained in Chapter 6, are not virtual. This phenomenon is really about using ICT, particularly Web 2.0 technologies, to facilitate networking among dispersed individuals and hence constitutes a variant of the virtual communities discussed above.

In terms of business the key question is what impact this is having on business or what potential it holds for business. Besides the obvious fact that these sites are in fact businesses themselves, there is interest from business more generally in utilising the technologies involved for internal and external use. For example, the Web 2.0 technologies on which social networking sites rely may have an internal impact as in the case of fostering and supporting collaborative working and communication in distributed organisations. In an external sense, virtual communities of this form could be used to improve CRM. For example, many companies use blogs and tweets as tools for marketing or CRM.

Certain social networking sites such as Facebook are attempting to establish themselves as a third application layer on top of the Web and the Internet. In this sense these sites wish to encourage their members to engage in most of their online communication through the social networking site, rather than through the more open environment of the World Wide Web. For the user of the social networking site this offers a more convenient way of communicating with other members of the social

network than through more open standards of communication such as email. This enables the social networking site to gather masses of data about the attributes and activities of its users, which is of great value for business purposes such as marketing. Some commentators worry, however, about the possible infringements of data privacy that might arise from this and caution of a potential backlash against social media by its users. In 2018 the company Cambridge Analytica was alleged to have harvested personal data from millions of Facebook users. This data was apparently used within campaigns which attempted to influence the results of the 2016 US presidential election as well as the UK's referendum on leaving the EU.

REFLECT

Consider whether online communication through proprietary websites is a good thing in relation to the idea of net neutrality – that no organisation or country should have control of the Internet.

7.7.4 Adjunct communities

Adjunct communities
Forms of virtual community that focus around the development of relationships between customers and the business.

Certain digital businesses are attempting to foster and support virtual communities as a means of adding value to their products and/or services. **Adjunct communities** are forms of virtual community that focus around the development of relationships between customers and the business. The key benefits to business are that by creating and supporting such virtual communities, businesses will be better able to build membership audiences for their products and services. For instance, the motorcycle manufacturer Harley-Davidson has built an adjunct community to help support communication between fans of its products.

Certain features of social capital, such as increased mutual support among members of a virtual community, can be particularly beneficial to companies. Enhanced levels of trust between members of a virtual community may support increased levels of trade with a company. These forms of added value may increase customer loyalty and trust.

There are two business models appropriate for adjunct communities. A communication exchange is a business model which attempts to add value to products and services through communications between a network of members. The company provides an environment in which members can partake in unedited communication exchange. Revenue is generated through membership fees, advertising revenue and cross-selling of products and services. In contrast, collaboration platforms tend to be much more focused on enabling collaboration between individuals and organisations and typically provide a set of tools and an environment for collaboration with a company.

7.7.5 C2C exchanges

C2C exchange
An ICT enabled facility that involves trade between complex networks of individual actors.

Other business models for C2C focus more precisely on facilitating customer-to-customer relationships of exchange. **C2C exchange** involves trade of typically low-cost items between complex networks of individual actors. Revenues from C2C communities may be generated through advertising, transaction fees and/or membership fees.

There are two main business models appropriate for C2C exchange. Electronic auctions constitute the prominent business model underlying C2C eCommerce and are discussed in more detail below. Information brokerages are companies specialising in the provision of information to consumers and to businesses. They help such individuals

and organisations make buying decisions for business operations. Revenue models in this area include membership fees, advertising fees and cross-selling.

C2C exchanges involve trade between complex networks of individual actors. Although typically the monetary value of each exchange may be low, added together billions of dollars are traded annually in such forms of C2C commerce. However, C2C exchange is not a new phenomenon. A range of traditional business models have been created for this purpose which include newspaper classified advertisements, flea markets and auction houses.

Users of newspapers typically list items for sale, normally in newspapers distributed on a local basis. Buyers inspect items before purchase and may collect and pay for the item in person. In a flea market, sellers stock and display items for sale, typically at their own homes or at organised markets. Buyers typically browse for artefacts and will negotiate prices and collect and transport items themselves. Within auction houses, sellers take items to specialist organisations for sale. Buyers are able to inspect items before an auction. Buyers will have to pay a registration fee to bid and are required to be at an auction or to nominate a proxy bidder. The highest bidder wins the auction and pays the auction house. The auction house in turn takes a percentage of the sale and pays the balance to the seller.

The value and take-up of a C2C exchange, such as that provided by eBay (see Section 7.7.6) is likely to be affected by Metcalfe's law (Section 6.5.4): the community value of a network grows as the square of the number of users increases. It is likely that the variety in a C2C network will strongly influence the take-up and use of such applications. In other words, the more people available to communicate with and share goods and information the more likely it is that people will participate.

7.7.6 eBay

CASE

eBay is one of the foremost examples of C2C eCommerce. Its dominance is due to early entry into what was a niche market at the time. Its business model relies on that used in *exchange and mart* catalogues that have existed for decades. The competitive edge for the business lies in the way in which eCommerce enables mass customers to trade low-cost items efficiently through an auction process across the globe. eBay uses what is known as a Dutch auction model for its business. In this form of auction, the seller places one or more identical items for sale at a minimum price for a set period. When the auction ends the highest bidder gains the item at their bid price. eBay also offers the ability for customers to pay for certain items offered through its website at a fixed price.

Pierre Omidyar created eBay in September 1995, using a website hosted by Omidyar's Internet service provider, and running the company in his spare time from his apartment. In its early guise eBay was little more than a simple marketplace where buyers and sellers could bid for items. The company took no responsibility for the goods being traded and gave no undertaking to settle disputes between parties.

By February 1996 so many people had visited the site that Omidyar decided to introduce a 10 cent listing fee to recoup his costs. By the end of March 1996 eBay showed a profit. Eventually the volume of traffic to the site persuaded his Internet service provider to ask him to move elsewhere. Omidyar decided to transfer the operation to a one-room office with his own web server where he employed the services of a part-time employee. He also developed software capable of supporting a robust, scalable website, as well as a transaction processing system to report on current auctions.

CASE
continued…

By August 1996 Omidyar had established one of his friends as the first president of eBay. In June 1997 the company approached venture capitalists for funding and secured five million US dollars. This enabled the company to establish a more extensive management structure for planned expansion. By the end of 1997 more than 3 million items (worth 94 million US dollars) had been sold on eBay amounting to revenues of 5.7 million US dollars and an operating profit of 900,000 US dollars. eBay had an operating staff of only 67 employees at the time.

In its early days eBay undertook only limited marketing and relied on the loyalty of its customer base and word-of-mouth referrals for its increased business growth. Eventually the company began to employ cross-promotional agreements including banner advertising on websites such as Netscape and Yahoo! as well as providing an auction service for AOL's classified section. This evolved into a conventional marketing campaign through traditional print and broadcast media in 1998.

In 1999 the company expanded internationally by creating communities in Canada and the UK. This was followed by expansion into Germany, Australia, Japan and France. During this year and into 2000 the company successfully held its position against strong new entrants into the online auctions market such as Amazon.com.

Millions of people join eBay each month from around the world and thousands of people around the globe earn a living as an eBay trader. Essentially, eBay's business model is a simple one of providing C2C auctions online. Much of this activity relies on collectors trading small-price items such as coins, stamps, militaria etc. Although the average item sold through these markets constitutes no more than tens of dollars, as a whole, billions of dollars are traded every year in the United States in C2C trading of this nature.

The concept is to provide a website where anyone wishing to buy or sell on eBay must register by providing personal and financial details. Every user of eBay is given a unique identifier. Sellers list items for sale by completing an online form. They pay a small listing fee for this privilege. The size of the fee depends on where and how the listing is presented and whether a reserve price is required for the item. Sellers also choose the duration they wish buyers to bid for the item. At the end of an auction, eBay notifies the seller of the winning bid and provides details of the successful bidder to the seller. The buyer and seller then make their own arrangements for payment and delivery of the goods, usually through email. Payment can be made by cash, cheque and postal order or electronically through a payment service or financial intermediary such as PayPal (paypal.com), which was for a time, a subsidiary of eBay. eBay charge a percentage of the final value of the transaction.

Since buyers pay sellers before they receive items, the business model runs on trust. The eBay feedback system is used to indicate problems with particular users. Users can file feedback about any user on the feedback site. This discourages trade with rogue participants. The only costs to eBay therefore amount to the costs of computing infrastructure and expenses associated with customer services. eBay keeps no inventory, has no distribution network and does not have to maintain a large amount of staffing to make the company viable.

DID YOU KNOW?

Alibaba Group is a Chinese multinational digital business that operates in all three areas of eCommerce described in this chapter. The various websites provided by the company now account for 80% of China's eCommerce transactions (see Cases section).

RECAP

C2C eCommerce is ICT enablement of the community chain. The community chain is founded in social networks, and the value it produces is social capital. ICT has been used to enable community in local areas. ICT is also the infrastructure underlying the rise in virtual communities and social networking. Forms of electronic community include virtual communities and C2C exchanges.

7.8 CONCLUSION

We have made the point in previous chapters that business is made up of patterns of activity that occur both internally to the business and externally with other economic actors. Commerce is clearly a name given to a generic pattern of activity that occurs between economic actors and which involves four key activities – pre-sale activity, sale execution, sale settlement and aftersale activity. We can also distinguish between different patterns of commerce in terms of the complexity and frequency of the pattern. Cash commerce is normally done on a one-off or irregular basis, and goods are paid for before being received. Credit commerce occurs on an irregular basis and rather than paying for value delivery up front, goods or services are invoiced and paid for after delivery. Repeat commerce is similar to credit commerce except that the activities are performed in a regular, repeating cycle with the seller.

These features of patterns of commerce are useful for understanding the ways in which ICT is applied within the wider value network. B2C eCommerce involves ICT enablement of key activity systems in the customer chain such as product identification, catalogue search, product comparison and purchase. This way of thinking about systems of commerce allows us to understand an organisation's experience of B2C eCommerce as moving through infrastructure of increasing complexity, such as information seeking and communication, marketing presence, online catalogue, online ordering, online payment and customer relationship management.

Whereas B2C eCommerce involves ICT enablement of the supply chain, B2B eCommerce focuses on ICT enablement of key activity systems in the supply chain. Most B2B eCommerce is directed at supporting the repeat commerce model in terms of electronic sourcing, purchasing and payment.

B2B eCommerce has been around for many decades, involving the exchange of electronic documentation in support of intercompany trade. B2C eCommerce really started to take off with commercial adoption of the World Wide Web. C2C eCommerce is the most recent form of eCommerce and overlaps somewhat with the area of social media (discussed in Chapter 9). One way of thinking about C2C eCommerce is that it is founded in social networks and produces social capital as value.

One advantage of the systems viewpoint adopted within this book is that we can examine systems at various levels of abstraction. Hence a system can be considered a set of subsystems and each subsystem can be regarded as a system in itself. We use this way of thinking in the next chapter when we consider a subsystem of B2C eCommerce (electronic marketing) and a subsystem of B2B eCommerce (electronic procurement).

7.9 REVIEW TEST

7.1 A digital good is …

Select the statement that best applies by placing an X in the box.

- ☐ … a good amenable to digitisation … to be turned into data
- ☐ … a component part of an ICT system
- ☐ … something believed to be worthy by technologists

1 mark

7.2 Commerce is an activity system consisting of four main activities.

Place the activities in sequence (1-4), with the first activity labelled (1).

- ☐ Sale execution
- ☐ Pre-sale
- ☐ Sale settlement
- ☐ Aftersale

4 marks

7.3 _____ is a superset of electronic commerce.

Fill in the blank term below.

☐

1 mark

7.4 _____ involves ICT enablement of activity systems within the customer chain.

Fill in the blank term below.

☐

1 mark

7.5 _____ involves ICT enablement of activity systems within the supply chain.

Fill in the blank term below.

☐

1 mark

7.6 _____ involves ICT enablement of activity systems within the community chain.

Fill in the blank term below.

☐

1 mark

7.7 Match the most appropriate type of eCommerce to the most relevant part of the value-network.

Match the type of eCommerce with the appropriate part of the value network by placing the number next to the letter.

Customer chain (A)	C2C eCommerce (1)	A. ☐
Supply chain (B)	B2C eCommerce (2)	B. ☐
Community chain (C)	P2P eCommerce (3)	C. ☐
Partnership chain (D)	B2B eCommerce (4)	D. ☐

4 marks

7.10 EXERCISES

- Determine whether an organisation known to you has adopted eCommerce. If so, attempt to determine the benefits it derives from it. If not, determine what benefits it might derive.
- Access a B2C site and attempt to assign the features you find to the phases of the customer chain.
- Consider a company known to you. Determine at what stage it is in as far as B2C eCommerce is concerned.
- Take a company known to you, and determine what information is searched for using the Internet.
- Find a website for an SME in your local area. Determine how successfully it markets itself through the Internet.
- Find a website with an online catalogue. Describe the features of the online catalogue.
- Visit the Amazon.com site and attempt to determine what forms of customer profiling it employs.
- Investigate the range of CRM systems offered by vendors.

7.11 PROJECTS

- Investigate the take-up of eBusiness and eCommerce by companies in your local area. Attempt to determine the importance of eBusiness to their operations.
- Choose an industrial or commercial sector. Investigate the degree with which B2B and B2C eCommerce has penetrated the sector. As a consequence how have the value networks in such a sector been transformed?
- Determine the levels of disintermediation and reintermediation among eCommerce conducted in a particular market sector, such as travel agencies or high street banking. In other words, what sort of structural change has been caused to the market through ICT?
- Interorganisational information systems are important to collaboration between business partners such as high street banks or major airlines. Determine the benefits associated with them for a particular partnership network. Also determine the costs associated with building and operating them.
- Choose a market sector and determine the most appropriate organisational form for eBusiness. Can the business be run entirely online or is it important to maintain a physical presence?
- Study the take-up of B2C eCommerce among a limited range of companies. Discover the degree to which the evolution of eCommerce in these companies corresponds to the growth model discussed.
- The rise of online trading has caused a parallel increase in online theft and fraud. Investigate the impact this growth has on the issue of consumer trust. Will trust be a major brake on the continued growth in B2C eCommerce?
- Customer relationship management is now a major philosophy for companies. Determine the degree to which it relies on customer relationship information systems. How do these information systems help improve organisational performance, and how can this be measured?
- Consider the most effective ways of evaluating B2C systems. How can companies determine the value that B2C eCommerce provides for them? Does conducting B2C eCommerce inevitably make such measurement easier, and if so, why?

- Among the various forms of B2B eCommerce described in this chapter, determine the most prevalent. For instance, determine the level of usage of intermediary-oriented B2B in a market sector known to you, such as retail.
- Those companies that survive in the eEconomy will be those that integrate effectively their front-end information systems, such as their B2B systems, with their existing core information systems infrastructure. Investigate the degree to which such integration is critical to the success of eBusiness.

7.12 FURTHER READING

There continue to be lots of books that hype the phenomenon of digital business. The book by Evans (2017) contains less hype than most. Chaffey's *Digital Business and eCommerce Management* (2014) is still worth a read, as is my own book on electronic business (2012).

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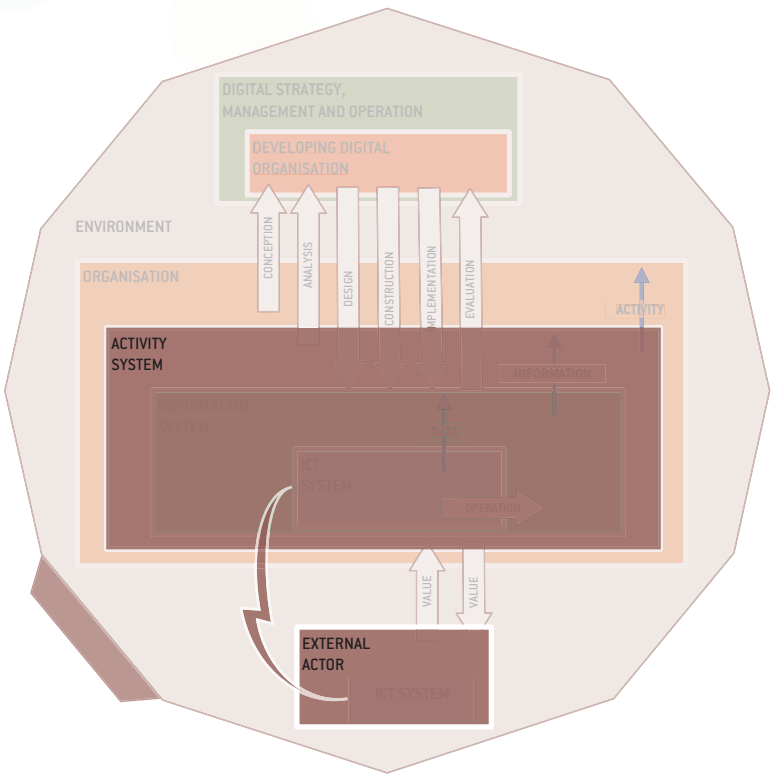
8 ELECTRONIC MARKETING, PROCUREMENT AND GOVERNMENT

'Half the money I spend on advertising is wasted, and the trouble is I don't know which half.'
– Lord Leverhulme (1851–1925)

LEARNING OUTCOMES	PRINCIPLES
Define the notion of electronic or digital marketing and consider various approaches to such.	Marketing is concerned with communicating the value proposition of some organisation to consumers. Electronic or digital marketing is attractive because of certain properties such as it being data-rich. Approaches to digital marketing include digital marketing communication, search engine optimisation and marketing analytics.
Explain the notion of electronic procurement in terms of innovation in electronic sourcing, ordering and payment.	Procurement refers to the set of activities involved in the sourcing, purchasing and paying for goods and services with suppliers. Electronic procurement offers savings in coordination costs.
Identify the ways in which the principles of eBusiness have been adapted within the public sector.	Over the last couple of decades, considerable innovation has occurred in the redesign of public sector service provision. Aspects of electronic government emulate forms of electronic business, such as C2G eGovernment.

CHAPTER OUTLINE

8.1 Introduction
8.2 Electronic marketing
8.3 Marketing data
8.4 Google
8.5 Electronic procurement
8.6 Electronic government
8.7 Indian identity number
8.8 Conclusion
8.9 Review test
8.10 Exercises
8.11 Projects
8.12 Further reading
8.13 Bibliography



8.1 INTRODUCTION

Since we are taking a systems viewpoint in this book it is appropriate to think of the systems of digital business as comprising a number of distinct but interacting subsystems. Chapter 7 considered three traditional forms of digital business in terms of the subsystem of eCommerce: B2C, B2B and C2C eCommerce. Within this chapter we travel down the systems hierarchy and first look at two important subsystems of eCommerce: electronic marketing and electronic procurement (Figure 8.1). In a sense, electronic marketing is an important subsystem of B2C eCommerce while electronic procurement is an important subsystem of B2B eCommerce. We also consider the impact of ICT within a parallel universe to digital business – its impact upon systems of government. This clearly supports the point made in Chapter 4 that organisation as a system is made up of patterns that may be common across different organisations in different sectors.

As more interaction with organisations occurs online, more and more potential exists for use of digital channels for the creation, transmission and receipt of marketing messages. As such ICT is increasingly used as a persuasive technology – as a means of influencing our behaviour. But as we shall see, one additional advantage of digital marketing is that it allows marketers to close the loop, in the sense of determining the impact of any marketing investment.

Electronic procurement is a form of digital innovation that is seen as a means of reducing major supply chain costs to companies and to public sector organisations. Procurement is very much about the sharing of data structures between organisations. Hence the role of standards for electronic business documentation is a significant part of the infrastructure here.

Digital innovation has clearly not only impacted upon the private sector. The application of ICT has been a major catalyst for change in various activity systems of government. One of the most significant areas of transformation has been in the ways in which digital innovation have changed the delivery of public sector services. But, as we shall, there are forms of digital government which emulate aspects of digital commerce in the sense of adopting patterns of articulation, communication and coordination that are similar to that adopted in the business world.

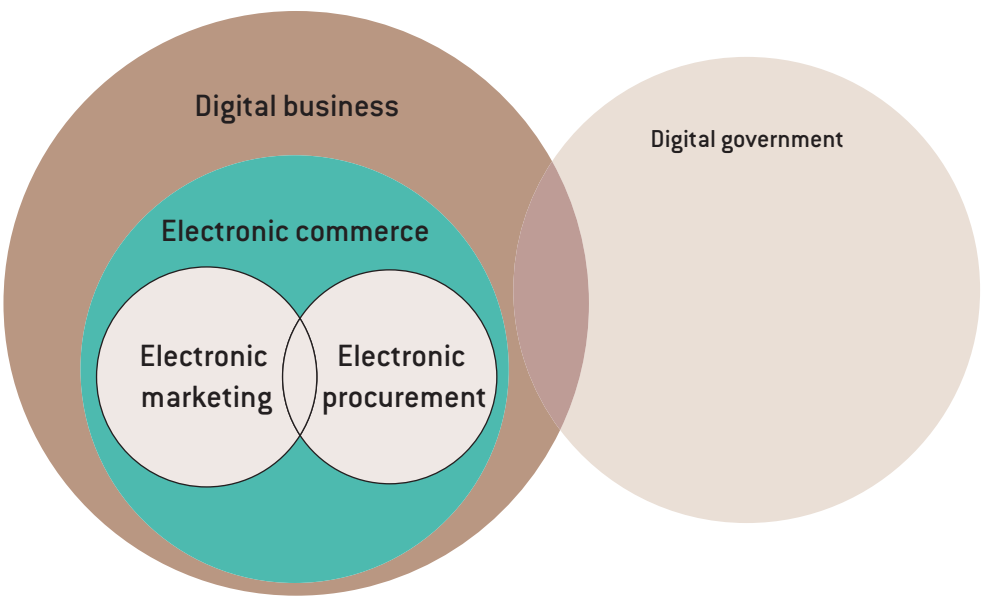


Figure 8.1 The position of electronic marketing and electronic procurement

REFLECT

There is evidence of marketing practice dating back to at least ancient Roman times. However, the term marketing as referring to the promotion of goods and services only came into use in the late nineteenth century.

8.2 ELECTRONIC MARKETING

Electronic marketing
The process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services using electronic channels.

Marketing is often defined as the activity of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organisational goals. The problem with this definition is that it suggests that marketers do an awful lot in the business. We shall focus on a narrower definition of marketing as concerned with creation and management of messages generated by the organisation about its key value proposition. This gives us a way of understanding why electronic marketing is now so important to business.

We have argued in Chapter 2 that organisations are best seen as value-creating systems. But to survive within its economic environment certain persons (consumers or customers) must conceive of what the organisation creates as of worth, and in particular, that one organisation's value is of more worth than another. Put simply then, a value proposition is a set of ideas as to why a customer should consume the value provided by some organisation. In this light, the core concern of marketing involves communicating the value proposition to potential or existing customers, particularly within the pre-sale activity system of commerce (see Chapter 6).

8.2.1 Marketing as communication

Any marketing communication can be considered as a message transmitted by the sender (marketer) to a delimited population of receivers, typically existing or potential consumers of some product or service. The marketers generally assert (intent) their belief in the content of the marketing message. The message content normally describes certain worthy properties of what is being promoted (Figure 8.2).

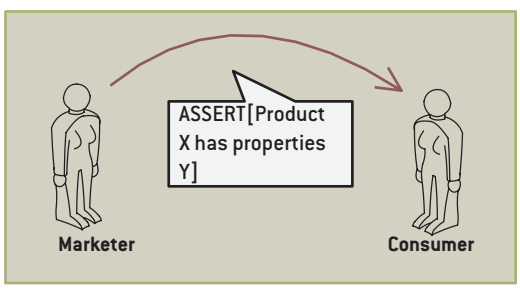


Figure 8.2 Marketing as communication

In essence, this assertion is an attempt to influence the subsequent behaviour of the receiver of the message, particularly to persuade the receiver that they should purchase the promoted product or service, and/or communicate with other potential consumers about the worthiness of the product or service (Figure 8.3).

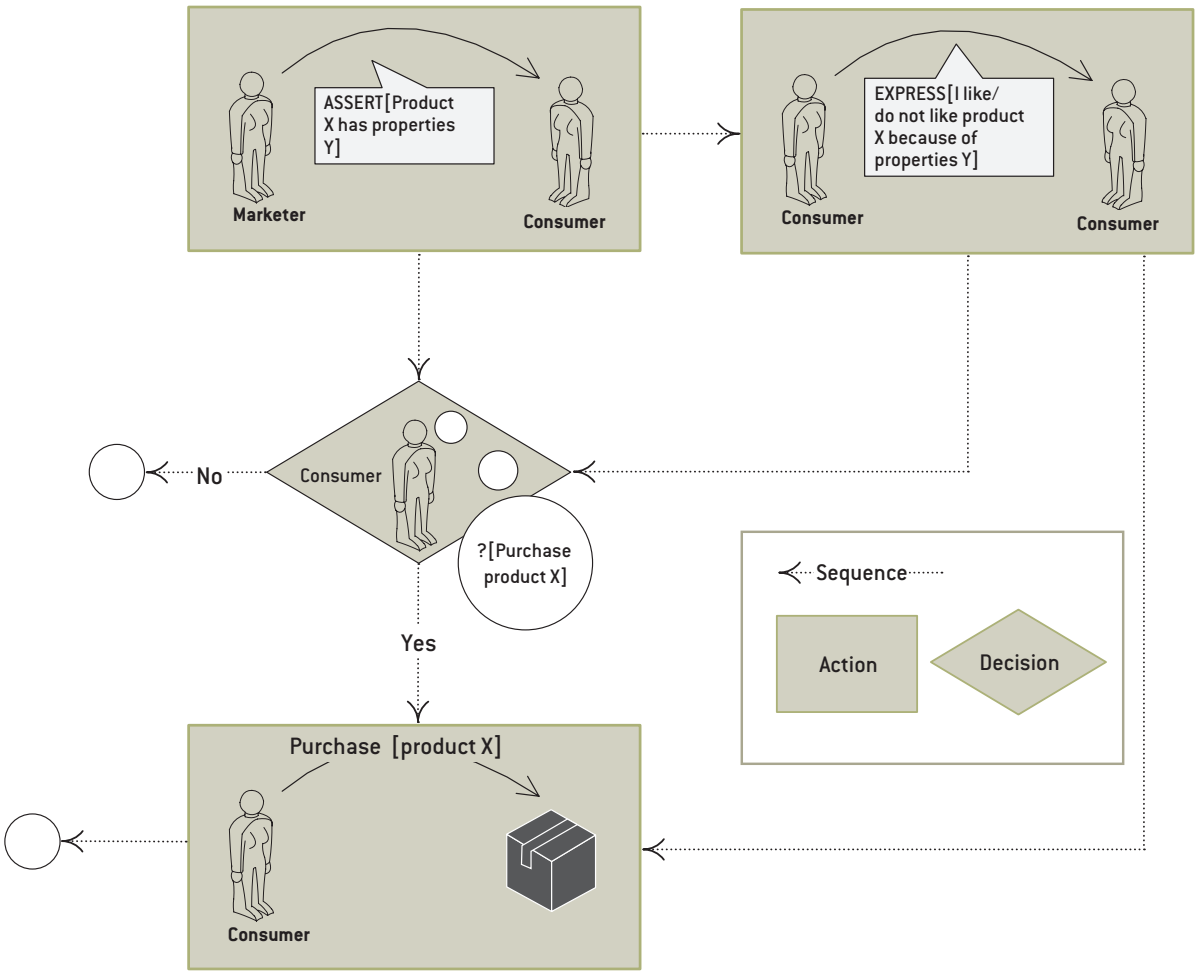


Figure 8.3 Influencing purchasing decisions

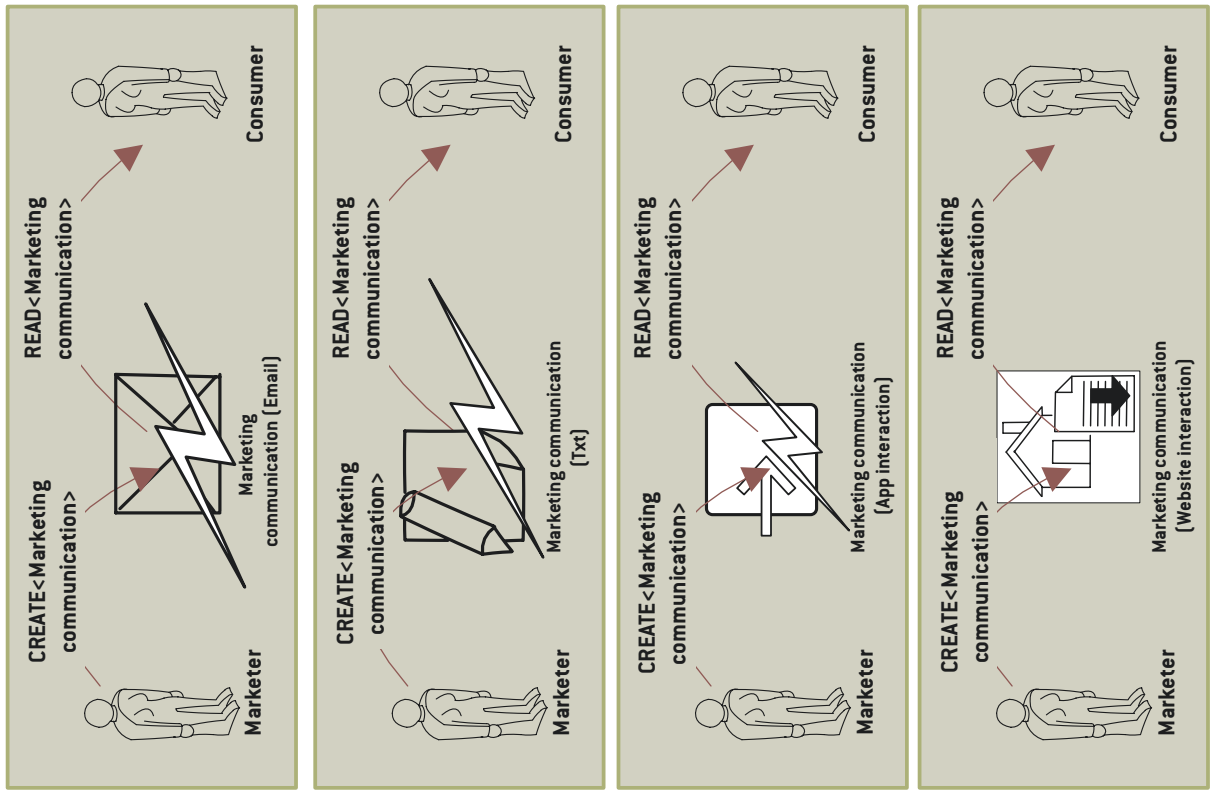
8.2.2 Marketing channels

Marketing channel
A channel for the communication of marketing messages.

A marketing communication can clearly be transmitted over a number of different communication channels. We can broadly distinguish between traditional (non-digital) **marketing channels** and newer (digital) marketing channels. Traditional marketing channels include postal advertising as well as newspaper, radio and television adverts. Digital marketing channels include email, texting, website interaction and app interaction. This helps us think about the characteristics of digital marketing channels that make them so attractive to business (Figure 8.4).

8.2.3 Traditional marketing channels

Traditional marketing channels are characterised as being push, passive, linear, event-driven and data-weak. The marketing communication is pushed to consumers (push). The communication has to be found or searched for by the consumer in some media



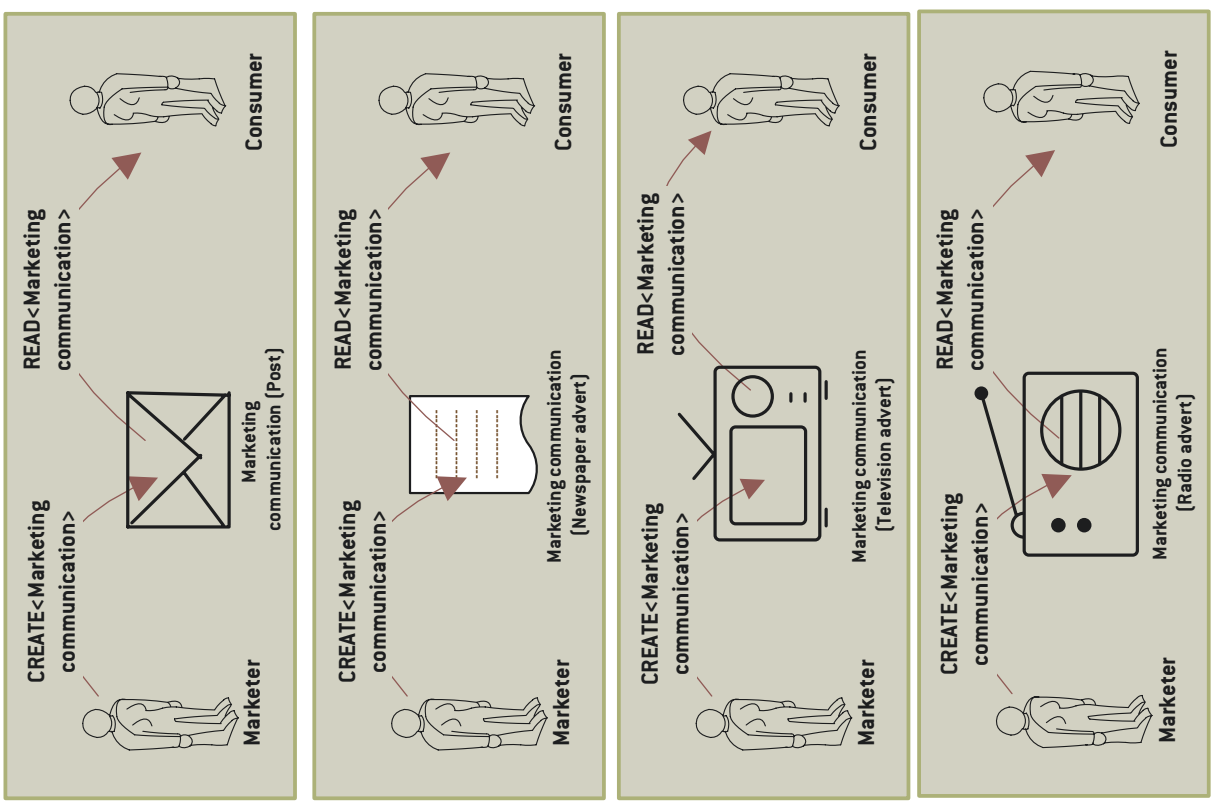


Figure 8.4 Traditional and electronic marketing

(passive). The communication is scripted to be delivered in sequence (linear). The message is typically broadcast at specific times to many potential consumers (event-driven). Little data can be directly gathered about the impact of the message in terms of consequent sales (data-weak).

Take an advertisement placed in relevant newspapers and magazines to promote a new type of car produced by an automobile company. The company pays to have the advertisement produced by a graphics company (scripting) and is likely to make a key decision on the types of newspapers and magazines to place the advertisement in on the basis of the intended customer base for the car (push). For a multinational automobile manufacturer, it will probably decide to run separate marketing campaigns in each of the countries it sends to (location-dependent). These decisions will be predicated on the assumption that potential customers will come across the advertisement while reading their newspaper or magazine (passive). The company will pay print companies to place the advertisement for a particular day; perhaps timed to coincide with some launch event for the car (event-driven). Since it appears in all copies of the particular newspapers and magazines it is effectively a broadcast of the advertisement. Advertising agencies have to engage in a number of post hoc techniques to attempt to capture evidence of the impact of particular advertisements such as interviewing a sample of customers (information-weak).

8.2.4 Digital marketing channels

Digital marketing channels are characterised as being pull, aggressive, interactive, time-independent and data-rich. Consumers are pulled to the marketing communication (pull). Marketing communications can be personalised and sent direct to particular consumers (aggressive). The consumer can interact with the content of the message (interactive). The marketing message can be communicated at any time (time-independent). It is possible to make the connection between receiving the message and completing a sale, and hence estimate the effectiveness of marketing messages (data-rich).

Potential customers themselves access the material using channels such as websites (*pull*). Such advertising also involves actively seeking out customers through technologies such as email and initiating some form of contact with them (*aggressive*). The potential customer can communicate with the company about its products and services using channels such as email and there is also potential for customising the material for particular customers (*interactive*). The marketing material can be accessed 24 hours a day, 365 days a year (*time-independent*). The material can also be accessed in different contexts in a one-to-one or one-to-many relationship between the potential customer and the business or in a many-to-many way between the customer audiences themselves. Because of the transaction-based nature of B2C eCommerce sites a vast amount of data can be captured which relate customer searching with eventual purchase (*information-rich*). Finally, marketing via the Internet can be achieved on an international scale from one location.

8.2.5 Approaches to electronic marketing

There are several different approaches to electronic marketing. We focus here on marketing through digital messages, marketing through websites, search engines and optimisation, viral marketing and marketing analytics.

8.2.6 Marketing through digital messages

Marketing through digital messages builds upon the approach of direct marketing as well as database marketing. Traditionally, direct marketing is a form of advertising in which companies provide materials such as fliers, catalogues etc. directly to consumers. The receivers of marketing messages are determined from a database containing addresses of current and potential customers.

There are a number of advantages to adding digital messages to direct and database marketing. Such marketing messages can be delivered directly and electronically over different electronic communication channels such as email, text and social media messaging. There is a significant cost-saving to organisations in delivering such messages electronically direct to the consumer access device.

8.2.7 Marketing through websites

Adverts are traditionally presented on websites in two ways – as banner adverts or as target adverts. A banner advert is a general-purpose advert presented to all visitors to the website. A target advert is a customised or personalised advert directed at a specific customer and usually based upon data gathered about this customer.

DID YOU KNOW?

Since electronic marketing relies upon digital communication infrastructure such as electronic mail the genesis of electronic marketing is sometimes seen to correspond to the invention and first use of such technology. The engineer Ray Tomlinson is credited with sending the first email to himself over the ARPANET in 1971. ARPANET was the precursor of the modern-day Internet.

8.2.8 Search engines

Search engine
A system that allows users to locate websites matching keywords.

A **search engine** is an ICT system which searches for web documents matching a set of keywords entered by the user. The search results are generally presented in a list and are often called hits. Search engines work by storing data about content, which they retrieve from HTML documents. This content is retrieved by a web crawler or spider – a piece of software which follows every link on a website and records what it finds. The contents of each page are then analysed to determine how it should be indexed. Data are then stored in an index for use in later queries. A query can be a single keyword or a set of keywords. Keywords are matched against index entries and a listing of the best-matching content is produced.

8.2.9 Search engine optimisation

Search engine optimisation
The process of optimising the chances of marketed products and services returning as hits by a search engine.

The hits returned by a search engine are generally of two kinds. There are the hits produced by the algorithm of the search engine in association with the indexes generated by the search engine. Then there are the hits returned by marketing schemes run by the search engine. Marketers spend much time and money optimising the chances of their products and services returning as hits on search engines.

One example of such optimisation is the manipulation of meta-tags. Web documents contain meta-tags, which are bits of meta-data describing the content of the document. Choosing certain meta-tags and embedding them within web documents can improve chances of ranking highly on some returned list of hits.

8.2.10 Viral marketing

Viral marketing
The idea of spreading product referrals through a social network in a similar manner to the way in which a virus might spread through a population.

Viral marketing is a type of social media marketing which builds upon features of social capital evident in online social networks. A marketing message is 'seeded' into some part of the online social network, usually by getting one or more members of the network to send the message through their social connections. Viral marketing relies upon certain features of social capital, such as people trusting what their friends tell them to attempt to increase the persuasiveness of the marketing message. Those members of the social network who act as 'hubs' linking diverse parts of the network together are particularly important to the spread of marketing messages.

8.3 MARKETING DATA

Traditionally, as we have seen, the activity of marketing has been data-weak, meaning that it has proven difficult to collect data which provide evidence of the effectiveness of marketing. Digital marketing helps close the loop within marketing to directly address this problem.

8.3.1 Closing the loop

Click per acquisition
Only if a consumer purchases a product that he/she has clicked upon is a payment made to the marketer.

Companies such as Google and Facebook gain most of their revenue from advertising. In the past, marketers paid a fixed fee to channels promoting their goods and services. Nowadays, most use the approach of revenue payment/generation called **click per acquisition** (CPA). This approach is illustrated in Figure 8.5.

The consumer clicks upon some banner or target advert upon some website. They are taken to some marketing communication which asserts the worth of some good or service. Only if the consumer purchases the promoted product or service after reading the marketing message is some payment made to the site which promoted the good or service. The key advantage of this approach is that it allows marketers to gather data about not only what adverts have been viewed, but what adverts have led to which sales.

REFLECT

With the rise of digital marketing what role does marketing research now play within business?

8.3.2 Marketing analytics

Marketing analytics
A battery of techniques employed to measure the value of eMarketing activity.

A consequence of the trend for moving much business communication online has been that much of this communication has become accessible to intelligence gathering and analysis purposes. Much of this is now referred to as web analytics, which can be seen to be a subset of business analytics. Broadly, web analytics refers to a battery of techniques employed to measure website traffic. Techniques include measuring the number of visitors to a website, the number of page views and how users navigate around a website through clicks. Web analysis such as this is typically performed in association with marketing campaigns and is used as one means of assessing the success of such promotions.

As more and more data are collected through digital marketing there has been a consequent growth in the use of marketing analytics. Marketing analytics is one example of big data, and in particular the practice of conducting complex analyses using such data. Companies use bits of software to track and report website traffic. But

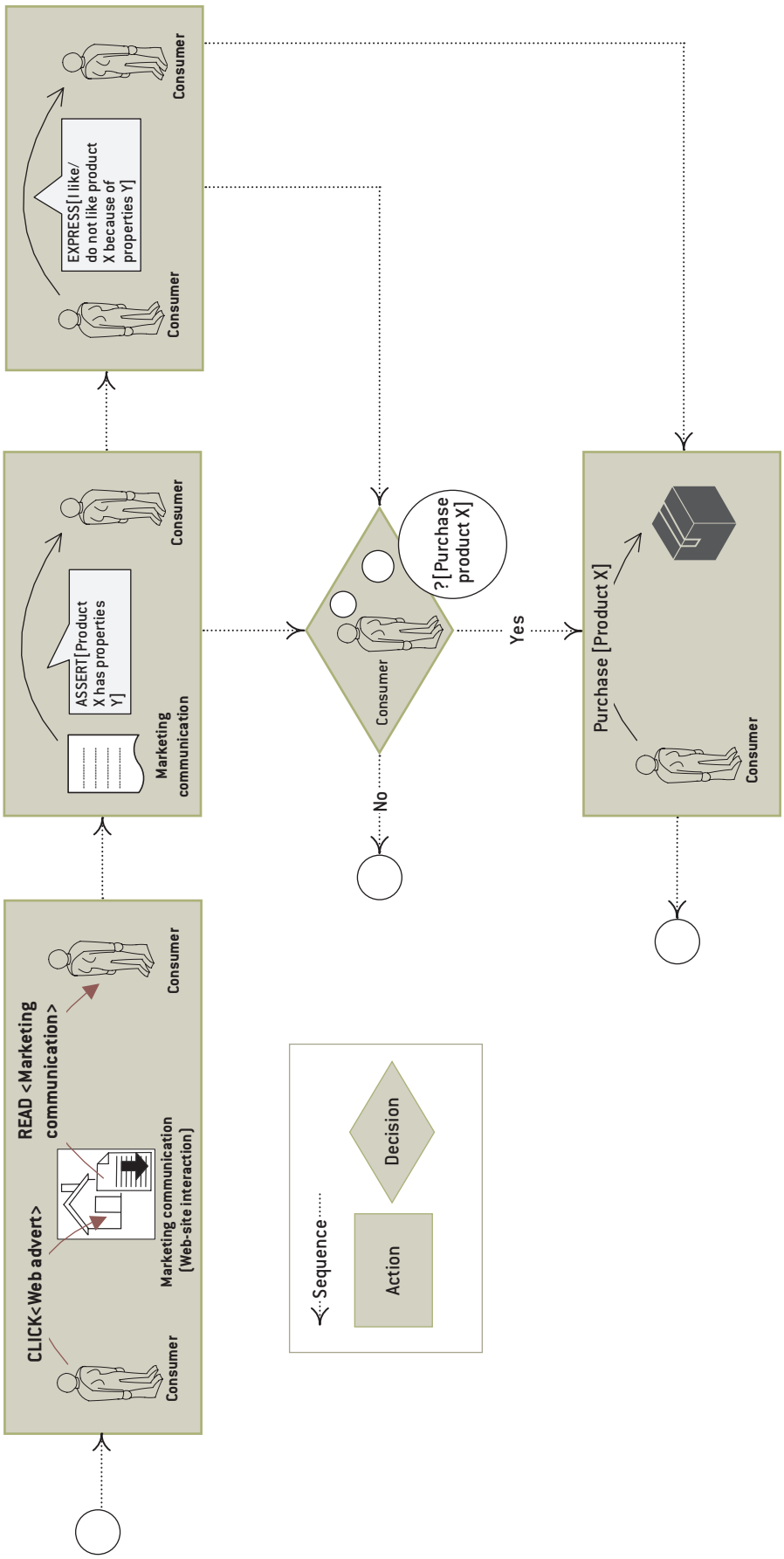


Figure 8.5 Click per acquisition

they can conduct various analyses on these data, such as determining which customer segments have viewed adverts the most. A customer segment is a classification of a type of customer in terms of properties or attributes such as age, gender etc. More importantly, they can analyse the data to determine which marketing messages have been the most successful in generating sales.

8.3.3 Tracking web surfing

The rise of business, web and marketing analytics suggests why data are said to be the new oil, because data are increasingly useful and hence valuable to companies. Transactional data gathered about people's activities are particularly valuable in areas such as marketing research. This explains why much of your web surfing activity is tracked. There is no such thing as free software. Apps supplied by companies such as Google gather data about their users.

For example, whenever you request a web page through a browser it generates a HTTP request message. The IP address of the requestor is also available to the web server servicing the request. These data are typically stored by the web server in a data structure known as a log file. Such data can be analysed to determine not only the volume of traffic to a particular web page, but combined with other data collection can determine what actions the user takes with the website. These data can then be shared with other providers to enable them to customise their future marketing messages to you, the consumer.

RECAP

Marketing is particularly concerned with communicating the value proposition of some organisation to consumers. The value proposition describes certain worthy features of the value created by the organisation, and is transmitted through marketing messages. Any marketing communication is some assertion (intent) and contains some content describing certain worthy features of the product or service. Electronic or digital marketing is particularly attractive because of characteristics such as being potentially data-rich. Approaches to electronic marketing include various forms of digital marketing communication, search engine optimisation and marketing analytics. Revenue is typically generated through cost per acquisition, which allows companies to measure the effectiveness of digital marketing. Marketing analytics is built upon a bedrock of web analytics.

8.4 GOOGLE

CASE

Google dominates any discussion of electronic or digital marketing because of the way in which its search engine has become dominant. As one of the small number of global technology companies some have raised concerns over the role it plays as gatekeeper to the Web.

Google was founded by Larry Page and Sergey Brin while they were students at Stanford University, on the back of research they were both conducting on improving the algorithms underlying search engines. The company was first created in 1998 and went public in 2004. Its published company motto is 'Don't be evil'.

Figure 8.6 lists the growth in the number of searches conducted through Google per year in billions from 2004 to 2016. Through a series of new product developments, acquisitions and partnerships, the company has expanded its initial search and advertising business into other areas such as web-based email, online mapping, office productivity and video sharing, among others.

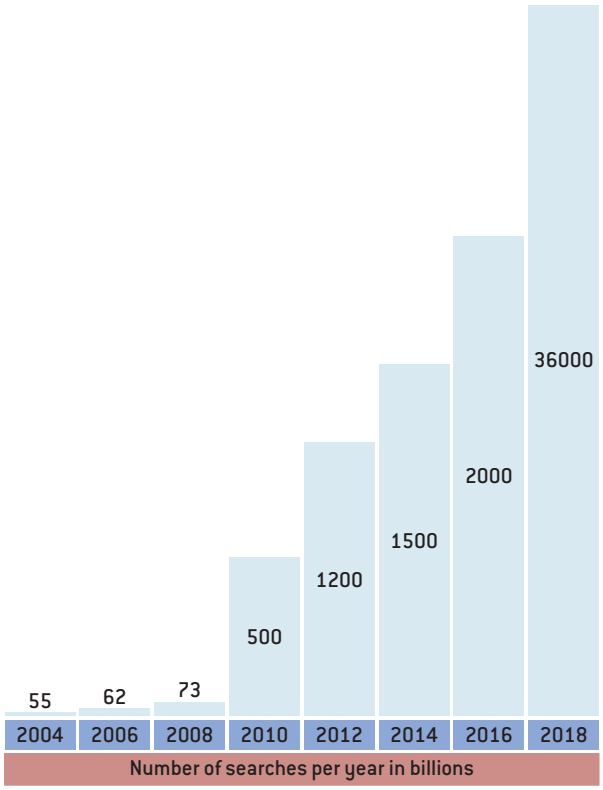


Figure 8.6 Growth in searches through Google

CASE
continued . . .

While at Stanford University, Page and Brin developed an algorithm known as Pagerank which underlies the operation of Google. Google uses webcrawlers to continuously build and maintain data structures which describe links between web documents. Pagerank analyses the links emanating from and pointing to web documents. It then assigns a numerical weighting based on this analysis which ranks each document examined. The algorithm treats links in a similar manner to academic citations. Generally, the larger the number of citations of an academic paper, the more important it is considered by the academic community. In a similar manner, Pagerank ranks a document as particularly relevant in terms of some keyword if it has many links to it.

In the early years of the Web there were many different search engines available. Google now dominates and is the most visited website in the world, handling over 1 billion queries per day and generating over 24 peta-bytes of data per day. This means that Google acts as the primary gatekeeper into the products and services offered online – what some see as a potential monopoly situation. A monopoly is a situation in which one producer controls supply of a good or service, and where entry of new producers is prevented or highly restricted. Some worry that Google's dominance of web search (and the associated marketing opportunities) is fast becoming a monopoly position, which may not be good for a digital economy. It is a bit like saying that the only way you have of buying goods and services is by visiting one, and one only, high street store.

Since Google is the most prominent example of a gateway into the Web it is not surprising to find that most of its multibillion-dollar revenue is generated from banner and target advertisements on its website. Such revenue is generated in two major ways under its adwords programme. First, advertisers bid for a series of keywords that they think should trigger an advertisement from their company on the Google website. If they are successful in their bid their chosen keywords when typed into the search engine generate a sponsored

CASE
continued…

link on the right-hand side of the Google website. Second, the related service, Google AdSense is also a key revenue stream. This allows website owners to display Google adverts on their own site, and earn revenue every time ads are clicked.

Google Analytics is a suite of web analytics software offered free by Google that tracks and reports website traffic. It has become the most widely used web analytics service on the Internet. This software can be integrated with AdWords to allow companies to track not only page views but also conversions through web advertisements – sales directly following from the viewing of marketing material.

Although Google's motto is 'Don't be evil', some see it as engaging in practices which might break this edict. Google has come under fire for implicitly allowing censorship of web content to users of the search engine in countries such as China. As we have seen, as its position as central gatekeeper to the Web, Google is in a unique position to collect data about you and use these data in various ways. This has led Google to become embroiled in the debate about who owns such personal data. Recent legislation enacted by the European Union has enforced the right for individuals to request technology firms such as Google to forget about the data it holds about them. This requires them to delete the appropriate data structures which identify and describe individuals and their activity.

REFLECT

In Chapter 6 we pointed out that axiology (the study of what people find to be of worth) very much overlaps with ethics (what people feel is good) and aesthetics (what people feel is desirable). We also hinted that marketing people are aware of this linkage and attempt to influence your purchasing behaviour by understanding as much as they can about you in terms of your ethics and aesthetics. Digital marketing clearly gives marketers much more data to use for this purpose. But ponder whether it is ethical for marketers to do this?

CAREERS VIDEOS

Mark Francis

Mark Francis undertook a BA in Business Studies and an MSc in International Marketing. He then embarked on a career in marketing, beginning at an information-providing company, but since then taking on marketing roles in the financial services industry – first at the London Stock Exchange and then at the New York Stock Exchange. Alongside these roles he also started up his own business in the late 1990s, Blue Flamingo Solutions, a digital enablement, web design and development company. Since leaving the New York Stock Exchange 2013, Mark has focussed on his business, which now has offices in Toronto as well as London.

Visit this book's companion website at www.macmillanihe.com/beynon-davies-BIS3 to watch Mark talking about his marketing career and his own business, and listen to his advice for budding entrepreneurs. After watching the interview, reflect on the following questions:

- What does Mark's business do?
- What extra skills are required to run your own business, beyond those required of an employee?
- What is digital enablement? What does it contribute to businesses?
- What impact has the prevalence of mobile devices had on businesses' commerce and marketing activities? See Chapter 9 of this book for more on mobile commerce.
- What skills are employers in Mark's sector looking for in prospective job candidates?
- What challenges or opportunities arise from developing a business internationally, rather than just in your home country?

8.5 ELECTRONIC PROCUREMENT

Electronic procurement ICT enablement of the activities of procurement.

Electronic procurement is the ICT enablement of the activities of procurement. Electronic procurement is a critical part of B2B eCommerce. So we first look at the importance of sharing electronic data structures within B2B eCommerce.

8.5.1 Sharing data structures

Commerce of whatever form involves the exchange of many data structures between economic actors and accompanying the trade itself. This is particularly true of B2B commerce in which such data structures help control credit or repeat commerce between organisations. This contributes to a significant part of the organisation's coordination costs.

The exchange of data structures is an act of communication. The data structure serves as a message with some specific content and with some purpose (intent). The data structure identifies and describes things of interest to the parties in the activity of commerce. But such data structures also indicate the action that results from the exchange.

So the intent of a purchase order, for instance, is a directive (see Figure 8.7). It directs the organisation, or more precisely certain actors enacting certain roles within this organisation, to which it is sent to fulfil it, namely to dispatch the described goods or services to the sender of the order. As an instance of B2B eCommerce, eProcurement relies on the creation and transmission of lots of data structures between companies; data structures such as purchase orders, shipping notes and invoices. Clearly, in B2B eCommerce, data structures are created and transmitted as electronic documents.

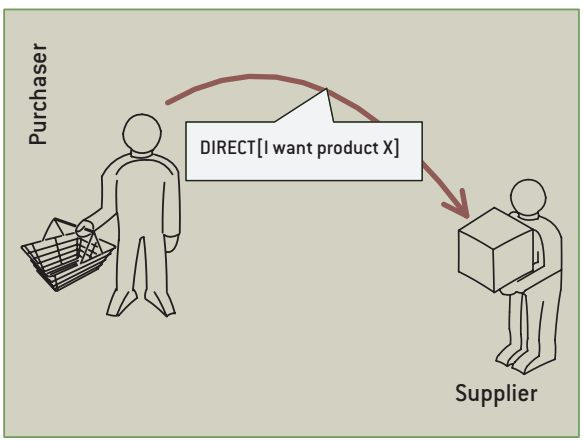


Figure 8.7 Supply as communication

8.5.2 The beer distribution game

CASE

The key role that the sharing of data structures plays in the supply chain as part of the value network can be demonstrated through use of a management simulation or game originally developed by Jay Forrester and his Systems Dynamics Group at MIT during the 1960s. The game – sometimes known as the beer distribution game – has been continually used since that time to demonstrate the important systemic nature of business activity as well as the importance of data and information to effective management.

The game is a simplification of the typical business supply chain. At its simplest this economic system consists of five economic actors – brewery (producer), distributor,

CASE
continued…

wholesaler, retailer and customer (consumer) – involved in the distribution of bottles of beer (value). These actors are clearly related by a number of exchange or commerce relationships. The retailer procures a supply of beer from a wholesaler and in turn the retailer sells this beer to customers. This situation is illustrated in Figure 8.8. Here, broad arrows are used to represent physical flow of goods while narrow arrows are used to represent the flow of data structures. Beer flows up the supply chain with associated data structures describing shipments. Orders and payments as data structures flow down through the supply chain.

Such data are needed to support repeat commerce between the customer and retailer, and the retailer and the wholesaler. In this scenario, retailers order supplies of beer in units of cases from their wholesaler. Accompanying the shipments of beer to the retailer will be shipment information frequently represented as a shipping note; there may also be an invoice for payment issued to the retailer by the wholesaler on a regular basis. At some regular interval (perhaps once a quarter) the customer makes a payment to the retailer. There is hence a regular business cycle of orders, deliveries, invoicing and payment; these data flows are used both by the wholesaler and the retailer to control their operations.

Beer flows down this supply chain in different units of volume for every week. The customer typically purchases one six-bottle pack of beer. The retailer regularly purchases four cases each containing eight packs. The wholesaler typically purchases four truckloads of beer from the distributor – each truckload carries 200 cases of beer; the distributor typically orders 200 truckloads of beer.

Shipments data also travels down the supply chain. Orders data travels up the supply chain, as does payments 'data'. There is also an inherent delivery lag between each of the actors in the supply chain. The overall average four-week lag between an order from a retailer and a response to order from the retailer is actually a composite of a supply lag between distributor and brewery, a supply lag between wholesaler and distributor, and wholesaler and retailer. Each of the actors will be experiencing fluctuation in their stock levels in response to fluctuations in demand along the supply chain. Delays in processing orders flowing down the supply chain feed back up through the chain in terms of delays in increasing levels of production and distribution.

This game has been run many thousands of time at management schools around the world. The experience is the same – one of oscillation and amplification characteristic of many business activity systems. Following an increase in demand the inventory level of the retailer declines. This leads to an increase in orders by the retailer causing, in turn, a decline in the inventory levels of the wholesaler, distributor and factory. Players soon stock out. Backlogs of unfilled orders grow. Faced with rising orders and large backlogs, players dramatically increase the orders they place with suppliers. Eventually, the factory brews and ships this huge quantity of beer and inventory levels rise dramatically.

The scenario enacted in the beer distribution game is effectively an example of the problems of control in systems of business activity. The effective use of data systems (ICT) and associated information systems can mitigate the managerial effects experienced in this scenario in a number of ways. Such systems can speed up the transmission and processing of data leading to more effective communication and decision-making. More effective integration of data between activity systems, such as making orders and producing beer, can also help reduce the lags experienced in the supply chain. Information systems can allow visibility of activities across the supply chain, for example, being able to match order fulfilment with product tracking. Information systems can also be used to store historical data, allowing trends in both consumer and supply behaviour to be determined and acted upon. Many such reasons underlie the growth in electronic procurement.

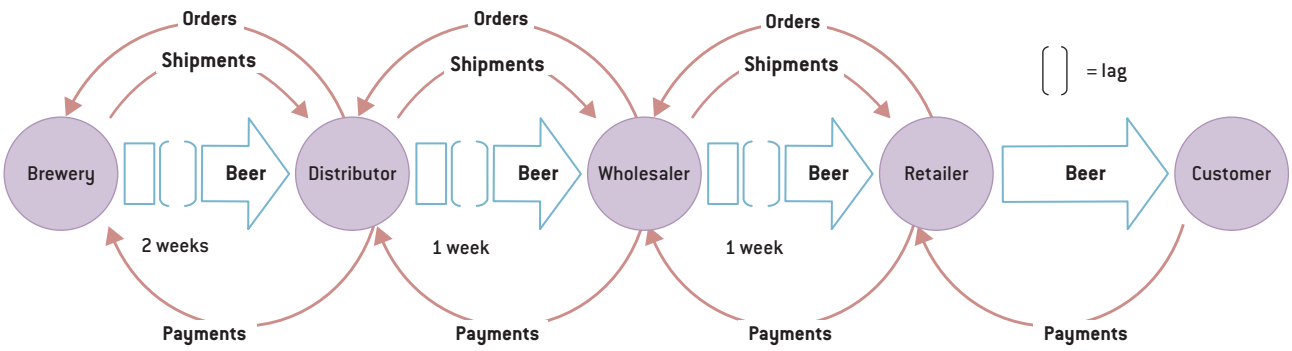


Figure 8.8 The flow of goods and data through a simple supply chain

REFLECT

Does the development of better information systems necessarily lead to better control of activity systems within commerce?

8.5.3 Electronic documents

Clearly, in any B2B relationship there must be agreement about the form of such data structures for this electronic transfer to become possible – what things are identified and described, and how they are identified and described in the document. Historically, a set of standards for electronic documentation was based in something known as electronic data interchange (EDI). More recently, electronic document standards tend to be defined in terms of Extensible Markup Language (**XML**), which is based upon the web language HTML.

XML
Extensible Markup Language is a meta-language for the definition of document standards.

Participants in some industrial area agree a set of tags and then these tags are used to form electronic documents with which to transmit and transfer data. The simple XML specification in Figure 8.9 describes data items relevant to the buying and selling of coffee beans.

```
<ProductDetails ID='1234'>
<ItemName>Kenya Special</ItemName>
<CountryOfOrigin>Kenya</CountryOfOrigin>
<WholeSaleCost>20.00</WholeSaleCost>
<Stock>4000</Stock>
</ProductDetails>
```

Figure 8.9 An XML specification

8.5.4 Commodity coding

Commodity code
A code used to identify and sometimes describe a product.

B2B transactions also rely on standard ways for identifying and describing things, through schemes like **commodity coding**. A European Article Number (EAN), for instance, provides a hierarchical set of codes which allow companies to code things such as product codes and manufacturer codes. Also known as the International Article Number it consists of a 13-digit code such as 4 012345 123456. International article numbers might even be represented within an organisation's data systems as

barcodes, and used to identify the manufacturer and type of products. So, in the case of Goronwy Galvanising, barcodes might be used to identify ungalvanised steel lintels inbound from customers as well as galvanised steel material outbound back to such customers.

8.5.5 What is procurement?

Procurement
A secondary activity in the internal value chain. Procurement is the process of purchasing goods and services from suppliers at an acceptable quality and price, and with reliable delivery.

Production-related procurement
Procurement designed to support manufacturing operations.

Operating procurement
Procurement conducted to support all the operations of the business.

The pre-sales activities of search, negotiate and order in the supply chain are frequently referred to by the umbrella term '**procurement**'. Sometimes, the term procurement is used to refer to all the activities in the supply chain, and then is equivalent to B2B eCommerce. Procurement is sometimes defined as the purchasing of goods and services from suppliers at an acceptable quality and price with reliable delivery.

Two types of procurement are important: **production-related** and **operating procurement**. Production-related procurement is designed to support the core operations of the organisation, such as a manufacturing operation. This type of procurement is directed at fulfilling the long-terms needs of the organisation for customised goods and services. And, as such, is normally undertaken through established and regular relationships with a limited number of suppliers. Hence, this form of procurement is typically controlled through some form of managerial hierarchy.

Non-production or operating procurement is conducted to support all the operations of the business. This type of procurement is designed to fulfil immediate needs typically for commoditised items. This means that relationships with suppliers tend to be irregular and temporary. Hence, this form of procurement can operate through the market.

Consider the case of Goronwy Galvanising. It has a regular need for zinc as raw material for its manufacturing. Hence, this is procured from one main supplier, Rito Metals, in a long-term relationship. In contrast, Goronwy has lots of requirements for things like office equipment, computer equipment and so on. This it fulfils through operating procurement in the market.

8.5.6 The traditional organisation of procurement

Traditionally, procurement is a human-intensive system of organisation. Employees first search for a product matching a need. Details of the product are then entered on a requisition form which is then sent to the purchasing department. Purchasing then complete a purchase order which is sent to an established supplier. The supplier dispatches goods to the company with an attached shipping note. When the goods have been checked a payment authorisation is issued to the finance department who pay the supplier. The goods are then dispatched to the originating department (Figure 8.10).

We can measure the performance of some system of organisation in various ways (see Section 2.5.4). Efficacy involves an evaluation of whether we are doing the right thing, efficiency is an assessment of whether we are doing something with minimum resource, whereas effectiveness involves asking whether what we are doing contributes to some higher-level goals.

So we might measure the efficiency of the systems of traditional procurement in terms of the time it takes to complete each activity on average. Some average figures for these activities are indicated in Table 8.1. The average duration of this system of organisation is large because of inherent delays, lags or waiting times involved in the articulation of various data structures by multiple actors. A requisition may sit in the in tray of a purchasing actor for up to 12 hours before receiving attention.

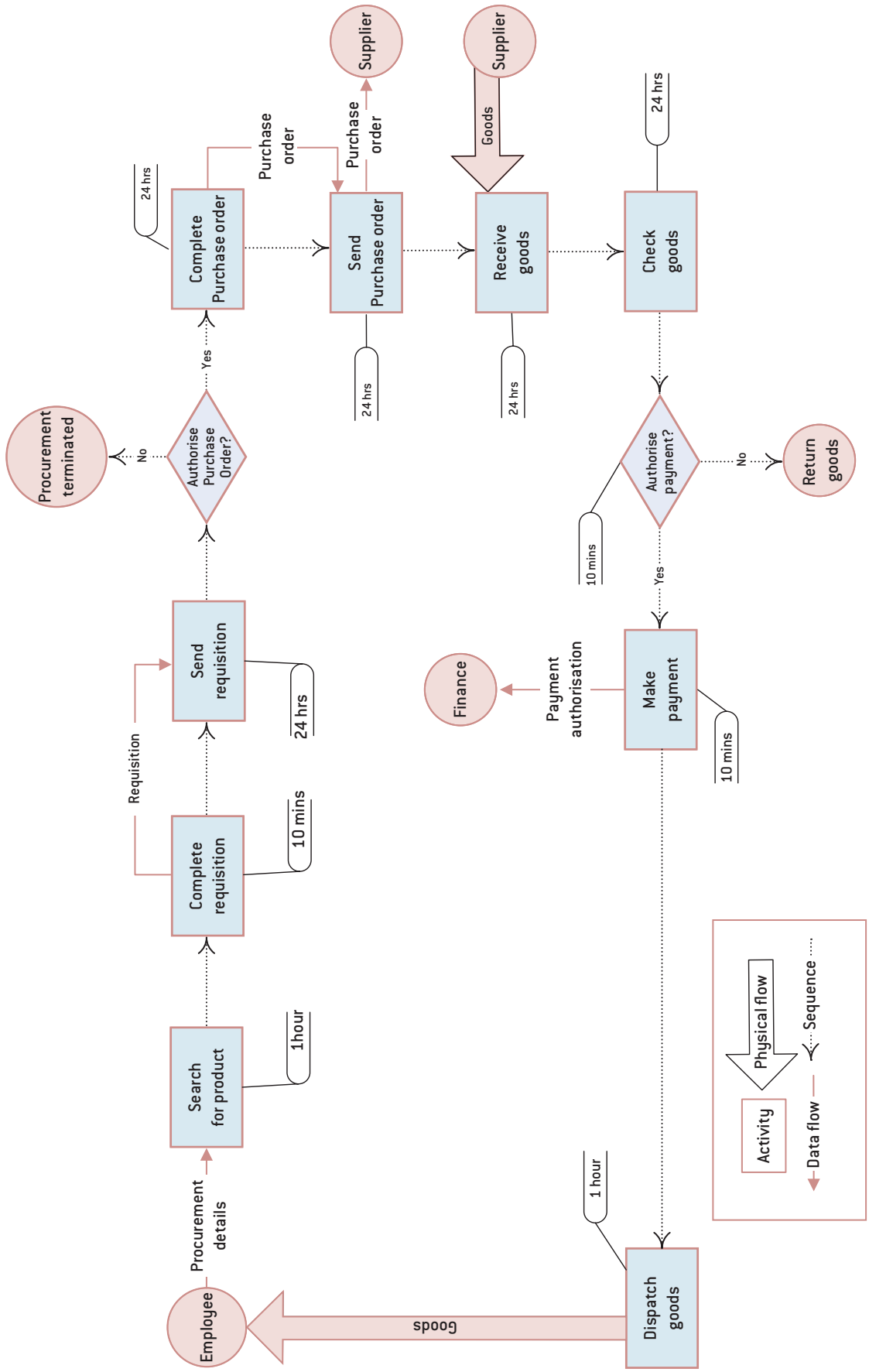


Figure 8.10 Traditional procurement

Table 8.1 An evaluation of the performance of traditional procurement activity

Activity	Average time
Search for product and product identified	1 hour
Complete requisition	10 minutes
Send requisition	24 hours
Receive requisition	12 hours
Authorise and complete order	24 hours
Send order	24 hours
Delivery from supplier	24 hours
Receive goods	24 hours
Check goods	24 hours
Authorise payment	10 mins
Dispatch goods	1 hour
Total	6 days 14 hours and 20 minutes

8.5.7 Electronic organisation of procurement

There are a number of different ways in which electronic procurement might work. Figure 8.11 illustrates just one. Here, employees search for a product matching a need online. Product details are automatically entered upon an electronic purchase order. The purchase order is checked, completed, sent electronically to a supplier and logged. The supplier dispatches goods to the company and these goods are checked against the purchase order. If satisfactory, electronic payment is made.

The efficiency of electronic procurement is evident in the reduction in time it takes to handle a purchase order. This is a classic example of the reduction in the cost it takes to coordinate the activity of a buyer and a seller (Table 8.2).

The example provided is more an instance of an operating than a production-related procurement. Production-related procurement is more complex generally because it involves quite a lot of activity in sourcing of bespoke goods and services. Electronic procurement can therefore be used to redesign the systems of sourcing, purchasing and payment for goods and services. The example we have covered relates to purchasing and payment, so let us have a look at sourcing.

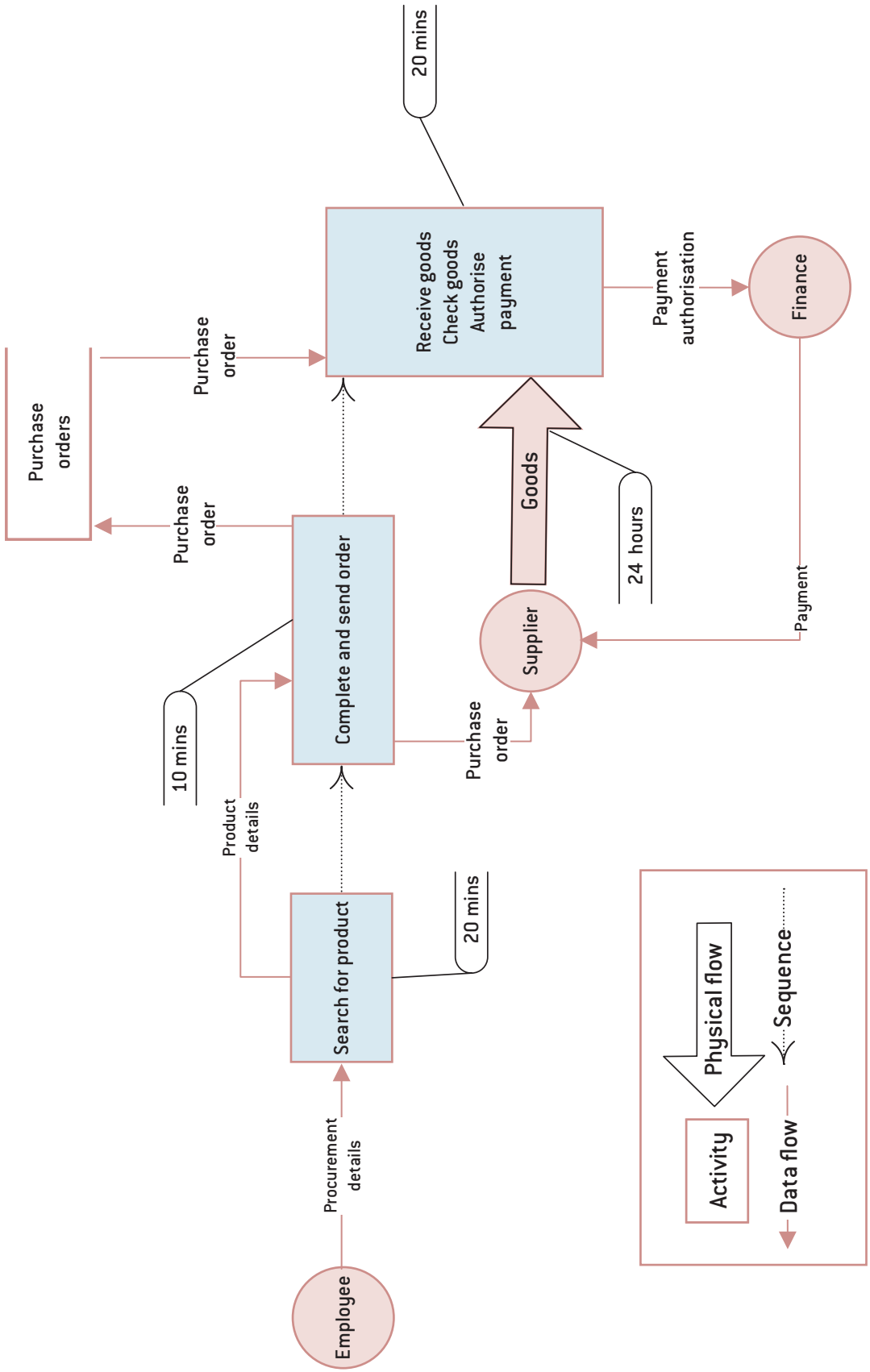


Figure 8.11 Electronic procurement

Table 8.2 An evaluation of electronic procurement

Activity	Average time
Search for product and product identified	20 minutes
Complete order	10 minutes
Delivery from supplier	24 hours
Receive goods, check goods and authorise payment	20 minutes
Total	1 day 50 minutes

8.5.8 Electronic sourcing

Electronic sourcing
The sourcing, typically of bespoke goods and services, from suppliers by electronic means.

Electronic sourcing typically involves the use of electronic tendering systems. Such systems allow organisational actors to prepare requests for quote (RFQ). Electronic RFQs can then be issued to potential suppliers. The system then manages the bids made by suppliers sometimes through auction. Actors select the best bid and award the contract to the supplier.

The ICT system for electronic sourcing is typically built to run within the ICT infrastructure of the organisation doing the sourcing. Parts of this ICT system are then made available to potential suppliers. Another way of doing this is through a B2B hub. This is an intermediary in the supply chain which manages procurement activities for clients, such as sourcing.

8.5.9 Just in time

Just-in-time
JIT is a set of practices where the flow of value is pulled through the value stream (value chain) when it is required by consuming activity.

Electronic procurement is particularly associated with a supply chain philosophy known as **just-in-time** (JIT) manufacturing. JIT is a set of practices where the flow of value is pulled through the value stream (value chain) when it is required by consuming activity. This pulling of value can be relevant both to the internal value chain and the external value network. Here, we focus upon its use within the supply chain as a way for inventory to be automatically replenished from an external supplier.

For just-in-time inventory management to work, some signal must be sent to a supplier just in time for them to take action to dispatch necessary goods. One way for this to work is to give a trusted supplier access to certain data structures held about inventory by the company. Such access might be provided through an Extranet.

REFLECT

A system is resilient if it can adjust and adapt to environmental turbulence. Some have claimed that JIT systems are not particularly resilient to environmental changes such as failures in ICT infrastructure or transportation systems. Reflect on how JIT systems might be made more resilient.

RECAP

Procurement refers to the set of activities involved in the sourcing, purchasing and paying for goods and services with suppliers. Production-related procurement supports core operations and involves the procurement of bespoke items or services. Operating procurement supports the supply of commoditised items or services for all aspects of the business. Electronic procurement typically offers savings in coordination costs. Procurement, just like many other business activities, relies upon electronic documentation. Procurement also relies upon standard commodity coding.

8.6 ELECTRONIC GOVERNMENT

Electronic government
The application of ICT within government organisations.

There are traditionally held to be three parts of the economy – the private, public and voluntary sectors. The public sector is concerned with providing various government services on a not-for-profit basis. The voluntary sector also provides various not-for-profit services, but these are typically non-governmental in nature. As a term, *electronic business* or *digital business* is normally used to refer to ICT enablement of activity systems within private sector organisations. But the redesign of activity systems through and with ICT is also of importance to the public sector, particularly within government and its agencies.

The term *electronic government*, sometimes *digital government*, refers to any ICT enablement of the activity of governing. The electronic government agenda is normally seen to have originated within President Bill Clinton's Administration in the United States during the early 1990s. At this time, Vice President Al Gore associated the development of the 'Information Superhighway' with the reinvention of government. Since the 1990s many major nation-states internationally have instituted programmes for electronic or digital government.

This agenda worldwide has been influenced by a collection of ideas often referred to as new public management, public sector modernisation of sometimes transformative government. You can see some areas of similarity with the systems view of organisation promoted in this book. The first idea is that government can be considered an activity system or a set of interrelated activity systems. These activity systems should be designed and controlled to fulfil some clearly defined goals. Public sector service delivery should be open to competition from the private sector or outsourcing to the voluntary sector. Citizens should be seen as the customers of public sector services and should receive the best value from such services. The performance of government and its agencies should be monitored through explicit performance measures.

8.6.1 The nature of government

Government
The activities of enabling and supporting democracy, developing and implementing policy, and delivering services.

Government typically fulfils three major functions: enabling and supporting democracy, developing and implementing policy, and delivering services.

Developing policy and enacting legislation are the two primary activity systems of the executive arm of government. This involves evidencing and formulating policy, enacting policy in legislation and moving legislation through democratic bodies, such as parliament. Enabling and supporting democracy involves activity systems as diverse as engaging with civil society, scrutinising the activities of government in bodies such as parliamentary committees and holding national, regional and local elections. Delivering citizen services involves activities as diverse as collecting taxes, paying benefits, running schools, delivering healthcare and collecting waste.

Electronic government to date in most countries around the world has focused mainly on the last of these functions, perhaps because of the ease with which various

business models associated with electronic service delivery have been adapted from the commercial sector.

We should also recognise that government is exercised in many countries through service tiers. For example, in the UK, central government refers to the government executive and its ministries as well as the Houses of Parliament (the Commons and the Lords) situated in London. Regional government refers to the fact that certain powers and activities are devolved to government administrations in Scotland, Wales and Northern Ireland. Local government refers to the lowest level of government. In the UK, Local Authorities undertake a number of different activities focused on relatively contained and limited areas of the country.

Different tiers of government provide different forms of value – different services to different people. So collecting income taxes or paying welfare benefits is primarily the responsibility of central government in the UK, while collecting council (household) tax or providing free school meals is the responsibility of local government. Yet other services are outsourced to intermediaries in the customer or citizen chain of government – such as Citizens Advice which provides help to people accessing government services.

We should also recognise that some public services can be provided as digital value, whereas other services involve the creation of non-digital value, but which can be supported through ICT. So paying taxes and applying for and receiving welfare benefits are undoubtedly forms of digital value, whereas providing policing and waste disposal are undoubtedly forms of non-digital value.

DID YOU KNOW?

The United Nations has conducted surveys of eGovernment globally every two years since 2001. It has developed an index of eGovernment maturity which ranks countries on their adoption of eGovernment. In 2018 the top 10 countries in rank order were Denmark, Australia, Republic of Korea, the UK, Sweden, Finland, Singapore, New Zealand, France and Japan.

8.6.2 Types of electronic government

We may view government in systems terms of the major control process in a political system; this provides meaning to the concept of governance. In the modern Western world it has been argued that governance is now undertaken by a network of stakeholders, not all of which are traditional political organisations or even public sector organisations. In this view, the disaggregation of the government value network which this implies demands an increasingly sophisticated infrastructure of technology to support communication and coordination between a diverse network of actors.

It is possible to identify at least five major forms of eGovernment in terms of the value network idea (Figure 8.12). These forms are located around the major value chains within the network and hence typically involve different stakeholders in the system of government.

8.6.3 Internal eGovernment

Internal eGovernment Internal eGovernment refers to the enablement of internal processes within the government body itself with ICT.

Government agencies must cooperate in delivering common services to its citizenry. **Internal eGovernment** refers to the enablement of internal processes within the government body itself with ICT. The major actor involved is the employee of the government body and the value chain supported is the internal value chain. In this area the significant innovation is the integration of back-office systems and processes within government. For example, within the UK, many back-office activities in government

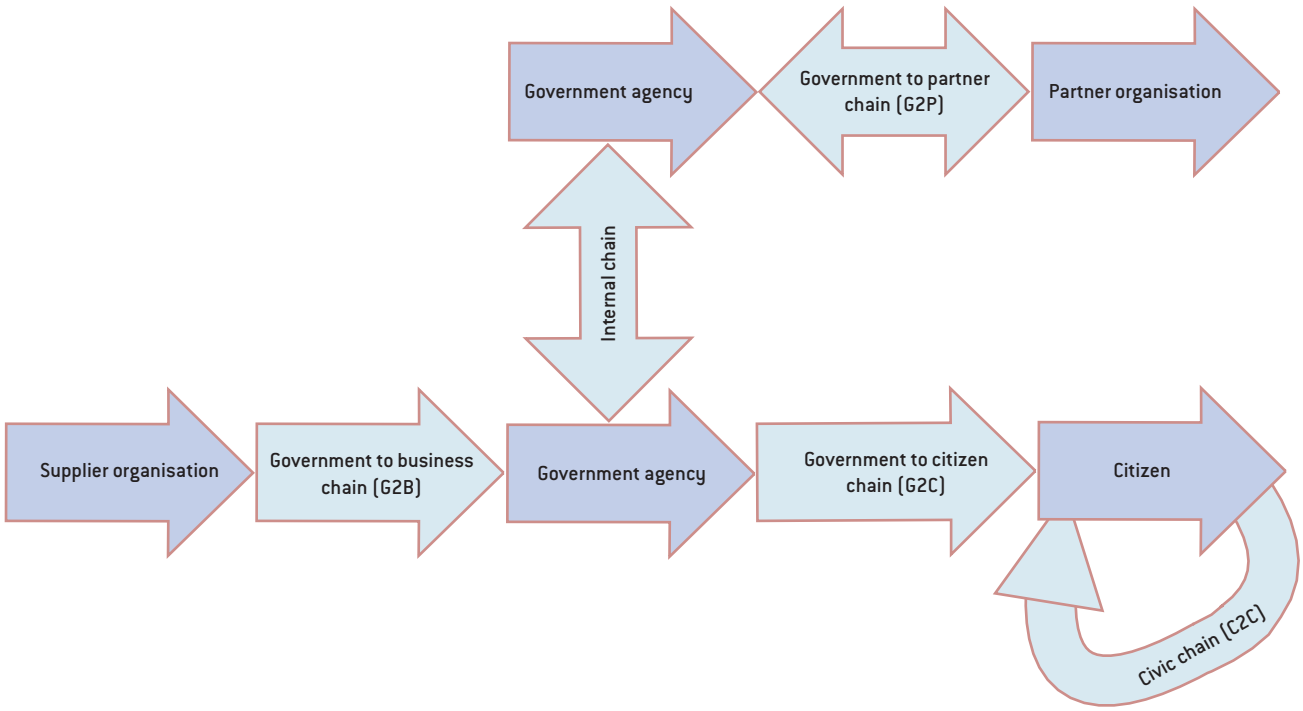


Figure 8.12 The value network of government

agencies such as HM Revenue and Customs, HM Land Registry and HM Passport Office rely heavily upon ICT infrastructure.

8.6.4 G2C eGovernment

G2C eGovernment
G2C, or government-to-citizen eGovernment, is a form of external eGovernment since it is particularly involved in supporting the customer chain of the government body.

G2C or government-to-citizen eGovernment is a form of external eGovernment since it is particularly involved in supporting the customer chain of the government body. Since the major stakeholder involved is the citizen, many of the so-called customer chain issues within digital business travel over into **G2C eGovernment**. However, many distinct issues arise in the public sector nature of service provision such as diffuse – sometimes conflicting – goals characteristic of government bodies and the difficulties inherent in the customer/citizen distinction. The key promise of digital government in this area is particularly seen as the process of disintermediation – providing direct contact between citizens and the agencies of government. For instance, much of the effort made by HM Revenue and Customs over the last two decades has been devoted to redesigning key aspects of its customer chain by providing G2C services via its website.

Take the example of paying taxes. To work in the UK you must have a national insurance (NI) record. Such data structures are held in the ICT systems of the Department of Work and Pensions. Your national insurance record is shared with another government agency – the Revenue and Customs service. For most working people in the UK both income tax and national insurance are deducted automatically from their paid income and transferred electronically into the bank accounts of the agencies involved. However, a certain group of people are classed as self-employed and these people have to declare their income on an annual basis using a tax return. This document can be filled in electronically using a website provided by the Customs and Revenue service. Tax due is calculated automatically by the business rule embedded within this application, and payment for any tax due can be made electronically through this website. A similar system is available called myTax, offered by the Australian taxation office.

8.6.5 Digital by default

Digital by default
This means that the primary access channel to government services is deemed to be through remote access.

There are currently at least three ways of accessing government or public services. Various agencies might provide face-to-face access with an employee of government. Hence many Local Authorities in the UK provide walk-in centres where staff help citizens with their issues, usually supported by accessing ICT systems. Another tier is access provided to a contact centre, typically providing telephone communication to citizens. The third tier of access is via a government website. To save costs many agencies are adopting a policy of digital by default, meaning that the primary access channel to government services is deemed to be through remote access. The problem here is that many of those persons who most access government services, such as the poor and elderly, are the most likely to be digitally excluded (see Section 6.5.7).

REFLECT

Can any government service ever be fully digital in the sense of only providing access to such services by digital access channels?

8.6.6 G2B eGovernment

G2B eGovernment
G2B, or government-to-business eGovernment, concerns electronic enablement of the relationships between government bodies and the private sector.

G2B, or government-to-business eGovernment, concerns electronic enablement of the relationships between government bodies and the private sector. One of the major forms of such relationship involves management of the supply chain. Hence many of such supply chain issues are held to be similar in nature to digital business issues in this area. However, many features of the context of public sector procurement shape the relevance of technological solutions in this area.

Procurement is, of course, not only an important activity for the private sector, it is equally important to the public sector. Government agencies are large-scale customers of private sector companies. In the period 2014 to 2017, 263 billion pounds sterling was spent on government procurement of goods and services in the UK. A number of G2B web portals have been built around Europe in an attempt to not only improve the efficiency of government procurement, but also to enable the private sector greater access to public sector contracts.

8.6.7 G2G eGovernment

G2G eGovernment
The use of eGovernment to support intragovernment cooperation and collaboration.

Much of eGovernment's success is based on delivering what has been referred to as 'joined-up' government. This is the key issue for G2G eGovernment – the use of eGovernment to support intragovernment cooperation and collaboration. This can be seen to be an internal value chain issue for the super-system of government. Significant issues in this area include interoperability of systems and data sharing between government agencies. For instance, many of the held benefits claimed for the introduction of a national identity card in the UK (see Section 11.6.3) revolved around improving public service delivery through better data sharing between government agencies.

Consider the activities undertaken by various government agencies that interact with two citizens that wish to get married. The activity system might look like that illustrated in Figure 8.13. The activities visualised are likely to be conducted by different government agencies before, during and after the marriage itself.

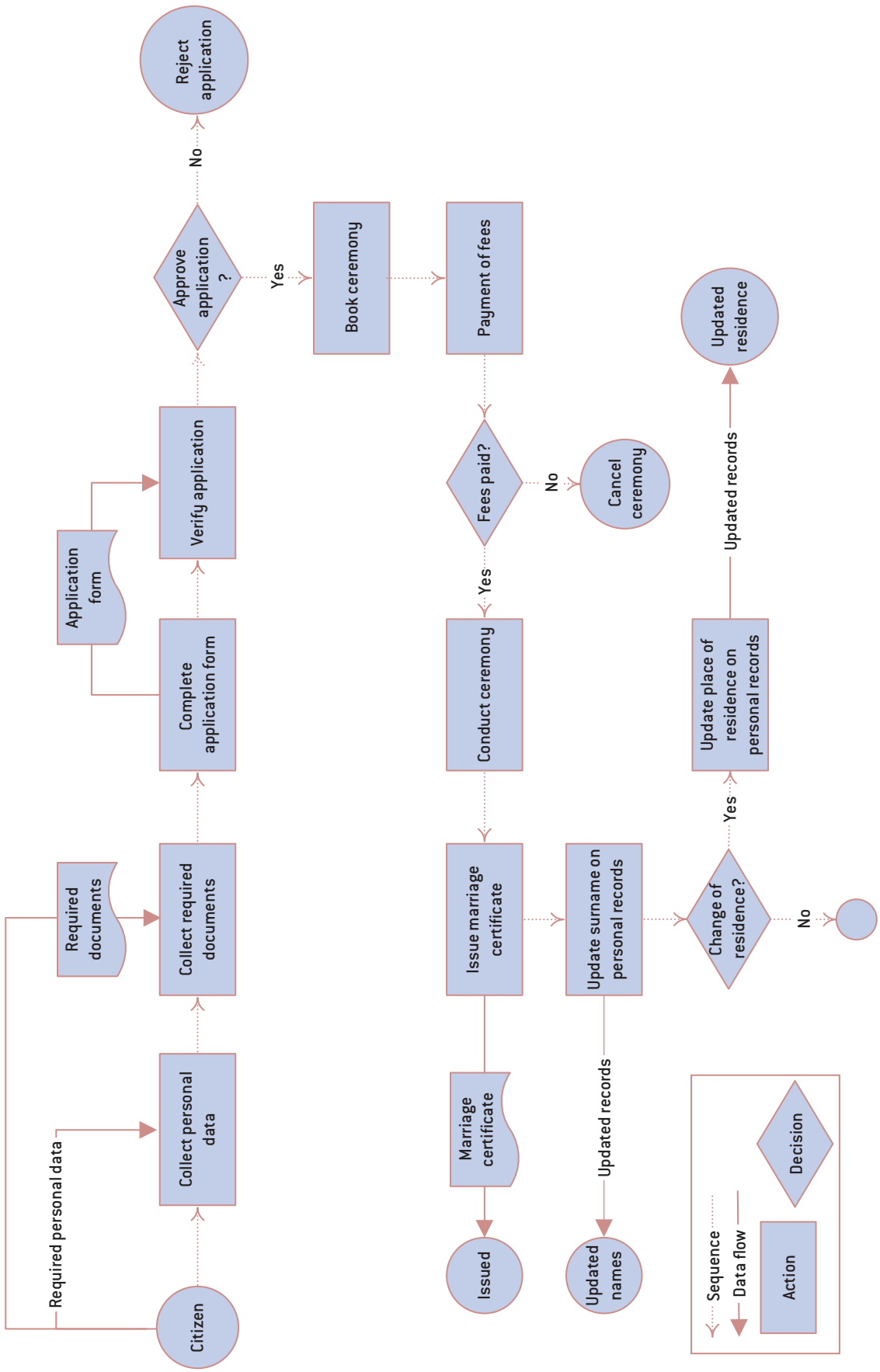


Figure 8.13 The activity system of civil marriage

This pattern of action is an example of how data structures (see Chapter 3) are critical to the life of citizens. A marriage certificate triggers a change to your institutional status, and many government agencies must react to this change in status.

8.6.8 C2C eGovernment

C2C eGovernment
Citizen-to-citizen eGovernment. Enablement of the community chain with eGovernment.

C2C (citizen-to-citizen) eGovernment concerns enablement of the community chain of government bodies with ICT. C2C interaction is not traditionally seen to be a part of government. However, it is likely to be an increasingly important part of governance, particularly in the way it links with two of the other functions of government – democratic accountability and policymaking. As an example, the UK government has an online petitioning system. Using this system any UK citizen can establish an online petition and collect signatories. If a petition collects 100,000 signatures, the issue may be debated in the House of Commons.

8.6.9 G2P eGovernment

G2P eGovernment
G2P (government-to-partner) eGovernment involves ICT enablement of activities between government and its partners.

G2P (government-to-partner) eGovernment involves ICT enablement of activities between government and its partners. Many services are now no longer provided by government agencies themselves. Hence there is a significant degree of re-intermediation evident in a government value network. Such services are either outsourced to private sector organisations or even run by voluntary sector organisations. In this sense, government works in partnership with such organisations and must share data with them about the citizen. Many voluntary sector agencies such as Citizens Advice are now funded by central government to deliver services which used to be part of public sector service delivery.

8.6.10 Citizens Advice

CASE

The Citizens Advice Bureau, now named Citizens Advice in the UK, is one of the foremost independent charities in the country. It has two main goals: to provide the advice people need for the problems they face, and to improve the policies and practices that affect people's lives. The organisation delivers advice free of charge largely through part-time volunteers working out of thousands of community locations in England and Wales, and run by hundreds of individual charities. Advice ranges from personal finances and housing matters to legal matters and consumer issues. Citizens Advice also campaigns for improvements in the delivery of public services.

During much of its history advisors used a paper-based system to record data about casework. Comprehensive paper 'manuals' of legislation and welfare information were provided to help advisors in their work. Staff communicated with other government agencies and private sector organisations primarily through letters. In recent years, to help support its dispersed activity infrastructure, the organisation has created a shared ICT infrastructure. A key part of this is two websites. One of these is accessible only to advisors and is used to update and distribute content on matters ranging from employment law to benefits entitlement, housing regulation and debt management. The other website is available to the general public and is updated on a regular basis not only to provide general advice on citizens' issues but also details of how to access Citizens Advice through the advice network.

8.6.11 The citizen record

CASE

It should be apparent that a major part of electronic or digital government relies upon the creation and sharing of data structure about the citizen. Some have suggested that this requires the need for a common citizen record held centrally but shared between all agencies that need access to it. But this idea has not achieved realisation in countries such as the UK because of its association with the potential abuse of personal identity management (see Section 5.10.2) for the purposes of government surveillance, monitoring and control.

DID YOU KNOW?

The passport is probably the oldest form of document used for the identification of individuals. The earliest recorded version of the passport was introduced by King Henry V of England with the Safe Conducts Act of 1414.

8.7 INDIAN IDENTITY NUMBER

CASE

Modern India is a significant force in the global ICT industry, particularly in relation to its offshoring operations situated in Bangalore. But India is also attempting a transformation in electronic government, part of which is the country's attempt to assign a unique code number to each of its estimated 1.2 billion citizens. This universal personal identifier is seen as important for Indian citizens in supporting their interaction not only with government but also many aspects of the private sector on the subcontinent.

The attempt to enrol persons in this national personal identity management system (see Section 5.10.2) was originally based upon a strategy of trying to alleviate poverty, improve access to government services and reduce corruption. India still suffers from high levels of poverty with some estimates claiming India has a third of the world's poor. The reasons for such poverty are complex but include the economy's high reliance on agriculture, its burgeoning population, poor penetration of market economy and government overregulation.

In response, a number of government programmes have been established which attempt to distribute food, fuel and fertiliser to the poor. However, a substantial proportion of such distribution goes missing. For example, two thirds of the subsidised grain that the government allocates to the poor in India is either stolen or adulterated by middlemen. The Indian government also spends 8 billion rupees a year to a scheme creating work for the rural poor. But much of this funding ends up in the pockets of middlemen who invent ghost workers to siphon off government payments. Registration for such government work programmes is also difficult for the poor because of its time-consuming nature and the need to obtain necessary paperwork, frequently needing to bribe officials to gain access to such documentation. Also, this paperwork is needed every time a citizen moves between states in the subcontinent. The lack of personal identity is also seen as contributing to high levels of voter fraud which is evident at regional and national elections.

One significant issue is seen to lie at the heart of such problems: the fact that many Indian citizens cannot prove who they are and where they live. India recognises at least 20 different proofs of identity including birth certificates, caste certificates, tax codes, passports and driving licences. Universal personal identifiers are considered important in a country where many people lack such identity documentation. Many villagers in remote areas even have the same forenames and surnames, and many lack skills in literacy. This lack of identification means that they cannot open bank accounts and find difficulty accessing government welfare and private sector credit. Two thirds of Indian households lack access to a bank account.

CASE
continued . . .

In 2010 a scheme was created in which a number of public and private sector organisations have been paid to enrol participants into the national personal identity register, known as Aadhaar (*foundation* in English). Enrolment is entirely voluntary but has proven extremely popular among the rural poor. The enrolment process involves taking biometrics of the individual such as iris scans and fingerprints. These biometrics are then associated with other personal data gathered about the individual and identified by a unique, assigned personal identifier. It is hoped that this will make the process of personal identification easier and faster for individuals in situations such as voter registration, applications for welfare and registration for work programmes. As a by-product it is hoped that national personal identification will help reduce the powerful position of corrupt middlemen in many areas of life. A positive side effect of universal identification will hopefully be that a greater number of individuals and households will be encouraged to open bank accounts. Government will then be able to have welfare payments paid directly into them, bypassing middlemen. This will then also make easier the transfer of so-called conditional payments that channel money in return for positive behaviours, such as getting female children to attend school, persuading mothers to have births in hospital and encouraging such mothers to inoculate their infants against major diseases.

As of November 2017, 1.19 billion people were reported to have been enrolled into the national identity register. Aadhaar does not grant any rights of citizenship to its holders but merely provides proof of residence. But the scheme is not without its critics. Some criticise the money spent on the scheme. Others cite the potential for data privacy infringement both by government and the private sector, and this has been challenged in the Indian courts. Yet others fear the potential for a voluntary programme to turn into a compulsory one and for this to be the precursor for the next logical step: the inevitable reduction of the welfare budget and the attempt to direct such welfare at the most needy in society. Despite the status of Aadhaar being challenged in a number of ways in the courts, the Indian government at the time of writing is pushing citizens to link their national identity numbers with a whole host of public sector and private sector services, such as bank accounts, mobile SIM cards and the claiming of certain welfare benefits.

RECAP

It is possible for eGovernment to be thought of in terms of the value network idea. It is possible to identify at least five major forms of eGovernment in terms of the value network idea. Internal eGovernment refers to the enablement of internal processes within the government body itself with ICT. G2C or government-to-citizen eGovernment is involved in supporting the customer chain of the government body. G2B eGovernment concerns electronic enablement of the relationships between government bodies and the private sector. G2G eGovernment is the use of eGovernment to support intragovernment cooperation and collaboration. Finally, C2C eGovernment concerns enablement of the community chain of government bodies with ICT.

8.8 CONCLUSION

In this chapter we have discussed the impact of ICT upon marketing, procurement and government.

Channels for electronic marketing have grown alongside the growth in channels for the electronic delivery of goods and services. They also have certain advantages over traditional marketing channels in being pull, aggressive, interactive, time-independent, both one-to-many and many-to-many, and information-strong. Companies now make significant investments in electronic marketing techniques, such as search engine optimisation, viral marketing and marketing analytics. The latter in association with

click per acquisition means of revenue generation allow digital marketers to measure much more precisely the persuasive effect of marketing messages.

The pre-sale activities of search, negotiate and order in the supply chain are given the umbrella term 'procurement', which sometimes also refers to all the activities involved in the supply chain. Electronic procurement is the use of ICT to enable the whole of the procurement process. Companies and public sector organisations gain significant performance improvement through eProcurement implementation in areas such as eSourcing, ePurchasing and ePayment.

Just as for eBusiness, it is possible for electronic or digital government to be thought of in terms of the value network idea. For instance, a government body's delivery of a service can be considered as a process of producing value for a number of different stakeholders. Each stakeholder will participate at different points in the value network and therefore will interact with different government systems. In this chapter we identified five different forms of eGovernment in such terms: internal eGovernment, G2C eGovernment, G2B eGovernment, G2G eGovernment and C2C eGovernment.

In Chapter 9 we extend the discussion further by considering the overlap of digital marketing with social media. We also consider how the increasing use of mobile devices has opened up certain opportunities for disruptive innovation in key areas.

8.9 REVIEW TEST

8.1 Traditional marketing channels are characterised as being …

Select all that apply by placing an X in the box.

- [ ] Push
- [ ] Pull
- [ ] Passive
- [ ] Linear
- [ ] Event-driven
- [ ] Data-weak
- [ ] One-to-many
- [ ] Location-dependent

7 marks

8.2 Electronic marketing channels are characterised as being …

Select all that apply by placing an X in the box.

- [ ] Pull
- [ ] Aggressive
- [ ] Passive
- [ ] Interactive
- [ ] Time-independent
- [ ] One-to-many and many-to-many
- [ ] Data-strong
- [ ] Location-independent

7 marks

8.3 Techniques for web-based electronic marketing include …

Select all that apply by placing an X in the box.

- [ ] Banner adverts
- [ ] Electronic mail
- [ ] Cookies
- [ ] Pop-ups

3 marks

8.4 Electronic _____ involves specifying needed goods/services and tendering for such goods/services through electronic means.

Fill in the blank term below.

1 mark

8.5 Production-related procurement is designed to support core operations.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

8.6 XML stands for …

Select the statement that best applies by placing an X in the box.

- ☐ Extraordinary Markup Language
- ☐ Extensible Markup Language
- ☐ Extensive Markup Language

1 marks

8.7 Government can be considered as three sets of activity systems …

Select the three that best apply by placing an X in the box.

- ☐ Developing policy and enacting legislation
- ☐ Enabling and supporting democracy
- ☐ Running Local Authorities
- ☐ Delivering citizen services

3 marks

8.8 Paying taxes is a digital or non-digital public service?

Select only one by placing an X in the box

- ☐ Digital
- ☐ Non-digital

1 mark

8.9 Paying taxes electronically is an example of what type of electronic government …

Select the one that best applies by placing an X in the box.

- ☐ G2G eGovernment
- ☐ G2C eGovernment
- ☐ G2B eGovernment

1 mark

8.10 Digital by default is the policy of offering access through electronic channels to public services as the primary access channel.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

8.10 EXERCISES

- Produce a brief statement of the characteristics of a traditional promotional channel such as a television advert. Produce a brief statement of the characteristics of an eMarketing promotional channel such as a banner advertisement.
- Generate a list of the efficiency and effectiveness improvements relevant to a particular organisation's use of eMarketing.
- Access a particular web portal and determine what eMarketing techniques are used.
- Select a particular eMarketing technique and try to determine the revenue model used.

- Examine and analyse the whole of, or part of, some procurement process known to you in terms of the time taken to complete activities.
- Determine what forms of eProcurement are suitable for operational as opposed to production-related procurement.
- Find one example of an eMarket and describe its key stakeholders and features.
- Find one example each of a vertical and horizontal Internet portal and describe their key features.
- Find one example of an interorganisational information system and analyse some of the reasons for its creation.
- Consider whether the costs and benefits associated with eCommerce differ with the size of company.
- Try to identify the sort of services provided electronically by a particular government agency, such as a Local Authority.
- See if you can identify two practical examples of G2G eGovernment.

8.11 PROJECTS

- Companies such as Facebook have made acquisitions in order to extend the range of the electronic marketing channels it offers. Consider the dominance of the Internet giants in terms of eMarketing and whether this is good for the industry.
- Investigate the importance of search engine optimisation to contemporary electronic marketing.
- Investigate how viral marketing is actually used to promote a chosen product and in relation to a company such as Facebook.
- Determine the relationship between Google Analytics and the idea of big data.
- The electronic documents used in B2B eCommerce are data structures containing many identifiers of things of importance to trade. Consider the role of the identifier as critical infrastructure for commerce.
- The beer distribution game demonstrates the importance of sharing data structures for the proper management of the supply chain. Consider the sharing of data structures in another part of the value network. For instance, examine one partnership chain and determine what data structures are shared between partners and for what purpose.
- Investigate the importance of standard commodity coding to B2B eCommerce.
- Choose two nation-states. Determine what stage they are at in terms of eGovernment. Use the forms of eGovernment discussed in this chapter to help compare the two nations.

8.12 FURTHER READING

Chaffey and Smith provide a thorough coverage of digital marketing approaches (2017). Lysons and Farrington cover forms of electronic procurement within the general context of supply chain management. The book on digitising government by Brown, Fishenden and Thompson (2014) takes a critical look at the development of electronic government within the UK.

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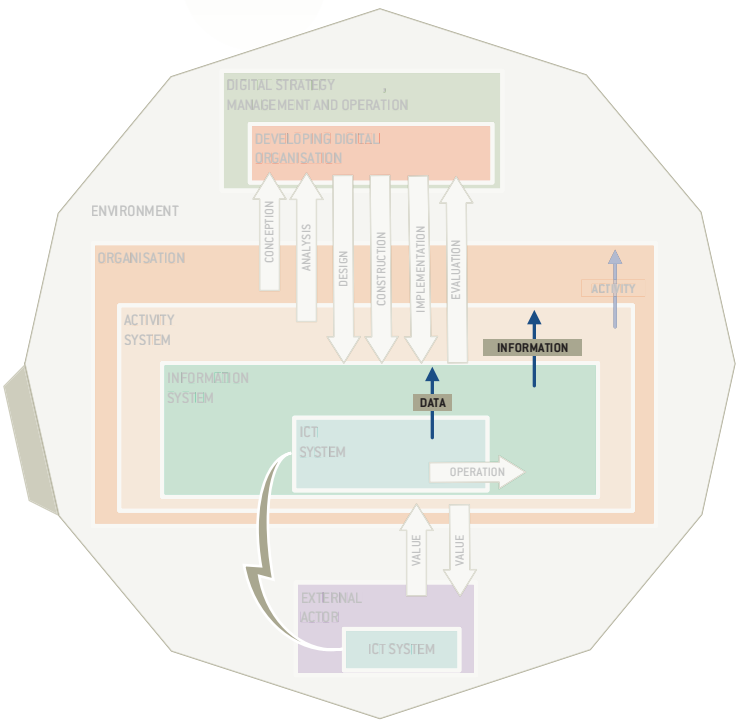
9 MOBILE COMMERCE, SOCIAL MEDIA AND DISRUPTIVE INNOVATION

'Just because something doesn't do what you planned it to do doesn't mean it's useless.'
– Thomas Edison (1847–1931)

LEARNING OUTCOMES	PRINCIPLES
Understand the growing importance of mobile commerce to digital commerce.	Mobile commerce is a subset of electronic commerce, driven by the advantage that goods and services can be ordered and paid for anywhere and at any time.
Explain the place of social media within the digital economy and society.	Social media refers to the production of user-generated content and the communication of such content through online social networks. Social media has been utilised in the organisation of political protest, played a part in the disruption of news agencies as gatekeepers to the news and is also the infrastructure through which cyber-bullying and trolling occur.
Describe the place of social media and mobile commerce as forms of disruptive innovation.	Both mobile commerce and social media are disrupting traditional ways of organising key forms of economic activity. They also have a role as infrastructure within digital ecosystems.
Identify the relationship between digital innovation and the ethics of changes to work systems.	Digital innovation inherently involves ICT innovation, but it also involves changes to information systems and sometimes to activity systems. As such, it is impossible to design ICT innovation without considering the ethics of such innovation.

CHAPTER OUTLINE

9.1 Introduction
9.2 Social media
9.3 Facebook
9.4 Mobile commerce
9.5 Uber
9.6 Disruptive innovation
9.7 Digital ecosystems
9.8 Web unicorns
9.9 Conclusion
9.10 Review test
9.11 Exercises
9.12 Projects
9.13 Further reading
9.14 Bibliography



9.1 INTRODUCTION

There is a tendency evident in much literature published on technology such as ICT to portray technology as inherently value neutral. In other words, technology as artefacts is seen as something necessarily separate from economic, social and political systems. Proponents of this viewpoint maintain that it is only through the uses to which technology is put that certain positive or negative effects emerge from technology within economic and social systems. We take a rather different view within this book and maintain that technology such as ICT are designed artefacts. As such, any technology, such as ICT, is inherently value laden in the sense that certain implicit choices as to purpose are implicitly or explicitly embedded in its make-up.

In Chapter 10 we demonstrate in more detail how any ICT has to be designed in terms of its overarching information and activity system(s). This means that as a system ICT is laden with the assumptions, beliefs and values of its designers. Within this chapter we consider some of the more recent digital innovations that have impacted or are impacting upon organisations of many different forms. We look not only at some more established areas such as mobile commerce and social media as key examples of digital business (Figure 9.1), but also the notion of a digital ecosystem which is disrupting the ways in which business actors organise themselves in the development of products and/or the delivery of services.

Social media, as we shall see, has come under the spotlight for both good and bad reasons. For instance, it has been seen not only as a catalyst for political protest but also as a vehicle for the dissemination of extremist views. Mobile commerce, likewise, is seen as positive in the sense of providing greater degrees of access to goods and services to millions of users worldwide. However, some worry about the ways in which the design of certain mobile commerce applications undermine established principles of how business should work in providing worker rights.

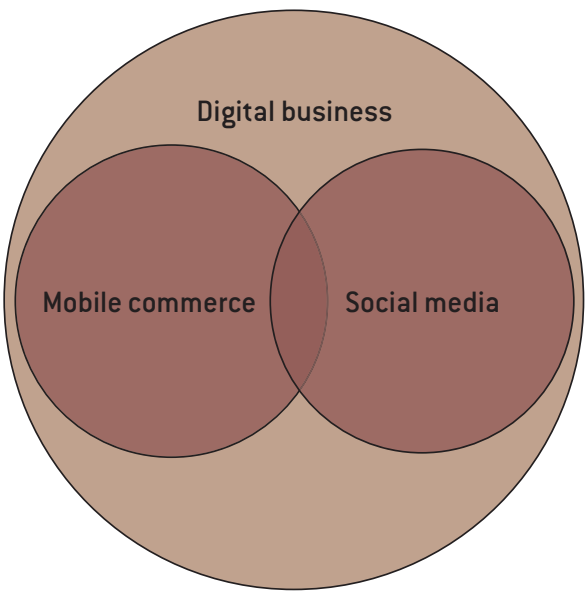


Figure 9.1 Mobile commerce and social media

9.2 SOCIAL MEDIA

Social media
The attempt to build and support social networks through the application of ICT.

The term '**social media**' first started to be used to describe the functionality associated with several so-called Web 2.0 applications (see Section 5.7). Web 2.0 is not a new version of the Web, but consists of sites and tools using the web open standard infrastructure. Such applications are particularly directed at facilitating collaboration and coordination among dispersed actors.

Having said this, it is quite difficult to pinpoint precisely what is meant by the term social media. The term is often used to refer generally to any means for creating and sharing digital content, such as written material, photographs, video and audio material. But the term social media is also associated with the sharing of such content via online social networks. Certain characteristics of social networks, such as the network effect, strong and weak links and social capital (see Chapter 6) make social media particularly attractive to business. Certainly, as a prime medium for electronic marketing, particularly viral marketing (see Chapter 8). But social media is also impacting upon other areas of the digital environment, such as the digital polity (see Chapter 6).

9.2.1 The growth of social media

The main tools of social media were created in the early to mid-2000s – so this is comparatively a recent example of the embeddedness of ICT within contemporary society. LinkedIn was founded in 2002, Facebook was founded in 2004, YouTube was founded in 2005 and Twitter was founded in 2006. In the period since their foundation the number of users of such social networks has grown astronomically worldwide (Figure 9.2).

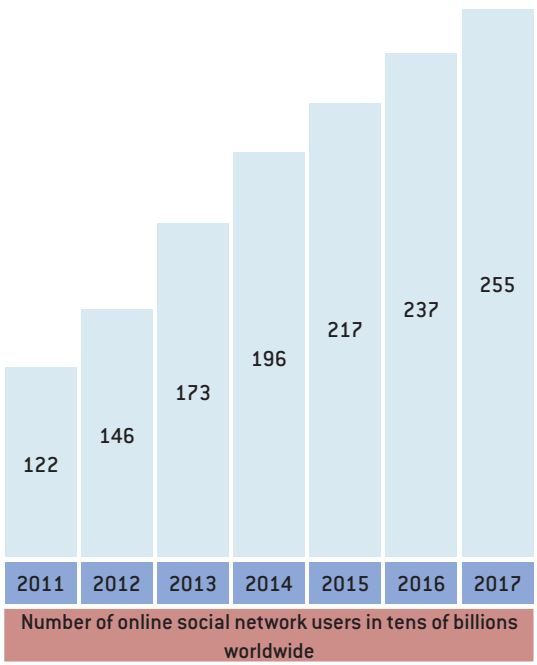


Figure 9.2 The growth in the number of users of online social networks

9.2.2 Digital content

We have mentioned before that the term 'content' originally referred to web pages (see Section 5.3). A web page is a data structure coded in HTML and consists of two parts: the content and the tags. Consider a simple piece of HTML – <title>This is a title</title> – the

content here is the text 'this is a title', while the tag is the keyword, in this case title, placed between angled brackets. This tag tells a web browser to display the piece of text on the screen in the format of a title.

But we all know that content upon a web page can now be an image, a video or some audio, as well as text. And that such content is now easily created or captured using both fixed and mobile access devices. So much digital content can be user-generated. But perhaps more importantly such content can be shared or distributed in several different ways to other actors, for example by posting to a website or by messaging to individuals. This means that digital content can spread rapidly through online social networks.

9.2.3 Electronic messaging

SMS
Short messaging service or SMS refers to a text messaging protocol that restricts messages to a string of 256 alphanumeric characters.

MMS
MMS (multimedia messaging service) allows image, video and audio content in a text message.

The earliest form of electronic messaging is electronic mail (email), which emerged way back in the 1960s and for which there are public (open) standards. Text messaging or texting began in the early 1990s with something known as the short messaging service or SMS. This restricted messages to a string of 256 alphanumeric characters. **SMS** morphed into **MMS** (multimedia messaging service) which allows image, video and audio content in a text message. Finally, social media messaging refers to a series of proprietary adaptations of SMS and MMS – such as Facebook Messenger and WhatsApp.

All these types of electronic messaging have the advantage of being asynchronous. A mobile phone call is synchronous, meaning that the sender and receiver can both send messages (speak) at the same time. Electronic messaging is asynchronous, meaning that there is a delay between one person sending and another person receiving a message (Figure 9.3).

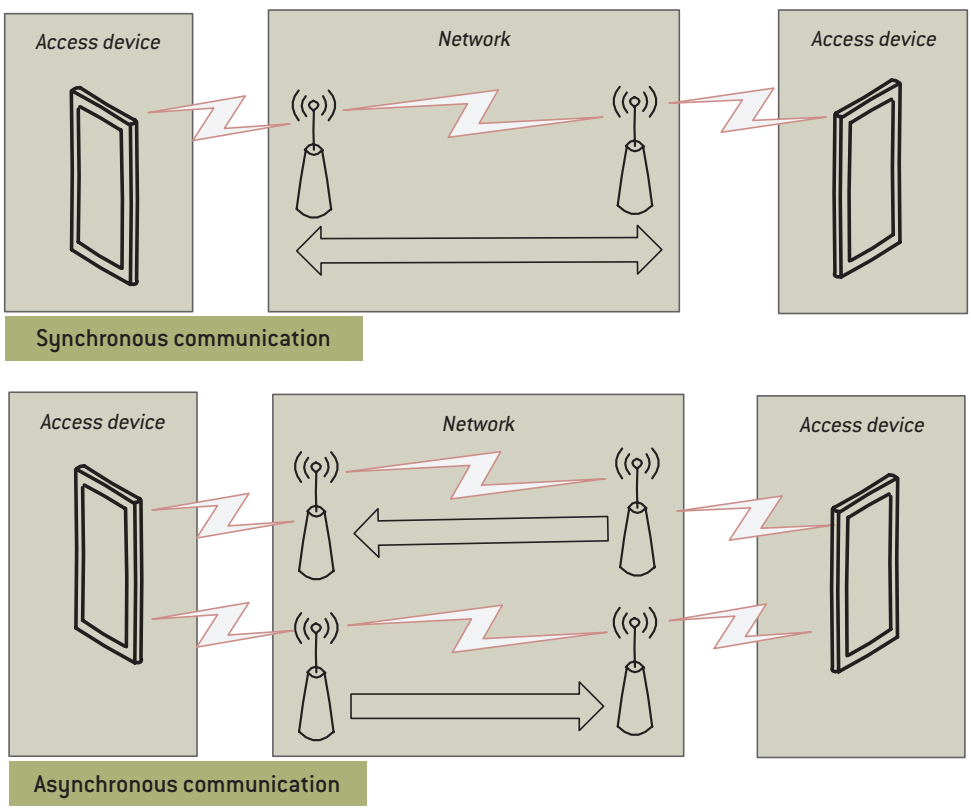


Figure 9.3 Synchronous and asynchronous messaging

9.2.4 Communication through social media

Much communication via social media is what we referred to as phatic communication in Section 6.5.2. In other words, it serves a social rather than an informative function. But because of the growth in social media there are an increasing range of occasions when social media is used for informative and instrumental communication. Enterprises use social media to facilitate collaboration on things such as project work. Adverts assert the properties of some product or service through social media. People can direct others to attend events such as 'flash mobs' and people can commit to attending through electronic messaging.

9.2.5 The value of online social networks

Social media sites such as Facebook and LinkedIn offer a number of things to their members, particularly associated with some of the features of online social networks that we considered in Chapter 7. The value of Facebook to its members lies primarily as a tool to build and maintain strong links with people in an online social network. But the size of its membership also offers its membership opportunities to explore and develop weak links. In contrast, LinkedIn is a social networking site which specialises in professional matters. As such, the usefulness of being a member of LinkedIn is the opportunity afforded by communicating over and developing weak links.

On the opposite side of the fence, business is interested in online social networking for a number of reasons. Business seeks to exploit the network effect (see Section 6.5.4) to more effectively market its goods and services. It also uses social media to search for and recruit new staff and to crowdsource new ideas as a means to innovate.

9.2.6 Social media and political organisation

Social media has been used for purposes other than business. As it is now probably the dominant medium for electronic communication, it has been much used in the dissemination of political messages, as well as for facilitating the organisation of political protest. For example, social media was critical to the organisation of the so-called Arab Spring. It has also been important within lobbying and within election campaigns in Western democracies.

9.2.7 Social media and the Arab Spring

CASE

In December 2010, a man in Tunisia burned himself to death in protest at his treatment by police. This event is generally considered the beginning of the so-called Arab Spring, a term used to describe the revolutionary wave of demonstrations and protests which spread across the Arab world in early 2011. Across many countries in the region, protest has mainly involved campaigns of civil resistance involving strikes, demonstrations, marches and rallies. Such civil unrest has led to the overthrow of a number of ruling regimes, such as in Tunisia, Libya and Egypt.

For the past couple of decades within the Arab world radical Islamists and jihadis such as Al Qaeda have made extensive use of the Internet, the Web and more recently social media for their own ends. Evidence suggests, for instance, that Al Qaeda made extensive use of the Internet in planning the 9/11 attacks in New York. However, the Arab Spring demonstrated that these media can also be used to promote the principles of democracy within the region.

CASE
continued…

Political analysts put this down to a number of factors. Firstly, the fact that the Middle East population is disproportionately younger than in Western nations: in many Middle Eastern countries between 55% and 70% of the population are under the age of 30. Secondly, it is the young who are likely to have the highest levels of eLiteracy. Thirdly, youth are more likely to seek their information on world events from the Web and international media rather than internal broadcast television channels and newspapers, which traditionally have been state-controlled or state-influenced.

Each of these factors served to establish a base for political activism which fuelled the Arab Spring. Within many Arab states the Internet, Web and social media have become a place for expressing ideas, concerns, complaints and frustrations which cannot be voiced through other channels. Within the virtual communities of the Web, social restrictions such as gender segregation can be subverted. Social media allows people not only to communicate and build common feeling, but also to organise themselves for political protest.

An example of how social media can encourage political activism is when someone establishes a page on Facebook debating a political issue. The page is then seen by various other Facebook members, who first comment on it and then begin to interact with one another. Once the group has achieved some solidity, members of this virtual community start to post photographs, video footage and links to YouTube. As this happens, further communication occurs through other social media such as Twitter. This expands the virtual community of people who are linked in to this debate. Since social media is not limited by geography, an issue which starts within one nation-state can quickly become global.

Take two specific examples of how this occurred and continues to occur: one from Egypt and one from Tunisia.

In January of 2011 the President of Tunisia, Zine el Abidine Ben Ali, was deposed in what many refer to as the Jasmine Revolution. At the start of this revolution the rap artist Hamada Ben Amor recorded and distributed via Facebook and YouTube a song entitled *Rais Lebled*. This song raised awareness of the poverty and oppression experienced in the country. What made this song even more potent as a rallying cry for protest was the fact that rap as a musical form had been banned by Ben Ali's regime.

In February of 2011 President Hosni Mubarak of Egypt was overthrown. This wave of popular protest was encouraged by the activism of young bloggers such as the Egyptian student Kamel. Kamel began writing his blog to denounce his brutal treatment at the hands of the Egyptian police. It all started with a banal accident with Kamel falling off a train onto a platform. When policemen approached, he expected them to offer assistance, but instead received a beating. In response to his public humiliation Kamel created his blog which quickly gained a wide and sympathetic audience. Many such persons turned to Facebook as a medium to document their own degrading experiences at the hands of the regime.

The case of a young Egyptian businessman from Alexandria, Khaled Said, was much discussed in this manner. He was reportedly beaten to death by two police officers in 2010. Popular outrage resulted in the creation of a Facebook page entitled, 'We are all Khaled Said'. This page is seen as instrumental in forming a network of activists who planned the first day of protest on 25 January in Egypt.

The use of the Internet, the Web and social media was, of course, not restricted within national boundaries. Such technology ultimately played an important part in distributing pictures, videos and reports about the civil unrest in these countries around the world. Not surprisingly, governments in the region did not stand still in the face of such tactics. One countertactic they employed was to attempt to control not only conventional media but also access to social media. Within Egypt in February of 2011 there were 13.5 million users of the Internet. 3.5 million of these were Facebook users and 12,000 Twitter users. On 25 January 2011 the Egyptian government attempted to block access to these two

CASE
continued…

social media sites, both in terms of the fixed telephony network and the mobile telephone network. On 27 January the government even switched off the national access provider for the Internet within the country for a short period. Internet services were not restored fully until 2 February and SMS services were not re-established until 6 February.

However, this attempt at switching off the communication infrastructure in the country appears to have backfired. It seems to have alienated not only those persons with a grievance, but large apolitical segments of Egyptian society, such as the business community. Moreover, the blackout did not actually prevent access to social media by determined activists. Numerous activists were able to use circumvention software to enable them to access Facebook and Twitter during the blackout period.

The Internet, the Web and social media were not the cause of the Arab Spring – the causes were linked to complex social, economic and political factors – but these technologies helped support the organisation of political process: the coordination of political activity through convenient communication channels that were reliant on a convenient ICT infrastructure.

9.2.8 Narrowcasting content

Some have seen social media as disrupting the very idea of news, and in particular the broadcasting of such news from a limited number of news agencies. This is seen by some as one form of disruptive innovation (Section 9.6). Ever since the invention of the broadsheet and the later invention of the newspaper, news has been produced by a limited number of journalist organisations. Such news as a form of targeted communication is broadcast from one organisation to many individual actors on a periodic basis. In this way of organising news production, distribution and consumption what constitutes news is heavily controlled by the producing and distributing organisations. Some refer to the function performed by such organisations as a gatekeeping function in the sense that such organisations have traditionally guarded the gates to news content. They spend considerable time, for instance, verifying and validating news content.

Narrowcasting
The process by which content is targeted at specific individuals with certain profiles.

In the digital age such a gatekeeping function has begun to break down. As a content industry, journalism has been subject to much disruptive innovation through the increasing **narrowcasting** of content. Much of the generation of content which would traditionally be classed as 'news' is produced outside journalist organisations. The number of delivery channels for such content has multiplied, leading to a continued increase in user-generated content. But such content is also not broadcast but targeted at specific individuals with certain profiles (narrowcasted). In such a situation, the traditional quality control function of the gatekeepers to the news is put under strain.

For instance, the British Broadcasting Corporation (BBC) has traditionally been seen as the major gatekeeper of news content in the UK. Such content is of course also broadcast around the world on television and radio channels. However, the use of such traditional media for accessing news content by the young, digital natives (see Section 6.1.2), is diminishing. Digital natives are more likely to get their concept of what is newsworthy from a large range of narrowcasting channels – groups and individuals which target their news content at certain segments of their social network.

This change to narrowcasting, as well as the decline of the gatekeeping function of the news, can be seen as a form of disintermediation (see Chapter 6), and has been used to explain certain surprising and worrying recent events.

REFLECT

Why were the predictions of the broadcasting media so wrong in relation to the EU referendum of 2016 (Brexit) and in the US presidential election of the same year? What role did social media play in these events?

9.2.9 Issues with social media

The disruption of the news as a major content industry is not the only issue arising from the increased use of social media. For example, many people have been caught exercising bullying behaviour through online social networks, not just in schools but also in workplaces (*cyber-bullying*). This often goes hand in hand with *trolling* – the posting of inflammatory and sometimes abusive content on social media. Social media messages and content are sometimes deliberately controversial and insulting to generate a reaction from their readers. It must also be remembered that such messages are frequently not produced by humans but by bits of software, sometimes referred to as *chatterbots* or *chatbots*. Such 'bots' are increasingly being used by business to disseminate advertisements, but also more worryingly as agents of cyber-warfare (see Cases section).

RECAP

Social media refers to tools for user generation of digital content and the communication of such content through online social networks. The usefulness of online social networks for their members relies upon the network effect as well as strong and weak links. Social media is of interest to business in areas such as viral marketing. Social media has played a part in the organisation of political protest, and in the disruption to news agencies as gatekeepers of the news. Social media also has a dark side, illustrated by problems such as cyber-bullying and trolling.

9.3 FACEBOOK

CASE

Social media has become synonymous with Facebook in many people's minds. Facebook was launched in February 2004 as a social networking website by Mark Zuckerberg along with his fellow computer science students Eduardo Saverin, Dustin Moskovitz and Chris Hughes. The name of the company is taken from the name given to a book commonly given to university students within the United States at the start of the academic year. Zuckerberg and the others' original idea was to build a website that offered an online version of such a document to students at US universities. Initially, Facebook was intended as a means for Harvard students only to network. The website was later expanded to other colleges in the Boston area, the Ivy League group of universities and

CASE
continued . . .

Stanford University. Over time, students at other universities as well as high school students were gradually admitted to Facebook, not only in the United States but also in other countries, such as the UK. Nowadays, membership is free and open to anyone aged 13 and over. Figure 9.4 shows estimates of the number of active Facebook members in billions worldwide.

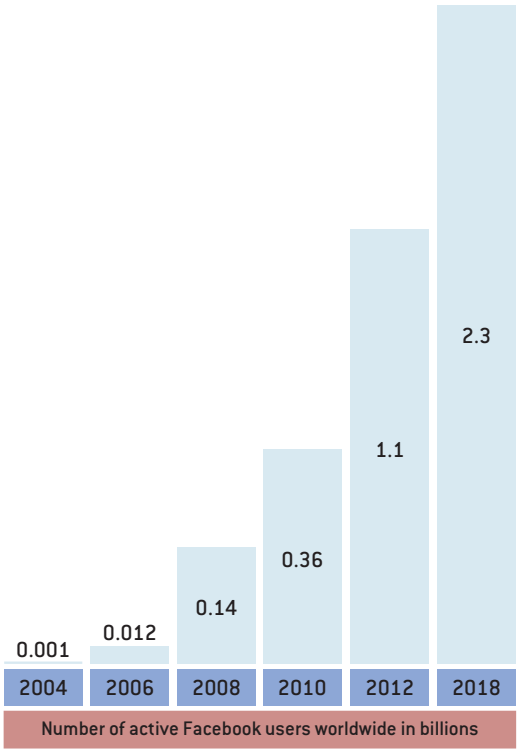


Figure 9.4 The number of Facebook users worldwide

The basic functionality of Facebook, which has of course been growing over the years since its inception, includes the following. All Facebook users have their own personal profile. A Facebook profile usually consists of a profile picture, contact information, lists of personal interests, photos, notes and other personal data. To this profile other users may be added as 'friends'. Facebook friends can interact in different ways: writing on profile walls, exchanging public or private messages, or using a chat feature. They may also receive automatic notifications when one of the friends in their network updates their profile.

An additional facility for Facebook users is the creation of public or private groups formed around common interests. Public and private organisations can maintain their own pages (the so-called 'Like' pages) as a form of advertising. A member using the 'like' function for one of these pages opens up their network for viral marketing (see Section 8.2).

The entry requirement for all Facebook users is to have a username and a profile picture. The extent to which data upon one's profile can be accessed by other Facebook members, however, can be controlled through a number of specific privacy settings. For example, all Facebook profiles have their own Wall – that is, a space on which Facebook users can write short messages and post hyperlinks; however, Facebook users can decide who can see (and write on) their wall, and who cannot. One of the most popular applications in Facebook is the Photos application that allows Facebook users to upload and share albums and photos.

CASE
continued…

Millions of websites now integrate with Facebook through social plug-ins that allow people to share things such as songs listened to or articles read with other Facebook members. Facebook is of course no longer just a website. Most content is now shared through the Facebook app on mobile devices (see Section 5.2).

In 2010 Facebook reshaped the way in which its users can interact by introducing a new Facebook Messenger service. This is a combination of text messaging, instant messaging (chat), emails and regular messages. The key point here is that although such communication uses common protocols, all messages travel through the proprietary communication channel managed by Facebook. So, although the content of your messages is secured, the meta-data associated with your messages is a valuable resource for Facebook.

REFLECT

Is a Facebook friend the same as a 'real' friend? What does friendship consist of as a social relationship and in terms of social capital?

CASE

As probably the most prominent example of social media, Facebook has come under fire for acting as a platform for patent untruths broadcast as 'fake news'. A lie wrapped up as Facebook content on the website or as a message sent through the social network can travel around the globe in a matter of minutes. Such untrue messages can have nasty consequences in terms of the actions taken as a result of them. More worrying is the claim that increasing use of social media serves to demote rather than promote open, rational debate. Here is how some see this happening (see Figure 9.5). A Facebook user enters a series of newsfeed preferences into the Facebook Newsfeed function. These act as an expression of the type of content that member X would like to see. The Facebook Newsfeed filter continually reads news content published on the Web and decides whether or not such content matches a user's preferences. It updates the user's newsfeed only with content that matches preferences. This has the potential effect that the content reinforces rather than changes the attitudes, viewpoints and prejudices of the user. Not surprisingly, this is sometimes referred to as the 'echo chamber effect'.

REFLECT

Some have claimed that the increasing use of social media such as Facebook serves to demote rather than promote open, rational debate in contemporary society. The German philosopher Jurgen Habermas argues that a society's conventions are not necessarily in the best interests of its members. Individuals continually need to question, and, if necessary, change such traditions. They can only do this, he believes, through rational communication and debate within the public sphere. Do you think social media is offering such a platform for rational debate?

DID YOU KNOW?

The 2008 presidential election in the United States is credited as being the first election in which social media was used for political campaigning. In March 2018 Facebook came under intense criticism for apparently collecting data from its members which it passed on to the company Cambridge Analytica. This company is claimed to have used these data to help develop strategy for the Donald Trump campaign for the US presidency.

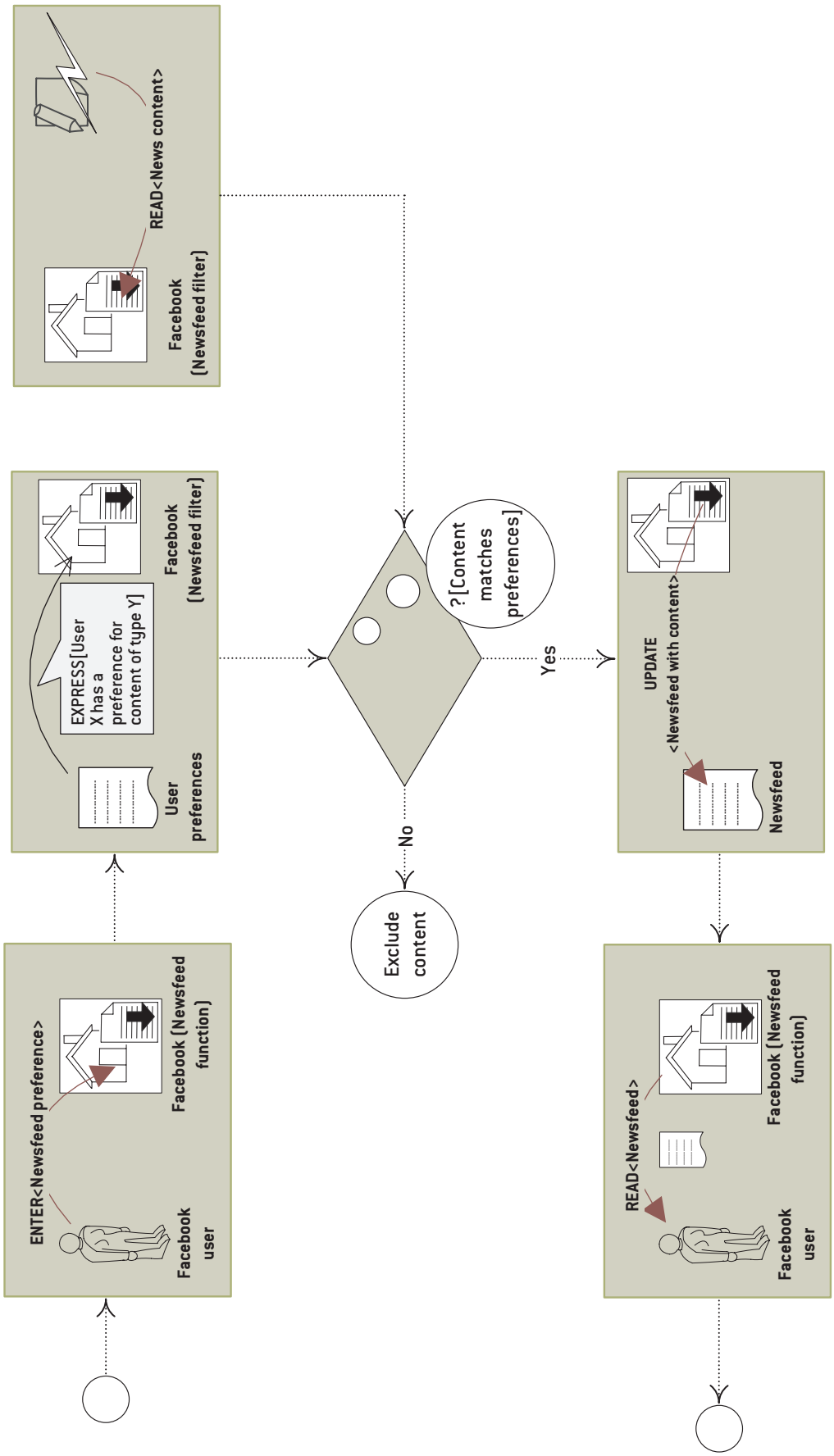


Figure 9.5 The pattern of social media reinforcing prejudices

9.4 MOBILE COMMERCE

Mobile commerce
The use of mobile access devices such as smartphones to conduct eCommerce.

Mobile commerce can be considered a subset of electronic commerce, and in particular of B2C eCommerce (Section 7.5). Mobile commerce relies upon a number of aspects of technological infrastructure that were discussed in Chapter 7. Various mobile access devices may be used by the consumer, such as smartphones or tablets. Such devices use the global positioning system (GPS) to engage with location-based services. The interface to the ICT system normally runs as an app on the mobile device. Requests to the ICT system travel as IP messages over the cellular telephone network. Most of the ICT system itself runs within a cloud data centre, which services the requests made by the customer. The ICT system may enact further requests to other cloud services, such as electronic payments (Figure 9.6).

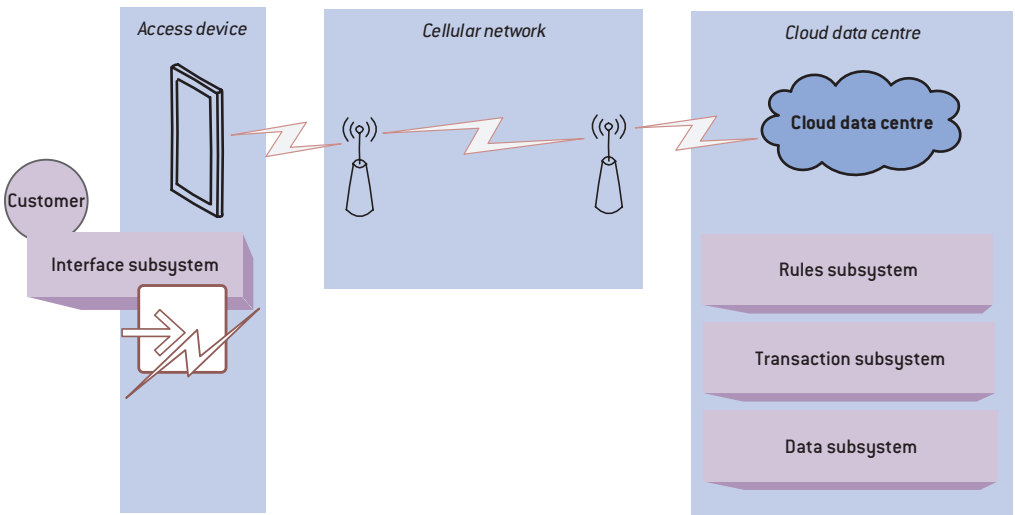


Figure 9.6 The infrastructure of mobile commerce

9.4.1 Mobile devices

There has been enormous growth in mobile access devices over the last decade or so. By 2020 it is predicted that there will be more than 6.1 billion smartphones owned around the world. More mobile access devices are now owned by people in the UK than fixed PCs. Many people also own more than one mobile device. All such trends suggest that there is the potential for substantial growth in mobile commerce (Figure 9.7).

9.4.2 Apps

App
Originally, an 'application' was any piece of software with sufficient functionality to do something useful. Now the term app tends to refer to a small, specialised program downloaded onto a mobile device and running within the mobile operating system.

Within mobile commerce an organisational ICT system is accessed through an **app** held on the mobile access device. Originally, an 'application' was any piece of software with sufficient functionality to do something useful. Now the term app tends to refer to a small, specialised program downloaded onto a mobile device and running within the mobile operating system. Not surprisingly, the app marketplace has grown astronomically, and has provided fertile ground for companies providing catalogues of such apps, including Apple, Google and Amazon (Figure 9.8).

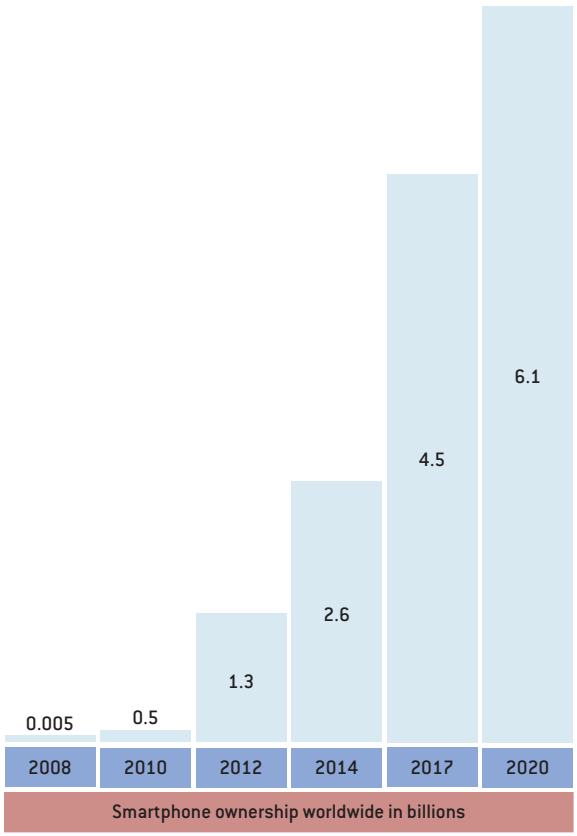


Figure 9.7 The growth in smartphone ownership

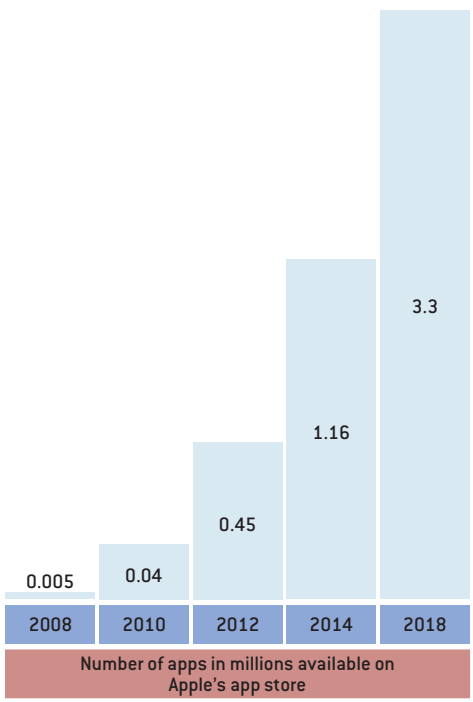


Figure 9.8 The growth in the number of apps available through Apple's App Store

9.4.3 Location-based services

Location-based services
A service that uses data about location within the provision of some digital service.

Some apps utilise the GPS capability of the smartphone or tablet to deliver **location-based services**. The global positioning system or GPS is a network of orbiting satellites that send precise details of their position in space back to earth. These signals are obtained by GPS receivers and are used to calculate the exact positioning of the receiver.

A location-based service uses data about location within the provision of some digital service. So a user might obtain a local weather forecast based on their current location or find Italian restaurants nearby. Certain access devices, such as a satellite navigation unit, determine location in terms of GPS. Some smartphones have GPS access. However, for the majority, when using a smartphone the location of the device is determined in relation to the delay in the signal received from the closest mobile phone towers (cell phone towers).

9.4.4 The pros and cons of mobile commerce

Mobile commerce has clearly grown astronomically on the back of technological infrastructure. At the time of writing, over 50% of eCommerce is now conducted as mobile commerce in the UK. Mobile commerce must therefore have advantages for both the consumer and the organisation; but there are also some disadvantages.

Mobile commerce means that many goods and services can be ordered and paid for almost anywhere, as well as anytime. Mobile commerce has encouraged growth in micro-payments – small sums paid electronically from various financial data structures such as bank accounts and using electronic point-of-sale technology. Certain innovative applications, particularly based on location-based services, can be offered through mobile commerce.

But the functionality of the ICT systems supporting B2C eCommerce via mobile devices must adapt to the physical limitations of the mobile interface, at least as far as the smartphone is concerned. Mobile commerce also relies upon cellular communications infrastructure which is patchy across a country such as the UK, as well as globally.

On the ethical front many worry about the increasing penetration of location-based services and the issues of data privacy that arise from this. Although on most mobile phones identification of location can be switched off, most users typically adopt the default setting of 'on' for all apps that need it. This means of course that a whole new data stream is opened up to the mobile commerce infrastructure. Not only can organisations capture data about what you are doing with them, they can also reference such activity to particular locations.

RECAP

Mobile commerce is a subset of electronic commerce. Mobile commerce relies upon mobile access devices, apps, cloud services and GPS. A major advantage of mobile commerce is that goods and services can be ordered and paid for anytime, anywhere. Disadvantages lie in the limitations of certain mobile devices and the reliability of communication infrastructure. Mobile commerce has enabled aspects of the gig economy, an example of disruptive innovation. It also has a part to play in digital ecosystems (see Section 9.7).

CASE

The number of mobile access devices (Section 5.2.1) in the world outstrips the number of fixed access devices, such as personal computers. This is particularly true in areas of the world such as Africa, where access to ICT infrastructure is achieved primarily through mobile phones in many countries. In 2007, Vodafone launched an electronic money transfer and micro-financing service known as M-Pesa (M for mobile and Pesa the Swahili word for money) in Tanzania and Kenya. This service operates without banks, allowing users to deposit and withdraw money, transfer money quickly to other users of the network, pay bills and purchase mobile phone time. Millions of such M-Pesa accounts have been opened in Tanzania and Kenya since its creation and the service is now credited as important infrastructure for the economies of both countries.

9.5 UBER

CASE

Uber was established in 2009 and describes itself as an online transportation network company. The business is built around two apps: one app allows customers to search for a ride, submit a trip request and pay for a trip, the other app allows drivers to search for a customer, message the customer and indicate to the Uber ICT system pickup and drop-off. Uber is one example of the growth in the gig economy, which relies on coordinating actors through digital technology. A gig economy is one in which work is done on the basis of short-term contracts or freelance.

As an ICT infrastructure, Uber solves a coordination problem – it serves to coordinate the actions of two groups of actors: drivers and passengers. A passenger wishes to travel from a nominated location A to a nominated location B for a designated price. A driver wishes to transport passengers between nominated locations for a designated fee. In a sense, then, Uber enables passengers to issue directives and drivers to make commitments through the application (Figure 9.9).

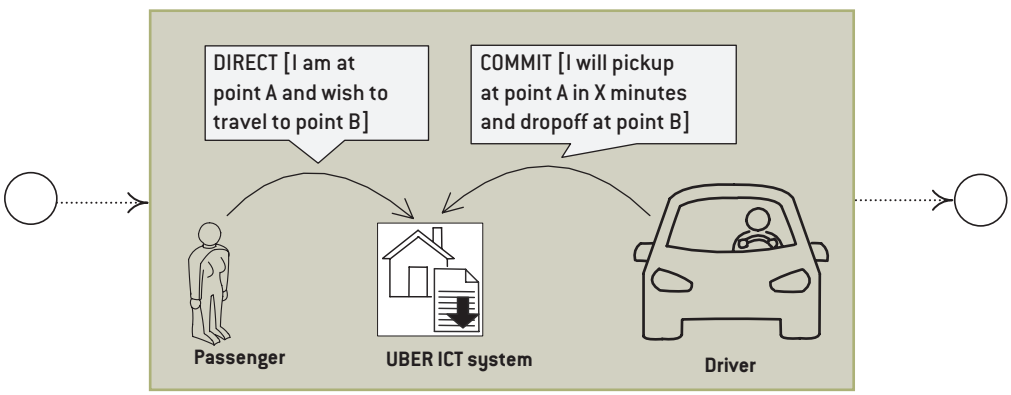


Figure 9.9 Uber as a communication system

9.5.1 User and driver registration

CASE

To use Uber the customer first must register details with the ICT system and download the customer app to their mobile device. Likewise, the driver needs to register with the system and download the driver app (Figure 9.10).

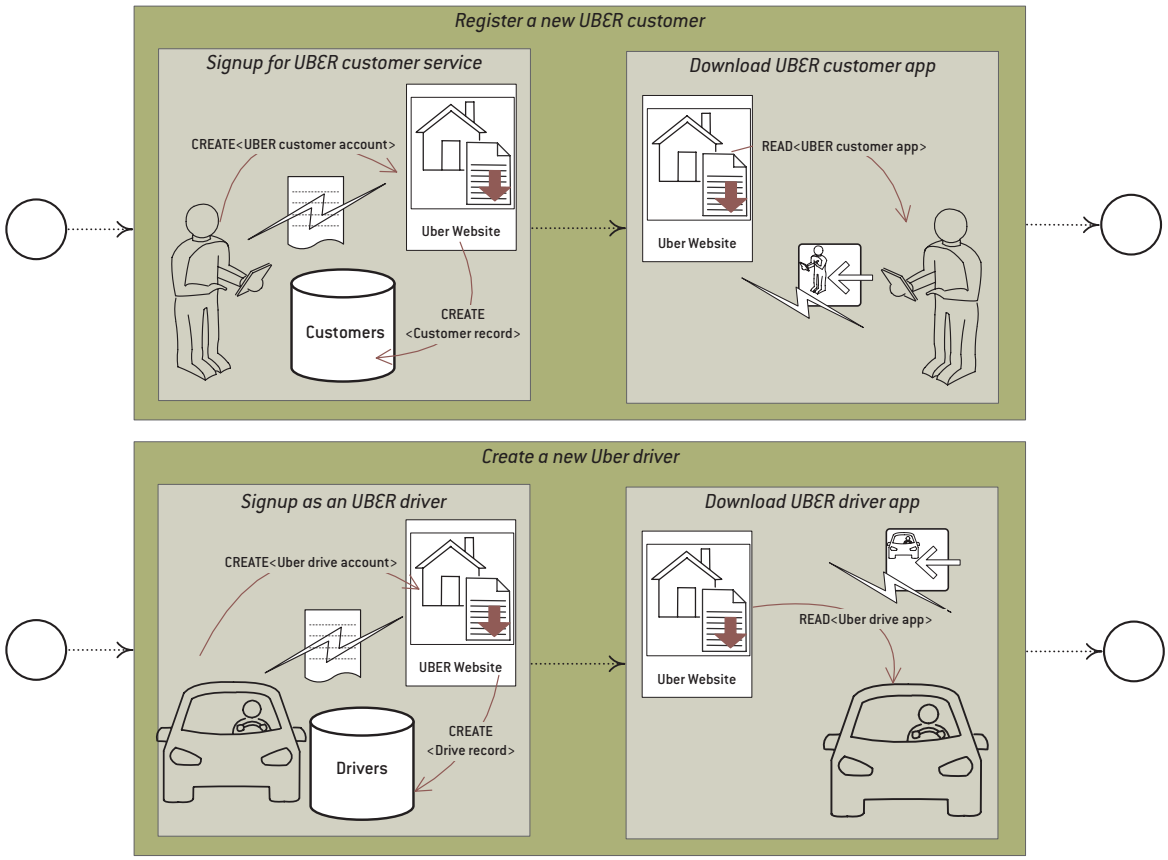


Figure 9.10 Uber registration

9.5.2 Making an Uber request

CASE

The customer can then use this app to request a journey, as illustrated in Figure 9.11. Using the app the customer can create a request which indicates the vehicle type. This request is matched by the request system against prices for available vehicles of the specified vehicle type. The customer can then confirm the request and indicate the pickup location by amending aspects of this data structure.

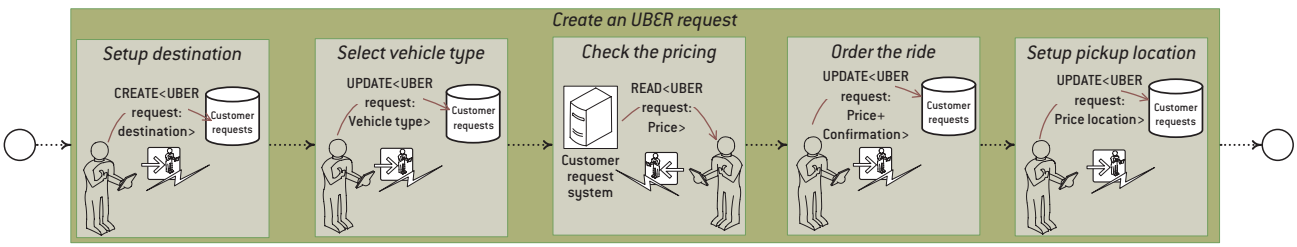


Figure 9.11 Making an Uber request

9.5.3 Fulfilling a request

CASE

Uber uses location-based services. The mobile access devices of both passenger and driver signal to the ICT system the current positions of these actors. This allows the Uber infrastructure to know what resources are available in each location at one time, and of

CASE
continued …

course, where its customers are located. Drivers can use their app to signal their intention to fulfil a passenger request. They also signal when a passenger has been picked up and when a passenger has been dropped off. This triggers payment from the passenger and a fee paid to the driver (Figure 9.12).

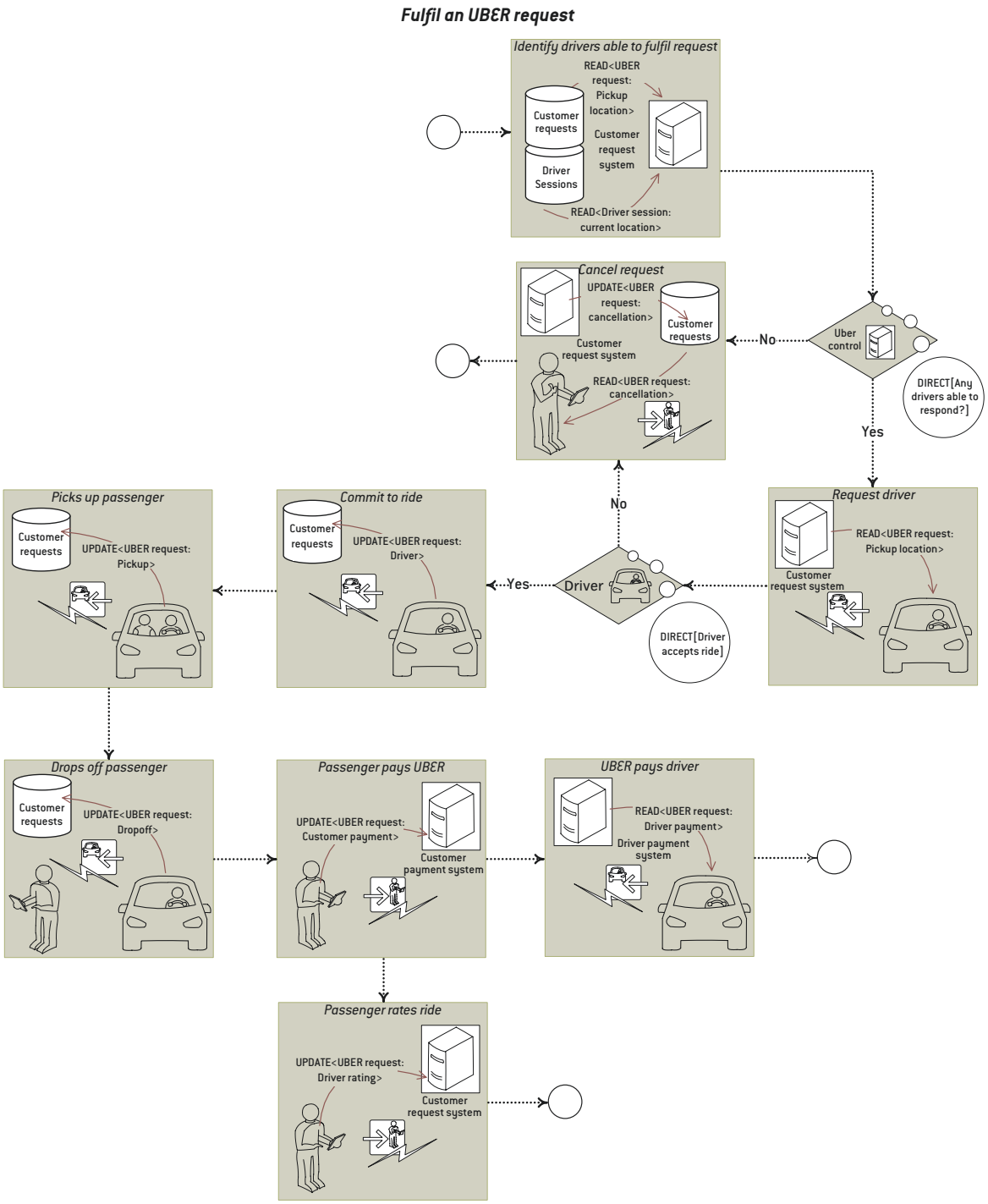


Figure 9.12 Uber and location-based services

9.6 DISRUPTIVE INNOVATION

The capacity of ICT to articulate data structures efficiently has been used to disrupt major industries and sectors, allowing organisations to innovate with business models. According to the economist Joseph Schumpeter, '*creative destruction is the essential fact about capitalism … [which] … incessantly revolutionises the economic structure from within, incessantly destroying the old one, incessantly creating a new one*'. There are many examples of such creative destruction afforded through digital innovation. Some see Uber as an example of such creative disruption or disruptive innovation in the sense that it is a challenge to the traditional taxi service. But others question the ways in which Uber disrupts. Uber certainly uses its infrastructure to subvert many conventions of business practice. Taxi drivers are employees of taxi companies and thus subject to employment practices which are usually enacted in employee legislation. This gives taxi drivers certain rights such as holiday entitlement, sick pay etc. Uber considers that its drivers are self-employed and hence not entitled to these rights. This came under challenge in the courts, which have since declared that Uber drivers are employed workers and hence have the same rights as normal workers.

So innovation through ICT is not as straightforward as many would make out, largely because any such innovation normally impacts upon work and any such innovation inherently has an ethical dimension to it.

9.6.1 The impact of ICT

We shall make the case in Chapter 10 that digital innovation can and should be designed. But to do this properly we need to break with conventional ways of thinking about ICT in relation to innovation within systems of organisation. One way of understanding this better is by examining the impact of ICT upon work.

Within the physical sciences, work is activity that transforms the world in some way. In relation to physical systems, the idea of work equates to a measure of energy transfer. To move an object from point A to point B work needs to be done, meaning that energy needs to be expended. To maintain organisation work has to be done and through this energy expended. Organisation is a continual accomplishment of work in the face of disorder. Systems of organisation are islands of patterned order – **negentropy** – in a universe of disorder – **entropy**. And systems require the continual expenditure of energy though work to remain ordered or organised.

Negentropy
The process by which order is accomplished in a universe of disorder.

Entropy
The process of disorder, which is the natural state of the universe.

As we have seen in relation to human systems, work can be best thought of in terms of patterns or systems of activity that create value. The creation of value is not normally achieved through individual work, but through collective action. Actors coordinate their work within systems in the achievement of collective goals. And to do this they need to communicate about what work has been done, what work is being done and what work needs to be done. And for this purpose data structures are articulated either as messages or as stored records.

There is an obvious point to be made in relation to thinking about work or activity in this manner. This is that the design of ICT systems necessarily involves the design of activity or work systems through the mediating layer of information systems. Generally speaking, there are three ways in which human activity and ICT can be coupled through a new information system:

- ICT can be used to support aspects of an existing information system. This implies that some aspects of the information system are computerised, but that the activity system supported remains largely unchanged. We saw key examples of this way of innovating with ICT in the cases of Goronwy Galvanising and USC.

- ICT can be used to supplant aspects of an existing activity system and its associated information system. This implies that certain aspects of both the activity system and the information system are automated, in the sense that the logic of the ICT system replaces some aspect of human decision-making and action. Much of B2C eCommerce has involved replacing aspects of retail with interfaces to ICT systems rather than with humans working in offline retail outlets.
- ICT can be used to innovate, creating new activity systems for organisations or sectors. This is the most radical and potentially disruptive use of technology. Examples such as Facebook and Uber, as well as a range of web unicorns (Section 9.8), are frequently referred to in this regard.

So the impact of ICT is not a straightforward thing. We cannot assume that just introducing ICT into some information and activity system will necessarily improve the overall performance of some system of organisation. Take the issue of productivity, which has been the most studied in relation to the impact of ICT.

Organisations naturally expected that the introduction of ICT would inevitably raise the productivity of their workforce, but over a number of years, this link between ICT system usage and productivity was examined and questioned by people like Eric Brynjolfson. In the early 1990s, Brynjolfson studied the relationship between productivity and the application of ICT for office-based (white collar) organisations in the United States. The evidence suggested that whereas delivered computing power had increased by two orders of magnitude between the 1970s and 1990s, productivity, particularly in the service sector (the heaviest users of ICT), had stagnated. Spending on computers reached its peak in the mid-1980s, but although productivity (measured in terms of service transactions handled per worker) increased rapidly during the early 1960s, it remained relatively stable up to 1990.

Productivity paradox
The paradox observed in the first three decades of computing that productivity did not rise with more investment in ICT.

Brynjolfson considered a number of explanations for what he referred to as the **productivity paradox** at the time. In subsequent work (Brynjolfson and Hitt, 1998) he confirmed the hypothesis that companies had not reaped benefits in terms of productivity because they had not systematically planned for, managed and designed the introduction of ICT.

9.6.2 The ethics of digital innovation

In Chapter 6 we considered how there is a clear linkage between what we find of worth and our personal values, which guide us in the decisions and actions we take. Hence the study of value (axiology) overlaps with the study of living a good life (ethics). In Chapter 10 we shall argue that digital innovation, particularly digital innovation which disrupts, is viewed as value neutral and frequently as inevitable. This is to ignore the fact that digital innovation inherently involves a process of choice among a usually vast range of alternatives, and that such design choices are inherently value laden rather than value neutral. Hence there is always an ethical dimension to any design, because we both explore design choices and make design decisions from some value position. The apparent inevitability of certain digital innovations relies upon a set of often implicit assumptions which frame what is appropriate use of technology. Likewise, digital innovations rely upon the myriad of again often implicit choices made about using certain digital innovations such as Uber and Facebook in particular ways.

Worldview
A set of underlying assumptions held by a particular stakeholder group.

Within Chapter 10 we introduce the idea of a **worldview** (sometimes referred to as an appreciative system) and argue for the importance of analysing the worldviews of all stakeholders in some design project. Worldviews are essentially ways of valuing the world. For instance, our view of the purpose of some domain of organisation will colour

how we evaluate its performance, as well as how we design and implement control within the system. Hence all change to organisation, including change introduced through digital technology, is reliant on a whole range of often implicit values which we use to frame not only our current situation but also what we regard as appropriate future.

Some of the worldviews utilised by the designers of our modern digital technologies have begun to be questioned in various circles. The sociologist Shoshanna Zuboff (2015), for instance, has argued that the growing centrality of data to economic activity, as is evident in many of the commercial applications of social media and mobile commerce, is creating a new form of capitalism that she calls surveillance capitalism. Surveillance capitalism generates new forms of capitalist production not based upon the direct production of goods and services but based upon the collection and analysis of large amounts of data gathered about people and what they do. These data are used not only to understand but also to predict and influence human behaviour. This set of practices, Zuboff feels, is ethically suspect.

So ethical values have always been necessarily embedded in the application of technology for particular purposes. In Section 3.2.10 we considered how early computing machines based on Hollerith's design were used by Hitler's Nazi administration to compile two censuses of the German population in 1933 and 1939. These censuses effectively could not have taken place without the technology first invented by Hollerith originally for use in computing the US national census. These tabulating machines allowed the Nazi regime to identify Jews and other nominated groups in the population for eventual transmission to the death camps. Tabulating machines were even used in the death camps themselves to process data about the 'performance' of the extermination effort.

Take another example of ethics concerning the practices of the so-called Internet giants of Google, Facebook and Amazon. Is it right, some people ask, that Internet giants like Amazon earn vast profits from their activity while also paying very little in taxation in the various countries around the world in which they operate? In 2017, Amazon's pre-tax profits were of the order of 72 million pounds sterling in the UK, but it paid only some 1.7 million pounds sterling in tax to the UK Treasury. Meanwhile, offline retailers operating out of British high streets have to not only pay rent and Local Authority rates on their outlets, but also substantially higher corporation tax than that paid by Amazon. This has been seen as a contributory factor in the closure of many established brand names on the British offline high street.

REFLECT

If you think this situation is unfair, where would you place the blame for this situation? Is it because of the choices made by Amazon as to how it operates, or is it because more and more consumers, probably like yourselves, are choosing to shop online through retailers such as Amazon at the expense of high street stores?

9.7 DIGITAL ECOSYSTEMS

Digital ecosystem
An interdependent set of actors and activity systems that share digital platforms.

Another type of disruptive innovation is evident in what some refer to as digital ecosystems. A **digital ecosystem** is an interdependent set of actors and activity systems that share digital platforms. Digital ecosystems may be created within the ways in which one organisation operates or may support the workings of multiple organisations. In the latter case, such digital ecosystems are typically forms of P2P eCommerce or G2G eGovernment supporting a partnership chain (Section 7.4).

Take the example of Amazon and eBooks. For many book offerings on its website, Amazon offers a digital version – an eBook. However, to read such an eBook on the go you either need to download the Amazon eBook app to your mobile device or to purchase a specialised eBook reader from Amazon. Having got your business, Amazon can now engage in some targeted marketing to you via the app or the eReader, and perhaps get you to purchase additional content with it such as music or movies. The key digital platform here is the specialised Amazon format for eBooks, which enables Amazon to maintain control of not only its content, but how this is delivered to the customer. But it does not stop there. Amazon provides a whole range of software tools to authors to produce their eBooks, specifically for sale via the Amazon marketplace. It even provides infrastructure for authors to manage issues like direct marketing and direct sales.

The Danish firm, Danske Bank, created an online system which allowed potential homebuyers to get a full house-buying package including house market listings, mortgage offers, heating estimates and taxation cost estimates. It did this by aggregating its data with those of partner institutions. Various agencies within the NHS in the UK are also building ICT infrastructure which will allow not only the sharing of data but also the better allocation of scarce resource across various healthcare services provided.

In a sense the idea of a digital ecosystem has much in common with that of the value network (see Section 6.4). The idea of the value network is that organisations interrelate and interact in complex networks of value production, distribution and consumption. A particular organisation will take on roles in a number of different chains of value. ICT can make it possible to deliver value along them more efficiently and effectively. Michael Porter now acknowledges that with the rise of digital business certain 'secondary activities', such as ICT, offer far more than a support role. They have become critically embedded within primary activities. To deliver more efficiently and effectively requires organisational change. So the task is to analyse the existing value chain and see how aspects of it can be redesigned to improve performance. In the wider value network, similarly, it is to analyse activities and relationships with external stakeholders as preparation for redesigning those aspects of that network that are under the control of a particular organisation.

Value-network analysis focuses upon the activities and relationships of the business with external stakeholders. It looks for ways of disaggregating or deconstructing the value network, as well as ways of re-aggregating or reconstructing it. Disaggregation involves segmenting out elements of the value chain and perhaps outsourcing them to partners. Re-aggregation involves integrating elements of the value chain to streamline key processes.

Within such analysis there is also the importance of managing the value network of partners which might result from a reconstruction of the value network. It might include supply-side partners, primary activity partners, sell-side partners and value-chain integrators. On the supply side, partners are likely to include traditional suppliers (perhaps managed through hierarchies), business-to-business exchanges (managed in market terms) and wholesalers/distributors (perhaps managed in networks). On the sell side, business-to-business exchanges, wholesalers and distributors will also exist alongside traditional customers. Partners may also fulfil certain primary value-chain activities such as inbound logistics. Value-chain integrators are organisations that integrate aspects of the internal and external value chain for companies. An example is operating and maintaining the ICT infrastructure (see Chapter 12).

REFLECT

Does the concept of a biological ecosystem really fit with that of a digital ecosystem?

DID YOU KNOW?

Crowdsourcing is seen by many to be a source for much disruptive innovation. For example, Wikipedia has disrupted the industry for traditional encyclopaedias.

9.8 WEB UNICORNS

Web unicorn
Digital start-up businesses that rely upon the infrastructure of the Internet and Web with a market valuation greater than one billion US dollars.

Crowdsourcing
Crowdsourcing refers to the outsourcing of work to people collaborating over the Internet.

A unicorn is clearly a mythical creature. Digital start-up businesses that rely upon the infrastructure of the Internet and Web with a market valuation greater than one billion US dollars also used to be mythical. However, with the increasing penetration of the digital economy (see Chapter 6), such businesses are becoming commonplace. Many of these businesses are key examples of digital innovation and certain of these businesses are potential disruptive forces within market sectors in the future.

There are a number of infrastructure issues stimulating this growth in web unicorns. First, just like in areas such as mobile commerce, the increasing power of access devices and associated communication networks is creating greater levels of business opportunity. As an example, location-based services are reliant on certain sensors built into access devices, as well as the greater power and penetration of both cellular phone and wireless networks. The increasing application of various forms of cloud service (see Section 5.8) also make it easier for these companies to scale their offerings. Finally, there is a wide base of digital natives (see Section 6.1.2) ready and able to use the growing range of digital applications.

Uber is clearly one example of a web unicorn. Airbnb is another, founded in 2008 and which offers a web service for people to list, find and rent lodging. Funding Circle, founded in 2010, offers a peer-to-peer lending service and is one important example of crowdsourcing (see Section 5.7). Dropbox, founded in 2007, is a successful file-hosting service, while Spotify is a music podcast and video-streaming service.

Most web unicorns are US-based, with only a limited number being established in other parts of the world such as Europe. The UK has the largest number of such unicorns in Europe, but there is concern that a skew in the digital economy is being reinforced with the strong dominance of the United States in the area of digital business.

RECAP

Mobile commerce relies upon certain critical elements of ICT infrastructure such as mobile access devices, apps, cloud services and GPS. The clear advantage of mobile commerce is that goods and services can be ordered and paid for anywhere and at any time. Applications of mobile commerce have been pinpointed as disruptive innovations in key market sectors such as transport and the hotel and guest house sector.

9.9 CONCLUSION

Social media and mobile commerce are typically promoted as two of the most prominent forms of contemporary digital innovation. But, as technological infrastructure, both social media and mobile commerce build upon established aspects of ICT infrastructure as discussed in Chapter 5. The key value of such technologies lies in the ways in which they can disrupt established activity systems in areas such as journalism and transport. But such disruptive innovations also bring challenges to established conventions such as the commitment to truth and the rights of workers.

The term 'social media' is a difficult one to pin down. We see it as referring to the means for creating and sharing of digital content, such as written material, photographs, video and audio material. Such content is via online social networks, which rely heavily on the technological infrastructure of both the Web and the Internet. The value of social media lies primarily in its function as a tool to build and maintain strong links with people in an online social network, as well as the opportunity to explore and develop weak links. But such social networks can also facilitate communication imbued with hatred, injustice and untruth.

Mobile commerce is a subset of electronic commerce which relies upon many existing aspects of ICT infrastructure such as mobile access devices, apps, cloud services and GPS. The clear advantage of mobile commerce is that goods and services can be ordered and paid for anywhere and at any time. Mobile commerce has been instrumental in the establishment of what some call the gig economy which has fostered a rising class of people dubbed the 'precariat' – people who live in a precarious state of employment with none of the normal rights of job security.

It should be evident from this that social media and mobile commerce are not merely sets of information and communication technologies. The applications of content sharing through online social networks and booking services through mobile devices can be designed in many different ways to facilitate particular goals. Some of these goals are seen by many commentators as ethically challenging. In the next chapter we consider what digital innovation actually constitutes and introduce the idea of a business model to help us better understand how through processes of analysis and design. It is not just ICT systems that are designed, but whole systems of organisation.

9.10 REVIEW TEST

9.1 Electronic commerce is a super-set of _____ commerce.

Fill in the blank term below.

☐

1 mark

9.2 An app is …

Select the best statement that applies by placing an X in the box.

- ☐ An application of digital innovation
- ☐ An ICT application
- ☐ A small, specialised program downloaded onto a mobile access device

1 mark

9.3 Mobile access devices include

Select the best four that apply by placing an X in the box.

- [ ] General purpose tablet computers
- [ ] Smartphones
- [ ] Special purpose tablet computers
- [ ] 2G mobile phones
- [ ] Laptop computers

4 marks

9.4 A digital ecosystem is an interdependent set of actors and activity systems that share digital platforms.

True or false? (Select only one by placing an X in the box)

- [ ] True
- [ ] False

1 mark

9.5 The term social media is associated with …

Select the best three that apply by placing an X in the box.

- [ ] User-generated digital content
- [ ] News broadcasters
- [ ] Membership of online social networks
- [ ] Multimedia websites
- [ ] Sharing of digital content over online social networks

3 marks

9.6 Forms of electronic messaging include

Select the best four that apply by placing an X in the box.

- [ ] Electronic mail
- [ ] SMS messaging
- [ ] Mobile phone calls
- [ ] MMS messaging
- [ ] Proprietary MMS messaging

4 marks

9.7 Strong links exist between people who know one another but do not regularly interact.

True or false? (Select only one by placing an X in the box)

- [ ] True
- [ ] False

1 mark

9.11 EXERCISES

- Social media messaging now dominates electronic communication. What implications does this have in relation to control of such communication by large corporates such as Facebook?
- Consider the case of some other digital business such as Airbnb and determine to what degree it could be considered a case of disruptive innovation.
- Produce a list of the current top 10 web unicorns. Determine how many of these are US-based.
- More people in the world own a smartphone than any other form of access device. Consider the implications of this for growth in mobile commerce.
- Use of social media has been banned within many workplaces. Determine why such bans have been implemented.

- Difficulties of maintaining the privacy of content produced by Facebook users has been a continuing issue. The safety of user accounts has been compromised a number of times over the history of the site. Reflect upon this in terms of current thinking on data protection and data privacy.
- Social media appears to have been used in a number of different ways within the Arab uprising, such as to raise awareness and to organise political protest. Try to identify other areas of the world where social media has been used in a similar manner.

9.12 PROJECTS

- Sites such as Facebook are claimed to have played a major role in the organisation of political protest around the world, such as in the case of the Arab uprising in Egypt and elsewhere. Investigate the role of such sites in political activity worldwide.
- Several governments have tried to block or even ban Facebook – this has happened in the People's Republic of China, Vietnam, Iran, Uzbekistan, Pakistan, Syria and Bangladesh. Within certain Islamic states, claims have been raised that Facebook would include anti-Islamic content. Are sites such as Facebook a form of cultural imperialism?
- Consider whether we will have public service news broadcasters in the future such as the BBC, given the pressure placed upon these services by social media and narrowcasting.
- Find another example of a digital ecosystem. Determine what makes this ecosystem important and how sustainable it is.
- Find a web unicorn and do some searching for secondary material on the company. Establish its key value proposition and describe other key elements of its business model. Determine whether this digital business is sustainable into the longer term.
- Facebook use has successfully moved onto mobile devices such as the smartphone. What part does a growing range of such mobile devices play in the growth of the company?
- Facebook and Twitter are both private operations, subject to commercial pressures. Other commercial operations have bowed to government pressure to censor communications traffic. Consider whether the use of such commercial media for such purposes as political protest is viable longer term.
- Some commentators have recently raised concerns that governments worldwide may be tempted to switch off access to the Internet for their citizens at times of political instability, such as that experienced in Egypt. Assess the likelihood of this occurring and also the potential consequences.

9.13 FURTHER READING

The books by Fuchs (2017) and Lindgren (2017) provide critical accounts of social media within the digital infrastructure. Given its pre-eminence in recent times there are surprisingly few good reviews of the phenomenon of mobile commerce. The book by Hayden and Webster (2015) is a little hyped, but covers most bases well.

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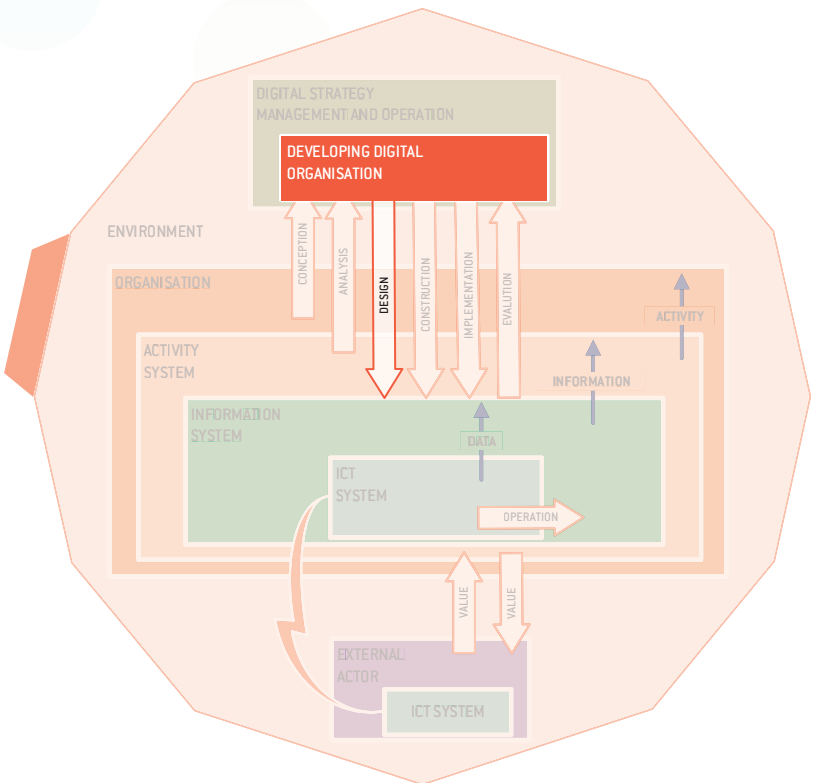
10 DESIGNING DIGITAL ORGANISATION

> **'There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success than to take the lead in the introduction of a new order of things.'**
> – Niccolo Machiavelli (1469–1527)

LEARNING OUTCOMES	PRINCIPLES
Define notions of design science, design theory and design artefacts as they apply to business.	Design science is the science devoted to what might be, which is implemented through design theory. Design artefacts are the output of applying design theories in practice.
Understand the idea of problem-setting in organisations and how this activity should be undertaken.	Problems of organisation are best set as problem situations that exist for would-be improvers. A problem situation consists of an issue or series of issues that arise from some existing domain of organisation. The elements of a problem situation can be visualised as a rich picture.
Explain ways of investigating domains of organisation.	There are several ways of investigating domains of organisation – conversation, participation, observation and documentation.
Describe a way of modelling systems of organisation as they are now or as we would like them to be.	Visualisations as storyboards are a useful way of describing systems of organisation for design purposes.
Define the relevance of project-based management for the design of systems of organisation.	Within business analysis and design, activity is organised as projects. Project management consists of project planning, project organisation and project control.

CHAPTER OUTLINE

10.1 Introduction
10.2 The design orientation
10.3 Problem-setting
10.4 Investigating domains of organisation
10.5 Designing organisation
10.6 Establishing projects of business analysis and design
10.7 PRINCE2
10.8 Conclusion
10.9 Review test
10.10 Exercises
10.11 Projects
10.12 Further reading
10.13 Bibliography



10.1 INTRODUCTION

Richard Buckminster Fuller, the twentieth-century American architect, is best known for his invention of the geodesic dome. But Fuller believed that design was an attitude needed to confront some of humankind's greatest problems – sometimes referred to as the grand challenges of our age – such as increasing population, feeding the planet, managing water resources, reducing inequality and tackling global warming. This is because the solutions to many such problems demand that we organise ourselves differently – such as reorganising our patterns of water consumption as one way of better managing our finite source of fresh water. So whenever we change our ways of doing things such as this, we inherently design.

Stafford Beer was a British cybernetician (cybernetics is the study of control as considered in Chapter 2) and one of the first people to apply systems thinking to problems of organising. He was one of the first to suggest that what we think of the institution of organisation emerges from patterns of action that serve to constitute organisation. As we have mentioned a number of times in earlier chapters, an important property of open systems, of which organisations are key examples, is equifinality. This means that an open system can achieve its goals or purpose in different ways. So there are likely to be a multitude of different patterns of organisation that meet the same defined objectives or goals. The consequence of this is that we should be able to *design* different patterns of organisation and then evaluate which is the most appropriate pattern for resolving aspects of some problem situation.

In this chapter we consider business and organisation more generally in terms of what is known as the design orientation, or design thinking. As we shall see, this fits well with the systemic and action-oriented view of organisation promoted in this book. It also allows us to understand more clearly what digital innovation and digital strategy mean, which are two topics for Chapter 11.

10.2 THE DESIGN ORIENTATION

Design orientation
The notion that design is an activity worthy to be taught.

Within this section we examine the nature of design thinking and how it relies upon design theories and design artefacts. We then look at different types of design artefact and highlight our focus within this book upon designing systems of action.

Business as an area of activity is clearly much more complex nowadays. The application of ICT is partly to blame for such increasing complexity. And people worry about what we teach in business schools in response to this complexity as well as the positioning of ICT within such complexity. Therefore, a key question must be: Is business education still fit for purpose in the digital age covered by this book? What is clearly needed is some response to the management of complexity – particularly the sociotechnical complexity engendered by the increasing embeddedness of ICT within organisation. Some feel that the best response to this is to view and teach business as a design discipline – perhaps even as an instance of design science.

10.2.1 Design science

The notion of science is traditionally directed at understanding *what is*. The natural sciences such as physics, biology and chemistry attempt to understand what constitutes the physical world. The social/psychological sciences such as economics, sociology, psychology and politics attempt to understand what the psychological and social world consist of. In the 1960s, Herbert Simon (1996), a founding father of both management

Design science
The science of the possible.

science and computer science, proposed another type of science, which he originally called the sciences of the artificial. Many now refer to this science, devoted not to what is but *what might be*, as **design science**. Simon described this science in the following terms, '*engineering, medicine, business, architecture and painting are concerned not with the necessary but with the contingent – not how things are but how they might be – in short, with design*'.

So design science is concerned not with *what is* but with *what might be*. Simon also implies in this quote that business should not really be categorised in its conventional role as a social science but as a design science. And, as a consequence, that managers are best seen as designers, employing design thinking.

10.2.2 Design thinking

So what is design thinking and how does it or should it relate to business education and practice? The best way of understanding design thinking is to look at what designers typically do. Designers find problems, engage with problem situations, model problems and their potential solutions, design with 'users' in mind and visualise things.

- Problems or problem situations are at the heart of design. Most business problems tend to be what the American philosopher Charles West Churchman referred to as 'wicked'. Wicked problems are by their nature ill-defined and ill-structured. There is also not one 'correct' solution to such problems, but a multitude of possible solutions.
- Designers must engage with the messiness of problem situations within business. Typically, such engagement is through dialogue, participation or observation of business situations. Through such engagement designers attempt to set problems and the direction of their solutions.
- Designers conduct experiments in understanding by building representations or models of problem situations. They also build prototypes as models of possible solutions to problems.
- Designers like to visualise both problems and solutions, because there are some key advantages to visualisation bound up with the adage '*a picture is worth a thousand words*'. Visualisations can not only cover more of some problem situation than a written description, they are particularly good at dealing with the complexity of such situations. Visualisations also make it easier to communicate things and visualisations tend to be easier to change than written descriptions or specifications.
- Finally, good designers like to co-create solutions with organisational actors and design solutions with the users of such solutions in mind.

10.2.3 Design theories and design artefacts

Design theory
A theory which proposes how to undertake design in relation to a class of design artefact.

Design artefact
The output of applying some design theory in practice.

Design science is implemented through design theory (see Figure 10.1). **Design theory** tells the designer how to design certain things. Design artefacts are the output of applying design theories in practice. **Design artefacts** need not only be physical artefacts – they can be ways of doing or organising things.

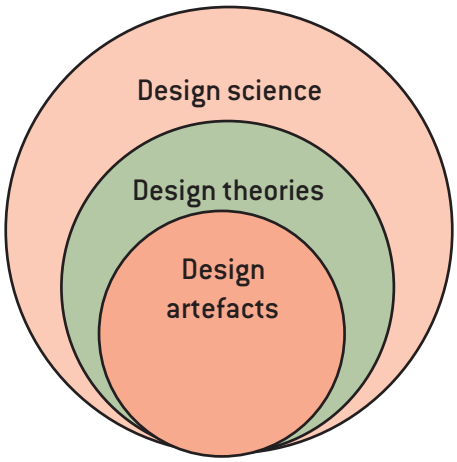


Figure 10.1 Design science, design theory and design artefact

10.2.4 Types of design artefact

Herbert Simon maintains that '*everyone designs who devises courses of action aimed at changing existing situations into preferred ones*'. Richard Buchanan (1992) believes that there are four major types of design – each dealing with design artefacts of greater complexity. In doing this, Buchanan is really distinguishing between different types of design theory needed to design different types of design artefact.

- Symbolic design involves designing communication through symbols. Hence the map of the London Underground is a set of symbols designed by Harry Beck to communicate the topology of the underground railway network in this city (see Section 2.7).
- Material design involves the design of products or tangible artefacts. Charles Rennie Mackintosh is famous for designing not only buildings but the interiors of buildings and artefacts such as chairs and tables.
- Interaction design involves designing interaction with products and services. Hence designers are concerned with continuously changing the way we interact with our access devices through operating systems and apps.
- Finally, systems design involves designing systems or patterns of action. Therefore there are crucial design decisions that need to be made in the systems by which we dispatch emergency vehicles to healthcare incidents.

Within this book we have clearly focused upon systems or patterns of action, although we have touched upon symbolic design and interaction design as well. Systems design is the most complex of design domains, but one of course particularly relevant to business.

10.2.5 The nature of design

If you were to visualise what design is, it might look like Figure 10.2. There is some perceived problem (the question mark). The parameters of the problem must be unravelled (the wiggly line). And, some sort of design solution must be arrived at and agreed with (the shaking hands).

But within this chapter we are going to try to consider design as something more like the visualisation in Figure 10.3. This demands that we follow a designated design

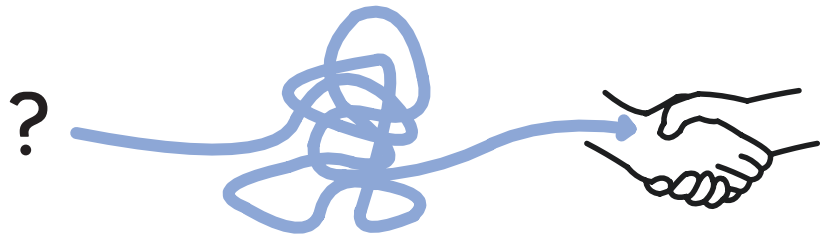


Figure 10.2 A visualisation of design

approach – sometimes referred to as a method or a methodology. Taking a design approach means applying some design theory to a design artefact. Doing this allows us to smooth out some of the difficulties experienced with design work in practice. It also allows us to impart design principles more easily to others.

Figure 10.3 Design through theory

Problem-setting
Establishing or setting the problem to be engaged with.

Problem-solving
Resolving some established problem.

There are a lot of different ways of thinking about design as an activity (Figure 10.4). Some people divide it up into two ways, such as divergence and convergence, or **problem-setting** and **problem-solving**. Most divide it into at least four ways, such as discover, define, develop and deliver; or exploration, ideation, evaluation and implementation.

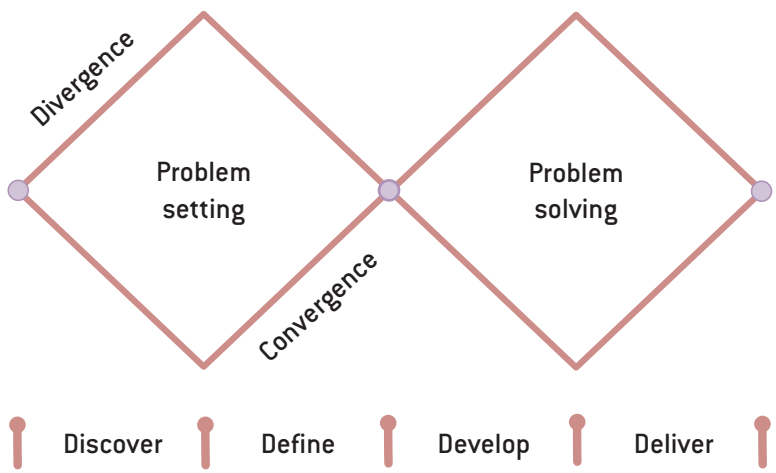


Figure 10.4 Design as activity

10.2.6 Designing with and for actors

Because any pattern or system of action is subject to equifinality, we know that there are a multitude of different ways in which we could redesign such a pattern to address one or more of the problems we identify for it. Some of these ways of doing things differently might involve the use of ICT such as customer websites, mobile apps, digital marketing, social media and electronic data structures.

However, the important point is that design is too important an activity to be left solely to designers. This is partly because designers normally display a tendency to design for other designers instead of the users or participants of some new pattern of action. Architects tend to wish to design for other architects and software designers for other software designers.

This is why designing systems of action must involve the actors who are involved in or affected by such systems of action. Because design always involves choice and choices are always best made by the people who have to act. This is sometimes referred to as *co-creation* within design.

We should also not assume that organisation design will necessarily involve digital innovation. Frequently, we can design improved ways of doing things without the application of expensive ICT. Sometimes, introducing ICT may degrade rather than improve certain patterns of action.

RECAP

Design science is a science devoted to what might be. Design science is implemented through design theory. Design artefacts are the output of applying design theories in practice. There are at least four different types of design artefact: symbols, products, interaction and systems of action. Designers engage with problem situations and conduct experiments in understanding by building models of problem situations. Designers like to visualise both problems and solutions, and good designers like to co-create solutions with organisational actors.

10.3 PROBLEM-SETTING

To begin to design you first must establish what to design. This means establishing or setting the problem to be engaged with. Problem-setting is often the most difficult part of design, because it typically involves determining not only the boundaries of the problem to be solved but the purpose to be served by any solution. Designing patterns of action is notoriously difficult because such systems are substantially 'soft' rather than 'hard' (see Section 2.3) and '**wicked**' rather than tractable.

Wicked problems
Complex problems in which the problem itself is open to interpretation.

Systems of action tend to be soft and wicked because:

- their boundaries or scope may be fluid
- the purpose of the system is likely to be open to interpretation, depending upon stakeholder viewpoint or worldview
- the definition of precisely what control means in terms of the system, and therefore how we should measure performance, depend on the worldviews of stakeholders.

Organisations are different from mere collections of people, or social groups in general, in the sense that they are normally established for a purpose: usually to produce value of some form (see Chapter 6). Organisations are typically seen as needing clear identities to establish a context for action. However, organisational purpose is a dynamic, not a static issue. Purpose is continually negotiated, understood and disseminated throughout the organisation by its actors.

Problem-setting involves exploring the problem space or problem situation and discovering its key features. It also involves setting boundaries around the problem – what you shall consider within design and what you shall not. Given the 'soft' and wicked nature of patterns of action, this involves engaging with stakeholders and their viewpoints.

10.3.1 Problem situations and stakeholders

Problem situation
A situation in organisational life that is regarded by at least one person as a problem.

In situations of organisation, the notion of a problem is rarely straightforward. Peter Checkland prefers the term **problem situation**. Problem situations exist for 'would-be improvers' – people who feel that the current state of affairs is unsatisfactory and desire change to the current situation or domain of organisation. He refers to a problem situation as a situation in organisational life that is regarded by at least one person as a problem. The French use the term *problematique* to describe a network of interrelated problems while the systems theorist Russell Ackoff (1967) referred to complex problem situations as 'messes'.

Stakeholder
Somebody with a vested interest in some problem situation. A role is defined by active participation in the domain considered a problem situation; a stakeholder merely has an interest of influence in some domain.

Stakeholders are some persons or group of persons who have a stake in some system of organisation – some interest in the problem situation and its solution. It follows from this that organisational systems are defined through intersubjective agreement between stakeholder groups (stakeholders, for short). Mason and Mitroff provided one of the earliest definitions of the term stakeholder: '*all those claimants inside and outside the organisation who have a vested interest in the problem and its solution*'. Actors enacting various roles within some domain of organisation are likely to be stakeholders. But stakeholders may also be external to the organisation but impacted by its performance, such as customers, suppliers, regulators and partners. It is also important to recognise that not all stakeholders will be would-be improvers of the problem situation because of differing worldviews.

10.3.2 Worldviews

Defining a system, and deciding what is in it, and what is its environment, depends on the viewpoint of the stakeholder. Stakeholders are normally groups of people to whom a particular system of action is relevant. As well as having different ideas about the boundaries of the system, they can also differ about what its key elements are and its intended purpose. These differences tend to reflect their differing **worldviews**.

Worldview
A set of underlying assumptions held by a particular stakeholder group.

Consider a manufacturing enterprise as a system of action. A customer might see it as a system to meet customer demand for a designated range of products, within resource constraints. A shareholder might see it as a system for transforming business needs into a satisfactory return on investment. A shop-floor employee might describe it as a system to achieve maximum utilisation of resources while maintaining secure employment and acceptable working conditions.

A worldview then is a set of underlying assumptions used by individuals and groups in understanding and constructing the world. This has much in common with Geoffrey Vickers' (1965) concept of an **appreciative system** – an '*interconnected set of largely tacit standards of judgement by which we both order and value our experience*'. He argues that decision-making depends on the different appreciative systems that decision makers bring to bear on a problem, and that the stability of organisations depends largely on shared appreciative systems.

Appreciative system
An interconnected set of largely tacit standards of judgement by which we both order and value our experience.

Each stakeholder will have a worldview which determines not only how they view the problem, but also what they regard as potential solutions. Frequently, differences in worldview will revolve around differences in the perceived goal of some system or pattern of action.

Let us take a sawmill, and consider how different stakeholders might see it. An industrial engineer might view it as a production system, and a management scientist as a profit-maximising system. The industrial engineer will be interested in how it transforms logs into finished products using resources such as plant and machinery, and will probably be studying it to determine effective control procedures

for the production process: to decide where machinery is placed, the way in which products are handled and so on.

The management scientist would probably be less interested in the physical activities of this sawmill than in their financial consequences. They might see it as a series of subsystems, such as a log handling and storage subsystem, a finished goods and warehousing subsystem, a marketing subsystem and a financial control subsystem. They might be interested principally in the way each subsystem communicates its needs to other subsystems, and how the flow of goods and information affects the financial performance of the firm. The system's environment in this case consists of the market for logs, the market for finished wood products and other elements such as the financial, labour and legal environment of the firm.

Consider another example – a university – as a system of action. As illustrated in Figure 10.5, different stakeholders will have different ideas as to what the purpose of a university is. This difference in perspective will lead to different issues that might be used to define the problem situation.

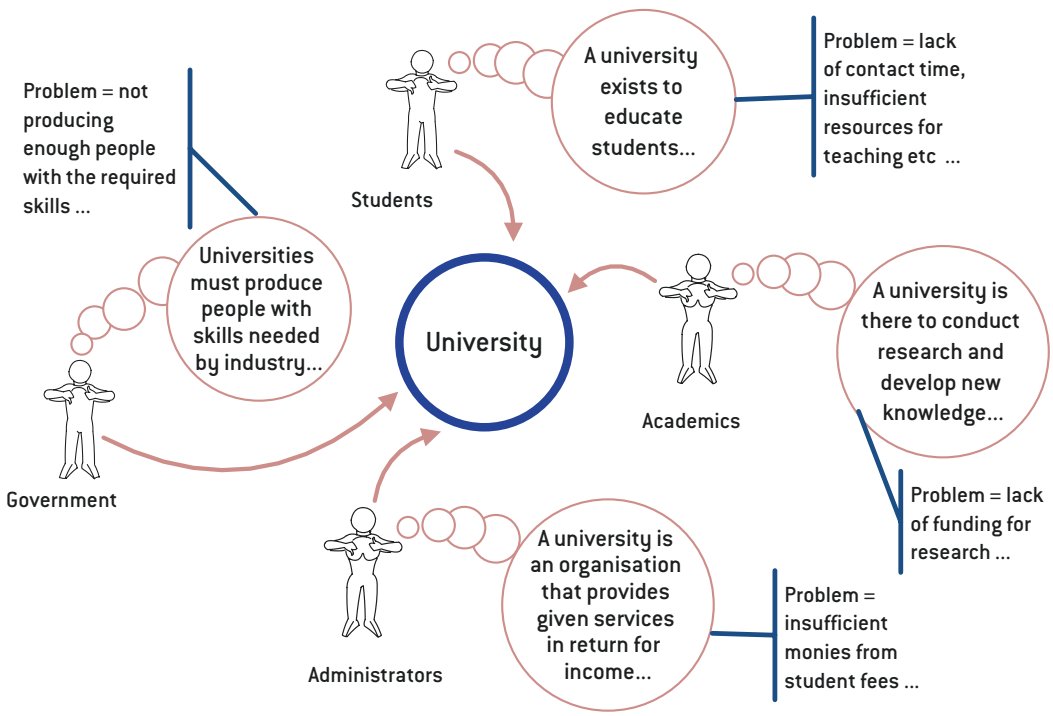


Figure 10.5 A problem situation

So to establish or engage with organisational problems, you must generate stakeholders, issues and worldviews. You also must try to represent these elements in some form of overall description of the problem situation.

REFLECT

Reflect on the following problem situation which is characteristic not only of countries like the UK, but also countries like China. You may be aware that many societies are experiencing a growth in their elderly population. For instance, the number of over-65s in the UK is greater than the number of under-16s now. But it is estimated that there is likely to be a 60% increase in the number of over-65s by 2030 in the UK. This growth in the elderly population puts strain upon healthcare services, as the older you are the more likely it is that you will suffer ill health. Reflect upon this as a systemic problem and consider how you might visualise this problem situation.

10.3.3 Brainstorming and prioritising issues

Brainstorming
The technique of generating issues and/or their solution in a free-form manner.

One way to engage with some problem situation is simply to brainstorm issues. An issue is anything seen as problematic by somebody with the current situation of organisation. As a technique, **brainstorming** demands that you try not to withhold any issues or judge any issues identified up front.

An issue can be written on a Post-it note and placed on a whiteboard or a wall. For example, one issue for administrators in a university might be that they receive lots of student applications past the deadline. Issues can then be clustered together in terms of their affinity. This means categorising or classifying issues and moving the associated Post-it notes together in terms of their affinity. Hence there may be a certain affinity between late applications and incomplete applications.

Clearly, it is unlikely that the designer will be able to handle all issues in one go. So, usually some form of prioritisation is used to identify the importance of issues or classes of issue. One approach is to cluster issues in terms of Must have, Should have, Could have and Won't have issues. These priorities spell out the acronym **MoSCoW**.

MoSCoW prioritisation
A way of categorising and sorting issues to be handled.

From this process of identifying and prioritising issues the designer can start to set a boundary around the problem situation. This will inherently involve making choices about what to consider within some design activity and what to exclude from this activity. Therefore the design might focus on resolving Must have issues but exclude the range of Should have issues from current consideration.

10.3.4 Stakeholder mapping

Stakeholder mapping
Analysing the types of and impact of stakeholders on information systems.

RACI matrix
A way of classifying the impact a particular stakeholder group will have on a design project.

Along with the identification of issues relating to some problem situation we also need to identify the likely stakeholders that will affect the success of the design. Then the designer needs to put themselves in the 'shoes' of each stakeholder and generate their likely viewpoints or worldviews on various issues identified. Sometimes it is useful to analyse the effect a nominated stakeholder group has or is likely to have upon some issue and its resolution. One useful categorisation is whether a stakeholder is Responsible for an issue, Accountable to an issue, should be Consulted or Informed about change to an issue. These categories of stakeholder spell out the acronym **RACI** and a matrix is sometimes produced to locate how each stakeholder group should engage with the design activity in these terms.

10.3.5 Rich pictures

Rich picture
A graphical representation of key elements of some problem situation.

To help bring together the elements of some problem-setting, the technique of rich pictures is sometimes useful. A **rich picture** is a free-form visualisation of some problem situation which should include some notion of the stakeholders, their worldviews and one or more issues that serve to define the problem situation.

Some definition of the problem is given focus by naming it and placing it at the centre of the rich picture. Various stakeholders are named and illustrated as mannequins or stick figures on the picture. Labelled arrows are drawn from the problem to a stakeholder if they are affected by the problem in some way. Labelled arrows are drawn from the stakeholder to the problem if the stakeholder in some way shapes the problem and its potential solution. The viewpoints of each stakeholder are visualised as one or more speech bubbles attached to the mannequin. Sometimes other icons are used to represent conflict or consensus between various stakeholder groups.

An example rich picture drawn from a design exercise by the author and conducted within the Royal Mint about the problem situation of perpetual inventory checking is illustrated in Figure 10.6.

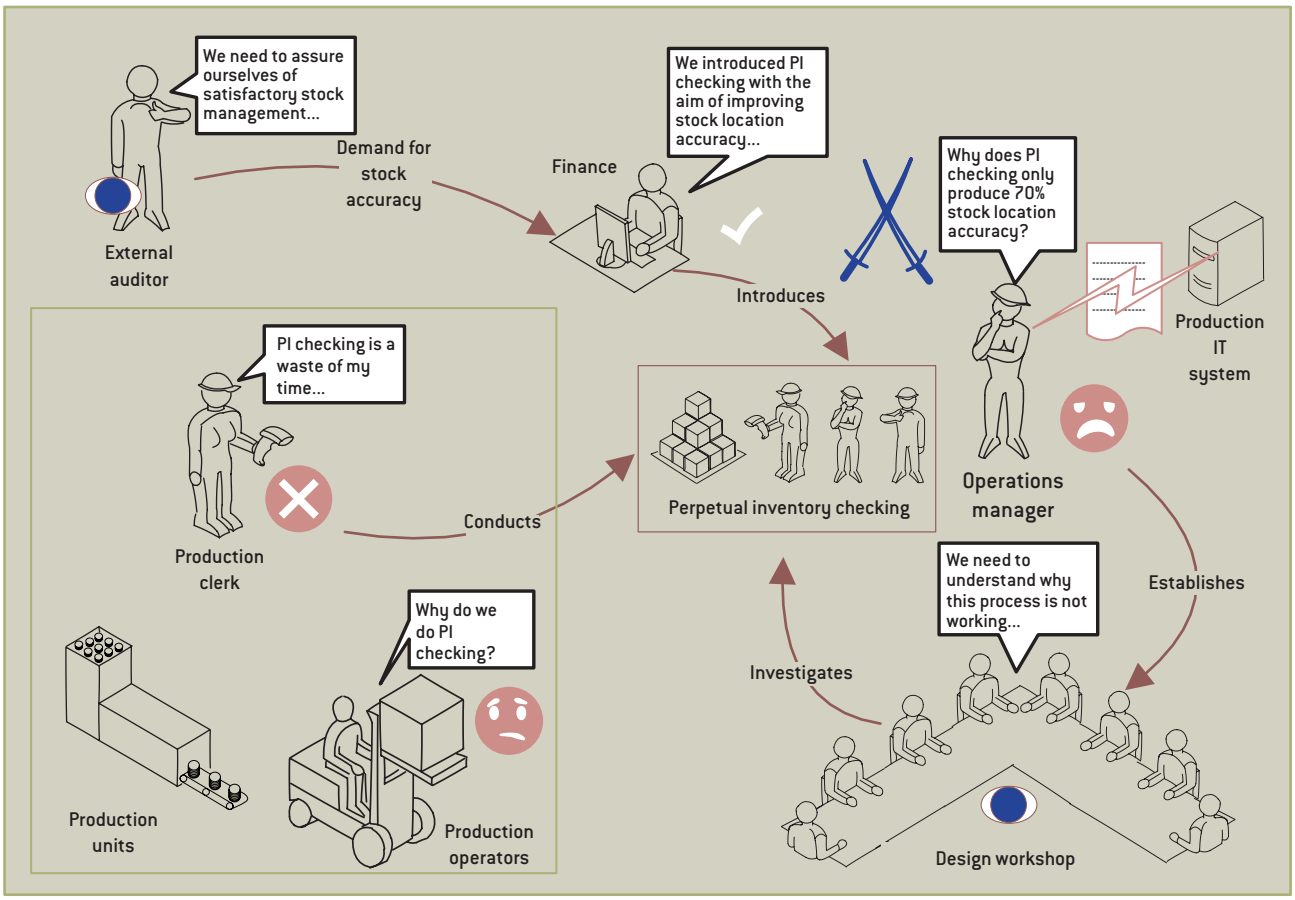


Figure 10.6 A rich picture of perpetual inventory checking

RECAP

Problems of organisation are best set as problem situations that exist for would-be improvers. But the way in which problems become situated relies upon the worldviews of different stakeholders. A problem situation can be conceived as an issue or a set of issues that arise from some domain of organisation. Stakeholders can be mapped in terms of groups that influence a problem and its solution. Each of these elements can be visualised as a rich picture.

10.4 INVESTIGATING DOMAINS OF ORGANISATION

We investigate domains of organisation to make sense of such domains. In terms of such sense-making there is much similarity between the work of the business analyst and that of the anthropologist. Both attempt to understand strange domains of action or to make strange familiar domains of action. But there is also one key difference between the business analyst and anthropologist: unlike the anthropologist the business analyst is concerned not only with how things are but how things might or should be.

The objective of an anthropological investigation is to understand and represent patterns of action making up some culture or broader social system. The objective of the business analyst/designer is not only to understand and represent patterns of action making up some more limited domain of current organisation it is also to understand motivations for changing such organisation, as well as designing new forms of organisation.

The anthropologist would normally investigate social situations using ethnography, a style of social investigation which typically involves intense periods of immersive participation within the domain being investigated. The anthropologist would record his/her experience of this immersion in the field within detailed field notes. In contrast, investigation within business analysis normally occurs in less intensive events, typically using some combination of investigation techniques in short periods of engagement with the domain in question.

There are several established ways of making sense of both existing and envisaged patterns of action within some domain of organisation, as illustrated in Figure 10.7:

- Participation. Utilising knowledge gained as a participant in patterns of action.
- Conversation. Holding systematic conversations with participants in the pattern of action considered.
- Observation. Observing actors taking action within the domain being investigated.
- Documentation. In some domains there may be a base of artefacts that can be utilised to help make sense of what is going on. It might be useful for the business analyst to hold a discourse with documentation or any other artefacts used within the domain being investigated.

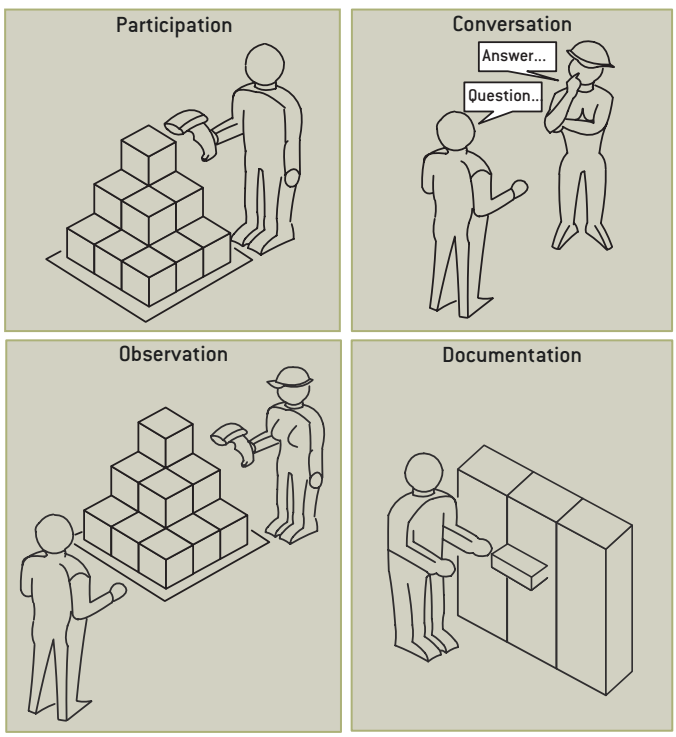


Figure 10.7 Forms of investigation

10.4.1 Business analysis as discourse

Discourse
A continuous stretch of language use, longer than a sentence, which is treated as a coherent unit.

One way to think of the investigation of domains of organisation is as a **discourse** between the business analyst and stakeholders in the problem situation. The term 'discourse' refers to a continuous stretch of language use, longer than a sentence, which is treated as a coherent unit. One of the most important types of discourse is conversation. We have made the case in Chapter 3 that conversation is joint action which is purposive. A conversation is typically made up of a sequence of adjacent speech acts. In other

words, one actor makes an utterance and another actor produces an utterance in response, this leads to a further pair of speech acts, and so on … Pairs of speech acts within a conversation tend to follow conventional patterns in which a certain utterance generates a preferred response. Some typical patterns of adjacency include:

- Question (directive) – Answer
- Assertion – Agreement
- Assertion – Disagreement
- Summons (directive) – Response
- Thanks (expressive) – Acknowledgement
- Apology (expressive) – Acceptance

Most conversations are typically built upon some common ground between participants. Common ground is the mass of knowledge, beliefs and suppositions that participants in conversations believe that they share with one another. The purpose of conversation is also typically to advance, accumulate or update such common ground.

The work of business analysis is particularly founded on a discourse between the business analyst and stakeholders in some problem situation. Typically, various types of conversation will be held with stakeholders. The purpose of such conversations is to build some common ground between the analyst and such stakeholders. This common ground may either constitute an understanding of how things currently are or an understanding of how things would like to be.

Conversations between business analyst and stakeholders can be done on an individual or a group basis. When such conversations are typically led by the business analyst with specific individuals, they are referred to as interviews. When such conversations are led by the business analyst with a representative group of stakeholders they, are likely to be referred to as a focus group, meeting or workshop.

10.4.2 Focus groups

Focus group
A type of one-to-many discourse in which a group of people are asked a series of questions about their perceptions, opinions, beliefs and attitudes towards something or some situation.

Unlike an interview, which is a type of one-to-one discourse, a **focus group** is a type of one-to-many discourse. A focus group is a discourse in which a group of people are asked a series of questions about their perceptions, opinions, beliefs and attitudes towards something or some situation. These questions are asked in an open group setting where participants should be encouraged to talk freely with other group members, and in doing so may formulate joint responses to the questions asked. The group nature of this form of investigation is seen to be important for generating consensus views of something or some situation. For instance, a focus group might be used to gauge likely reaction to a major business or technology change among employees.

10.4.3 Design workshops

Interviews and focus groups are particularly good means of investigation where the objective is to develop some common basis of understanding about some problem situation. Meetings and workshops are vehicles particularly for decision-making in areas such as the prioritisation of issues to be addressed or requirements for a new business model (see Section 11.2).

Collaboration meetings are typically events scheduled within the life cycle of a business analysis project, where either representatives of stakeholder groups are consulted on decisions made or participate in critical decisions that have to be

Design workshop
Sessions in which the business analyst and representatives of stakeholder groups get together in a structured situation to formulate thinking about either an existing domain of organisation or a new domain of organisation.

made. Collaboration meetings are particularly good for making or agreeing decisions on specific issues. But the meetings have to be designed with a clear rather than an open-ended purpose in mind. Hence techniques such as MoSCoW prioritisation are frequently used in such settings to keep participants focused on the task at hand.

Business design workshops are typically vehicles for joint design of problem solutions. Workshops constitute sessions in which the business analyst and representatives of stakeholder groups get together in a structured situation to formulate thinking about either an existing domain of organisation or a new domain of organisation. Workshops are normally facilitated in some way and are particularly suited for generating ideas, analysing systems and designing solutions.

Business analysis workshops are best held in an environment remote from everyday distractions in so-called 'clean' or 'white' rooms. The idea is to get everybody focused on the problem at hand and in generating a solution to the problem. This frequently means that the clean room is located in some other building from the workplace of stakeholders. Ideally, the workshop room should be full of requisite facilities such as tables and chairs arranged to facilitate open discussion, flip chart board or whiteboard (electronic or otherwise), refreshments, and computer and projection equipment where necessary. Such clean rooms may also be examples of hothousing. Hothousing is an approach to problem-solving which involves intensive periods of study, analysis and design.

Usually, an analysis workshop will be run according to a number of established 'ground rules'. A number of techniques are also frequently used for team-building purposes, managing discussion and for inspiring creativity, such as:

- Ice-breaking techniques may be used to ease the initial stages of team interaction and to get members of the team to contribute effectively as early as possible.
- Brainstorming techniques may be used to generate ideas.
- Disagreements may be managed by techniques such as documenting them as issues and 'parking' them on a list for later perusal.
- Workshops may be managed by enforcing speaking protocols such as 'only one person is allowed to speak at one time', 'nobody is allowed to speak for longer than five minutes at a time' and 'silence is taken to imply consent'.

10.4.4 Observation and participation

But there are other ways that the business analyst can make sense of some domain, particularly if the purpose is to analyse problems with an existing domain of organisation. He can observe how things currently work and can participate in the doing of things. She might also examine any documentation that is relevant and available to make sense of the situation.

Participation
A way of engaging with a problem situation by engaging in such practices yourself.

Observation
The recording of the detailed work behaviour of people and machines.

One of the best ways to understand a set of sociotechnical practices is to engage in such practices yourself – this is what is meant by **participation**. The key problem with participation as an investigative technique is that it is likely to take time. The key benefit is that in-depth sense can be made of some pattern of activity. In contrast, **observation** usually involves being present in work settings but not directly participating in the pattern of action. Instead, the analyst will be involved in recording the detailed work behaviour of people and machines. One way of managing observation for business analysis systematically is to walk through a process with the people doing the job. Ideally, this should be done several times with different workgroups to tease out any differences in practices across business domains.

RECAP

The objective of the business analyst/designer is not only to understand and represent patterns of action making up some more limited domain of current organisation, it is also to understand motivations for changing such organisation, as well as designing new forms of organisation. There are several ways of investigating domains of organisation – conversation, participation, observation and documentation.

10.5 DESIGNING ORGANISATION

Within previous chapters we have implicitly utilised a theory of digital organisation to help us make sense of the relationship between ICT (data), communication (information) and activity. This theory can equally be used as a framework for design – hence we may think of it as a design theory for digital organisation. Within this section we make aspects of this design theory more explicit in the sense of explaining more clearly how the various visualisations of patterns of organisation, illustrated in previous chapters, can be produced as design artefacts within activities of analysis, design and implementation. We also discuss how this design theory relates to other methods and techniques currently used within organisation design and digital innovation.

10.5.1 Visualising systems and patterns of action

We have adopted a form of visualisation to help express the patterning of action within particular systems of organisation many times already within this book. This form of visualisation is based upon the idea of a comic or a storyboard. Essentially, a comic consists of a sequential arrangement of both pictures and words to narrate a story (see Figure 10.8). A comic is therefore both a visual and verbal form of representation. A typical comic is made up of a series of panels, with each panel consisting of one or more cells. The sequencing of cells normally follows some convention of presentation such as a right to left and top to bottom arrangement across the page. Each cell is generally used to represent a snapshot of action within an overall plot and is used to narrate the storyline. Speech bubbles (to indicate external dialogue) and thought bubbles (to indicate internal dialogue) are attached to pictured characters. Captions are also attached in a more free-form way to cells and are used to convey additional meaning over and above that conveyed by the visualisation.

We have used such comic visualisations consistently throughout the book for a number of reasons:

- Comics are highly visual and we know that 'a picture paints a thousand words'.
- We deliberately use only a few constructs within a comic to help us think differently about organisation.
- Comics are deliberately free-form in nature – you can add to the core constructs of a comic with ease.
- Most people find it reasonably straightforward to 'read' a comic.
- We use comics to focus upon patterns of action by particular actors – putting actors and action at the centre of any representation of organisation.
- Such comics can be used not only to document common understanding about what people do or think they do – they can be used to document ways of improving some domain of organisation.

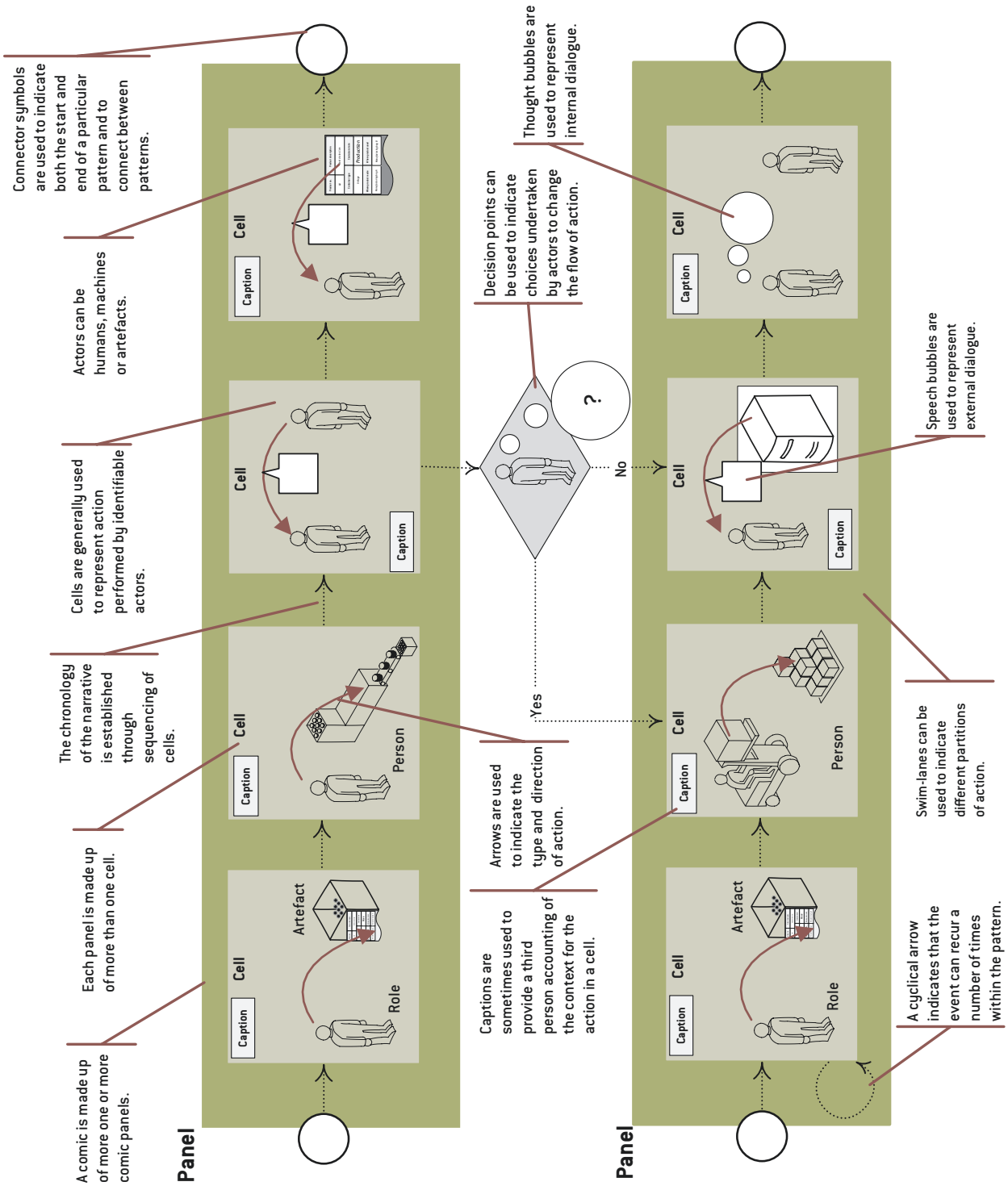


Figure 10.8 Elements of a pattern comic

Pattern comic
A representation of some story using comics for the purposes of analysis, design and implementation of systems of action.

The comics we have drawn, which we refer to as **pattern comics**, can be shown to have a relationship to more formal techniques employed in the analysis and design of systems of organisation and digital innovation, such as storyboarding, process modelling, value-stream mapping and service blueprinting. But they are deliberately much more free-ranging than such techniques to help encourage design as co-creation.

10.5.2 Six honest serving men

The notion of modelling some pattern of action is similar to the act of writing a story about something. In 1902 the author and poet Rudyard Kipling wrote a short poem attached to one of his *Just So Stories – The Elephant's Child*. The first four lines of this poem act as a useful framework to help analyse the form or shape of some pattern of activity as a story or narrative. And this is a useful first step towards visualising it in a comic.

I keep six honest serving men [persons]:
(They taught me all I knew)
Their names are What and Why and When
And How and Where and Who.

For instance, consider the story of what happens in household waste collection in the UK. Household waste collection is a key service performed by the public sector, by Local Authorities, in the UK. Over the last decade this system of action has become much more complex both for householders and for waste collection teams. The reason for this is that Local Authorities have been required to meet targets for increasing the recycling of household waste and reducing the amount of waste that goes to landfill.

The first key question to be asked is WHAT happens in this story? In other words, what are the key events in the current story of how waste collection is conducted by a typical Local Authority. We might express the events in this story as words and as follows:

> *A waste collection schedule is produced … This is sent to each householder in the local authority … Householders sort their waste … At a nominated time and in a nominated place they place the various types of waste they have sorted out for collection … A waste collection team is dispatched to collect a particular type of waste …*

The next question is WHY do things happen in this way? In other words, what is the purpose of an event such as making and distributing a waste collection schedule? As we made clear in a previous section you cannot think of organisation purely as acts of instrumental activity, such as sorting household waste. We must also think of it in terms of acts of data-handling or articulation and acts of informing or communication. Actors create data structures such as a waste collection schedule with the purpose of informing other actors, in this case householders. Acts of informing have the key purpose of facilitating coordination, in this case ensuring that waste of a particular type is placed for collection at a particular time and that it is collected at the indicated time.

WHEN do things happen is the next question. This encourages us to think of events happening in sequence (across time) – this happens, then this, then this and so on. Hence a waste collection schedule must be produced and distributed to householders before a waste collection team is dispatched to collect a particular type of waste, and before householder waste can be processed.

The question HOW do things happen encourages us to think of events as consisting of one or more discrete actions. It suggests the need to express these actions as delimited transformations of something into something else. Hence sorting waste is a discrete, delimited action, as is placing waste at a collection point. Dispatching a waste collection team is another transformation, as is collecting household waste from a collection point.

WHERE things happen directs us to consider the fact that all actions take place at given locations in space. Different waste collection teams, for instance, are likely to deposit collected waste at a different location depending on the type of waste collected.

Finally, WHO makes things happen is critically important to know about any pattern of action. Unlike in other approaches, such as process modelling, we have stressed in this book the importance of knowing which actions are enacted by which actors, as well as specifying who else is involved in or affected by such actions. Actors may be humans, such as waste collection controllers and waste operatives, or ICT systems such as a waste collection website or even a data structure such as a waste collection schedule.

Figure 10.9 is a high-level comic of the activity system of household collection built from asking these questions.

DID YOU KNOW?

The idea of storyboarding as a design technique is largely credited to Walt Disney Productions, that used it in the production of early animations, such as *Snow White*, in the 1930s.

10.5.3 Related design techniques

The idea of actions occurring in patterns is fundamental to many approaches which attempt to understand and design organisation:

- Workflow
- Organisational routines
- Soft systems
- Lean production

There are also many business design techniques which are based upon similar principles to those discussed here:

- Process modelling
- Narrative explanation
- Value-stream mapping
- Service blueprinting

Similar techniques are also used in relation to interaction design such as use cases and storyboarding.

REFLECT

How important is modelling to the effective management of organisations? Suggest some ways in which having a good model of an aspect of an organisation helps decision-making. What role should managers play in helping form consistent worldviews of problem situations among organisational stakeholders?

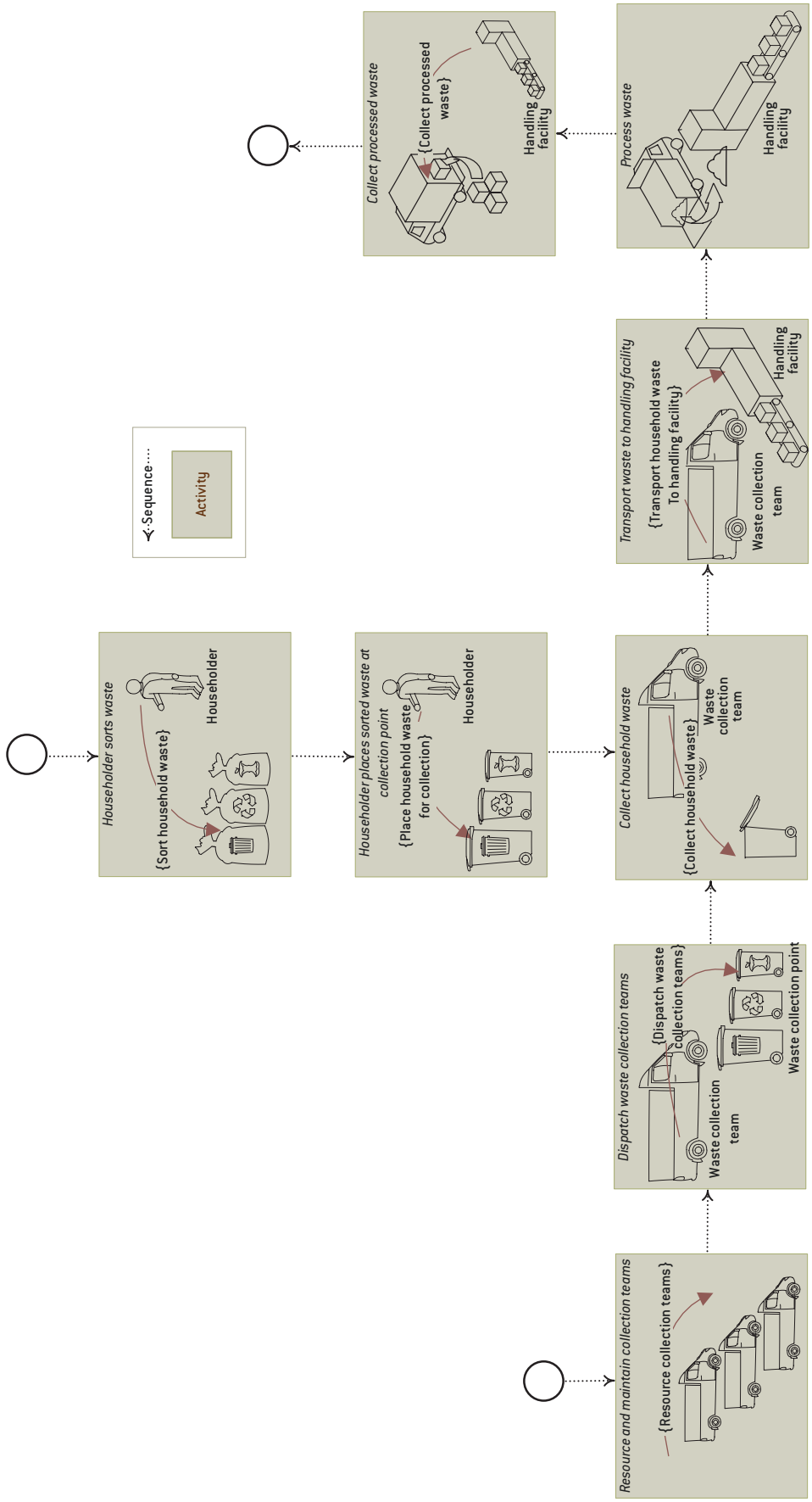


Figure 10.9 Visualising waste collection as a pattern of activity

10.5.4 Redesigning booking as a pattern of action

To help ground the notion of organisation design and the role that ICT might play within such design, let us consider a very simple pattern of action. This pattern of action occurs time and again across many different situations of organisation. Let us consider booking attendance at some event.

Bookings exist because of a coordination problem – when two or more actors must take joint but independent action to achieve a common goal. A booking is a means for getting actors in the same place at the same time to do some agreed thing. Let us assume that we investigate one of these domains through dialogue with people, participating in various booking events or observing what goes on with a booking. Further assume that we look at booking an appointment with a general practitioner (GP) and find that the following sequence of actions is involved.

- A patient indicates her need to see doctor X to the surgery clerk.
- A GP clerk requests the name and date of birth of the patient, as well as her medical problem.
- A GP clerk checks with the practice IT system that the patient is on the patient list of doctor X.
- A GP clerk indicates possible time slots for an appointment with doctor X.
- A patient indicates her preferred time slot to GP clerk.
- A GP clerk commits the doctor to seeing the patient on date Y at time Z.
- A patient attends an appointment with doctor X.

10.5.5 Motivating change

As we have seen, you do not normally design something new unless there is some perceived problem or problems with the current way of doing things. Hence a key step in any organisation design is determining the motivation for changing things. Here are three possible problems with GP booking as we have described it.

- Problem 1: Bookings can be made in at least two ways – by visiting the GP surgery and over the telephone. Because the GP clerk can only do one thing at one time she gives priority to people visiting the surgery when making bookings. This has the effect that people telephoning for a booking are kept waiting for long periods. And, when they get through eventually, the booking slots are frequently gone. This, in turn, causes much patient dissatisfaction with the service.
- Problem 2: A substantial number of patients fail to turn up to their booked appointments. This means that often a GP sees half as many patients as expected in a given session. And this is a limited and expensive healthcare resource.
- Problem 3: GPs as a resource are rationed by only offering booking slots for sessions two weeks ahead. Hence if you want to be seen immediately, you must persuade the booking staff, probably in consultation with healthcare staff, that you are an emergency case. But this also means that a limited number of emergency slots must be left open each day for emergency cases.

10.5.6 Suboptimisation

Because this pattern or system of action is subject to equifinality we know that there are a multitude of different ways in which we could redesign this pattern to address one or more of the problems listed. Some of these ways of doing things differently might involve the use of ICT, such as customer websites, mobile apps, digital marketing, social

Suboptimisation
The idea that optimising the performance of a particular subsystem will not necessarily optimise the performance of the whole system.

media and electronic data structures. However, when engaging in any organisational design we must take note of a key principle of systemic thinking: **suboptimisation**. Optimising the performance of one subsystem within some domain or pattern of organisation will not necessarily optimise the performance of the system as a whole; it could even worsen it.

ICT, for instance, can be used in the design or redesign of organisation. For many years the tendency was to replace existing activity systems, automating them in whole or in part. More recently the emphasis has been on seeing ICT as an agency to innovate new forms of organisation. An ICT system is designed as a key actor within some potential system of organisation.

But improvements in technology do not guarantee improvements in activity. As we shall see in Chapter 11 there are many examples of digital innovation that have contributed to organisational failure. This means, importantly, that activity systems, information systems and ICT (data) systems should be designed as one unified whole, as a necessary but not a sufficient condition for improvements in performance.

CASE

Consider a recent example of digital innovation in healthcare. A group of GP practices (GP at hand) situated in London now offer a service to their patients delivered through a mobile app. To gain access to primary healthcare you first have to engage in a dialogue with a chatbot supplied by the digital health consultancy Babylon. This software asks you a series of questions about your condition and then comes to a diagnosis as to some of the likely things that might be wrong with you. Based on this diagnosis it then decides whether or not you should gain access to an online consultation with a GP, and how urgently. This process is known as triage, and is similar to the process we have seen in the emergency response example where the ambulance service has to decide whether or not to dispatch an ambulance resource. These primary healthcare providers believe that this digital innovation provides an effective way of providing access to a scarce healthcare resource, such as a GP's time, among a large number of patients.

However, many within the medical profession have reservations. Some conventional GP practices have expressed concern that this innovation may be suboptimal for the delivery of primary healthcare as a whole. They believe that the people switching to this new service tend to be young, affluent and consequently relatively healthy. GP practices are funded from central government on the basis of the number of patients registered with them. But each patient provides the same funding, irrespective of their general health. This potentially means that GP practices running access to their services in a conventional offline manner may be left with a declining number of patients, but each of which demand a higher level of healthcare provision.

10.5.7 Role analysis

Any domain of organisation consists of a multitude of actors. An actor is any entity that can act and we have deliberately used the term *actor* in this book rather than *person* because we wish to emphasise that actors include humans, animals, machines and possibly even artefacts. In the past, for instance, animals such as pit ponies were significant actors within the coal industry. Nowadays, machines, such as vans, cranes and even ICT systems, are significant actors in the infrastructure of most organisations. A central premise of our idea of organisation as a system of action is that actors construct, produce or accomplish action. But actors accomplish action in patterned ways, and such patterns of action are different depending upon the settings within which actors find themselves. Social scientists explain such differential patterning of

action in terms of the concept of a role. So, within some domain of organisation, action is typically parcelled up between various roles. When designing a new mode of organisation, key decisions must be made as to what people should be doing and what machines should be doing. This essentially amounts to **role analysis**.

Role analysis
Analysing the requirements of a particular role.

Using the idea of equifinality, there are clearly numerous ways in which roles can be defined. Traditionally, managers want to design organisation in terms of overarching goals such as improving efficiency. But it is equally important to design organisation to be ethical and to offer enrichment for the actors participating in it. This is where role analysis comes into its own – as a balanced way of considering the complementary roles of people and technology.

The mindset we direct to the issue of role analysis within business analysis is frequently influenced by attitudes we have about how people are likely to work or wish to work. Some time ago the social psychologist Douglas McGregor identified two distinct mindsets, theories or worldviews that influence the way in which managers think about workers. McGregor called these two polar ways of thinking: **theory X** and **theory Y**. According to theory X the average human being is perceived as disliking work and hence avoiding it wherever possible. In such terms the average human being is likely to avoid responsibility and has little ambition. In contrast, according to theory Y, physical and mental effort are important and natural human functions. If humans are committed to the achievement of certain objectives, they will exercise self-direction and self-control. This theory would suggest that the capacity to exercise imagination, ingenuity and creativity are widely distributed in the population and should be encouraged within work.

Theory X
According to this theory the average human being is perceived as disliking work and hence avoiding it wherever possible. The average human being avoids responsibility and has little ambition.

Theory Y
According to this theory physical and mental effort are important and natural human functions. If humans are committed to certain objectives they will exercise self-direction and self-control. The capacity to exercise imagination, ingenuity and creativity are widely distributed in the population.

These two theories have clear consequences for the way in which systems or patterns of organisation are designed. If you design with a theory X worldview then you will assume that ways of organising must be constructed with the clear intention of monitoring the workforce and controlling their behaviour through coercion. The objective of information systems in this worldview should be to provide effective communication to management to exercise such close control. In contrast, a theory Y perspective would suggest that some system of organisation must be designed to encourage ingenuity and creativity. Information systems are there to encourage cooperation and collaboration among the workforce in the achievement of objectives.

So, when analysing current roles or future roles, the analyst frequently must balance managerial and worker objectives. Managers of certain systems of organisation will generally have objectives such as improving the efficiency and/or effectiveness of work. Workers will generally have objectives such as increasing levels of self-fulfilment and job satisfaction.

Traditional approaches to analysing systems of organisation tend to implicitly utilise a theory X worldview and treat organisation merely as a 'technical' system. They undertake the breakdown of such systems in terms of various levels of tasks. Such tasks are then closely studied in terms of specified performance measures. Increasing specialisation and segmentation of tasks is seen as the primary way of achieving organisational objectives. Unfortunately, such approaches have an equal tendency to conflict with individual objectives. The heavy specialisation of work can lead to substantial deskilling of the workforce, leading to high levels of demotivation and a decreasing level of flexibility in work.

REFLECT

Think of a domain of organisation such as a call centre or an automobile production line. Write a brief statement of how you think a theory X perspective on this domain would affect the design of a system of action for this domain. Then attempt to write a similar statement, but from a theory Y perspective.

Job satisfaction
The satisfaction that workers have with the role they are required to perform.

However, there is a lot of evidence to suggest that designing organisations with the worker in mind is likely to benefit institutions. For instance, increasing the satisfaction that workers have with the role they are required to perform is usually likely to increase productivity. It may also have other potential positive effects such as a decrease in staff turnover and a reduction in absenteeism at work.

Many studies have shown that there are several common features that supply satisfaction for workers in roles. First, workers generally find satisfaction in jobs which allow ample opportunity for the exercise of skills and the extension of skills through learning. Second, workers like to understand how their work fits into the overall system of organisation and how their work is valued by the organisation. Third, the greater the level to which the worker can control his or her own work, the higher the levels of satisfaction he/she is likely to find with her work. Fourth, jobs with high rates of satisfaction tend to be those which include opportunities for collaboration and communication with others. Fifth, jobs which include a mix of routine and new demands tend to be highly valued, particularly if the worker has control over which new demands to accept. Finally, one should not forget that work is only one part of the life of a person. Valued jobs are those which contribute to a satisfactory work/life balance. Work roles should minimise interference with the person's ability to participate in family and community life outside of work.

Role rotation
Rotating roles among a group of actors.

Role enrichment
Increasing the scope of a role, giving workers more responsibility for making decisions about their own work.

Role enlargement
Combining a number of different tasks within one role.

A number of design strategies may be employed to increase levels of satisfaction in designed roles or jobs. For instance, we can think about the level of specialisation both in tasks and decision-making associated with a designated role and devise distinct strategies of rotation, enlargement, enrichment and group working.

Role rotation involves rotating people between different jobs or roles. Such rotation increases variety and learning opportunities for the workforce. It also has substantial benefits in terms of improving levels of organisational flexibility. However, there is little evidence that rotating roles increases motivation levels among the workforce. For this, other strategies such as role enlargement or **role enrichment** are needed. **Role enlargement** involves combining a number of different tasks within one role. This strategy offers the potential of creating more complete and hence more meaningful roles for people. However, it also clearly reduces the levels of specialisation in an organisation. Role enrichment involves increasing the scope of a role. It consists of giving workers more responsibility for making decisions about their own work. The key aim is to improve the motivational aspect of work. Finally, groups act as an important source of support, encouragement and security for the individual worker. Hence, devolving a range of tasks to a team or group rather than to any one individual is likely to increase satisfaction among members of the group.

DID YOU KNOW?

During the Second World War at least part of the success of the German infantry forces was put down to the way in which decision-making was devolved down to individual military companies.

REFLECT

Many business theorists now believe that devolving decision-making down to the people doing the work makes such work not only more flexible but also more efficient. Research this topic briefly and write a small analysis of what this says about role analysis and the effectiveness of worker activity.

RECAP

The notion of modelling some pattern of action is similar to the act of writing a story about something. Visualisations as comics or storyboards are a useful way of documenting the what, why, when, where, how and who of some pattern of action. In terms of who, thought needs to be given to analysing and designing the roles played within particular patterns of action.

CAREERS VIDEOS

Stephen Cohen

Stephen Cohen studied European Languages and Business Studies at university before working in IT for a small software company. He subsequently became a project manager in various roles in the City of London before turning to management consultancy. He now leads the business systems team at Springer Nature, a large academic publishing company.

Visit this book's companion website at www.macmillanihe.com/beynon-davies-BIS3 to watch Stephen talking about business information systems, his career trajectory and his current role at Springer Nature. After watching the interview, reflect on the following questions:

- What sorts of tasks are involved in running a business systems team within a large organisation? What kinds of skills do you need to develop to be effective in such a role?
- According to Stephen, what value does an understanding of business information systems bring to organisations?
- Why are changes to systems not a 'magic bullet'? What else needs to go along with systems changes in order to bring about permanent improvement in processes and the streamlining of workflows?
- What does Stephen think will be the biggest changes to the industry over the next few years?
- What do 'agile' and 'scrum' mean in the context of project control? If you're not sure, read more about these terms in this chapter.
- What can you do, while still a student, to improve your prospects of employment in business systems?
- What is 'stakeholder management'? Why is it such an important skill to have for those wanting work in business systems?

10.6 ESTABLISHING PROJECTS OF BUSINESS ANALYSIS AND DESIGN

Project
An activity system established for a finite period to achieve a specified series of goals.

The ancient Greek writer Hesiod claimed long ago that '*it is best to do things systematically, since we are only human, and disorder is our worst enemy*'. This is the reason that business analysis or business design work is normally organised as projects. A **project** is any concerted and systematic effort to achieve a set of objectives. All projects consist of teams of people engaged in the achievement of explicit, clearly defined goals, usually within a set timescale. Expressed in such terms, a project is clearly a system of action. It involves designated actors undertaking coordinated sequences or cycles of activities. However, unlike the systems of organisation we have primarily considered in this book, projects normally tackle a limited goal and are temporary rather than permanent, meaning that projects are disbanded once the goal is realised.

10.6.1 The life cycle of a business analysis and design project

So, assume that the problem we have been investigating has been set and explored using something like a rich picture, what should we do next?

As we have seen, business analysis is normally organised in terms of projects. Since a project is effectively an activity system, the conventional way of planning a project is to segment it into a number of activities, each of which can be managed independently. Each of these activities may be broken down further into a series of tasks, and so on. At a high level, as a pattern of action any business analysis project can be seen to move through the following sequence of stages: conception, analysis, design, construction, implementation and evaluation. This pattern of action is illustrated in Figure 10.10.

Conception
Setting the problem to be considered and establishing a team to solve the defined problem.

Analysis
The analysis of systems of business (organisation more generally).

Design
The design of systems of business (organisation more generally).

Construction
Creating new systems of sociotechnical action.

Implementation
Introducing new systems into the domain in question.

Evaluation
Assessing the worth of something.

Conception involves setting the problem to be considered and establishing a team to solve the defined problem. We considered the issue of problem-setting in the previous section. This activity also bears a relationship with the idea of expressing business motivation which we will cover in Chapter 11. Business conception also involves establishing a team for a business analysis project.

Analysis involves investigating the domain and usually specifying how existing patterns of action work. For example, to redesign some element of manufacturing work, analysis would involve interviewing key actors and observing the work conducted at different production units within the manufacturing plant. This will enable the business analyst to document the current business model (see Chapter 11) for this domain in some detail. But analysis also involves identifying why we need to change things – the motivation for change. This is also described in Chapter 11.

Design involves conceiving of new patterns of sociotechnical action and specifying these as models. It also involves selecting among alternative patterns of action – a technique sometimes known as options identification. The techniques we discuss for documenting existing business models are equally applicable to expressing the designs for new business models.

Construction involves creating new systems of sociotechnical action. It involves building both technical systems such as ICT systems but also specifying new roles and patterns of actions within which actors will be expected to work.

Implementation involves introducing new systems into the domain in question. Because such implementation invariably involves changing things then managing change becomes important. Change management is a topic discussed in Chapter 11.

Any domain of organisation is in a continuous state of flux – it never stands still. Therefore, after implementation there should be some evaluation. **Evaluation** involves assessing the success or failure of the intervention proposed and implemented through business analysis. Such evaluation, as covered in Chapter 11, is likely to suggest further problem situations and interventions to consider.

This explains why business analysis as a pattern of activities is portrayed as a cycle rather than as a sequence in Figure 10.10. This means that the results from any one evaluation are likely to act as inputs into conceiving of the next domain of organisation to be considered. This emphasises that business analysis, just like its topic of concern, organisation, is a continuous and ongoing exercise.

Project management
The process of planning for, organising and controlling projects.

As systems of organisation, projects must be managed. **Project management** involves planning activities to realise goals, assigning staff to roles in terms of undertaking activities and controlling the project to ensure that it remains on schedule, within budget and achieves the desired goal.

10.6.2 Project planning

One popular method of planning a project is to lay out a project in diagrammatic form as a network (such as in Figure 10.11). This uses a notation similar to that we have used in previous chapters for representing various systems or patterns of organisation. Boxes

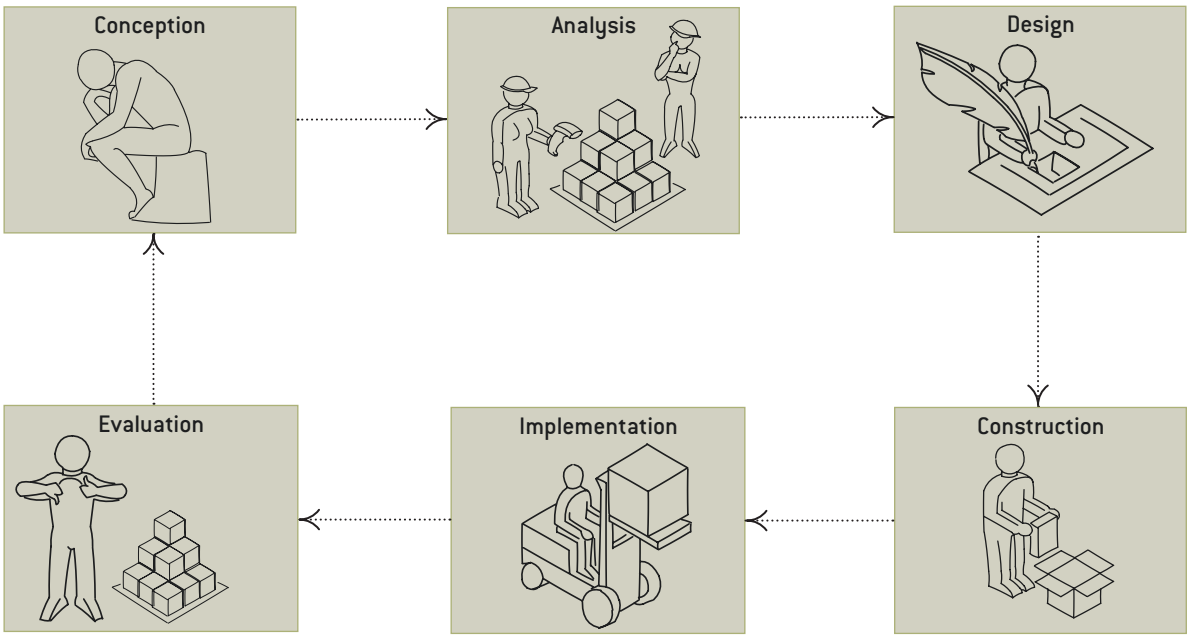


Figure 10.10 The life cycle of a business analysis project

Project planning
Determining as clearly as possible the likely parameters associated with a particular project.

Critical path
An activity within a project whose float is zero, and so determine the total calendar time required for a project.

Activity-based project planning
A form of project management in which planning and control is conducted in terms of project activities.

Product-based project planning
A form of project management in which project planning and control is focused around information systems products.

are used to represent project activities and dotted lines to indicate their precedence – which activities come before other activities, and which come after other activities.

The project planner then estimates the resources required to achieve each activity, usually expressed as person-days. The sum of these person-days, plus a contingency factor for emergencies, is the estimated time required for each activity. Doing this calculation for each activity in a project will give the project manager an idea of the overall person-days required for the project. Since person-time is also the most significant cost factor, this gives an idea of total approximate cost.

For each activity the earliest possible start date is calculated on the basis of predecessor activities. A latest completion date is also calculated for each activity on the basis of scheduled start dates for each of the activity's successors and the target completion date for the overall project. The difference between the calculated time available to complete an activity and the estimated time required to complete it is known as an activity's float. If the float is zero, the activity is said to be critical, since any delay in completing it will cause a delay in completing the final project.

A related concept is the **critical path**. This is the longest possible continuous path between the start activity for a project and the end or terminating activity. Since the critical path determines the total calendar time required for a project, any time delay along the critical path will delay the entire project by an equivalent amount.

This process of project planning described above is focused around activities, so it is known as **activity-based project planning**. More recently there has been an emphasis on a form of project planning based around products rather than activities. **Product-based planning** is particularly popular in agile approaches to business analysis and design work.

Fundamentally, product-based planning works with two concepts: deliverables and timeboxes (Figure 10.12). A deliverable is a part of some product, such as the design for some new pattern of action, that the project team agree to demonstrate to representatives of relevant stakeholder groups at a review session. A deliverable is normally expressed in terms of what the product will be able to do. A timebox is an agreed period of time for the production of a deliverable, and this is normally expressed as a fixed deadline. The timebox is never changed once established.

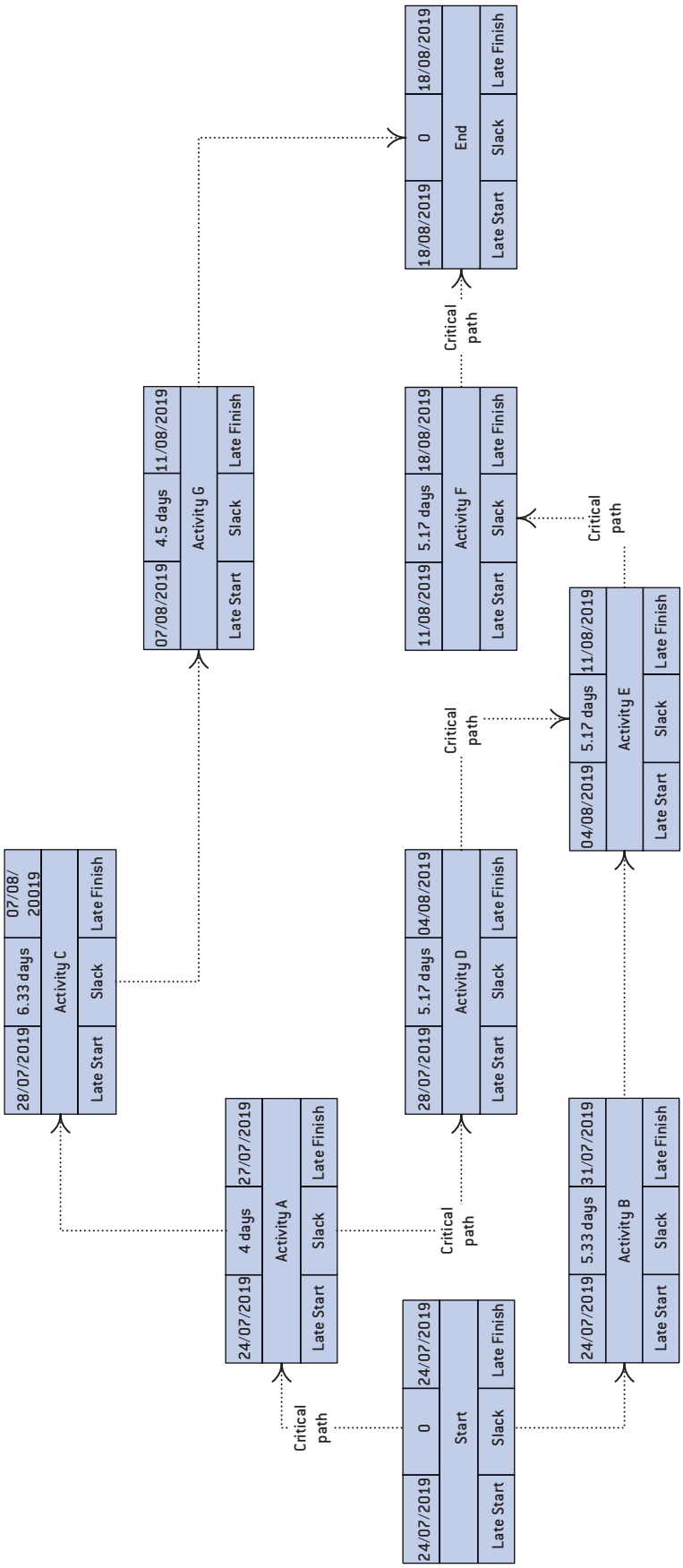


Figure 10.11 A project network diagram

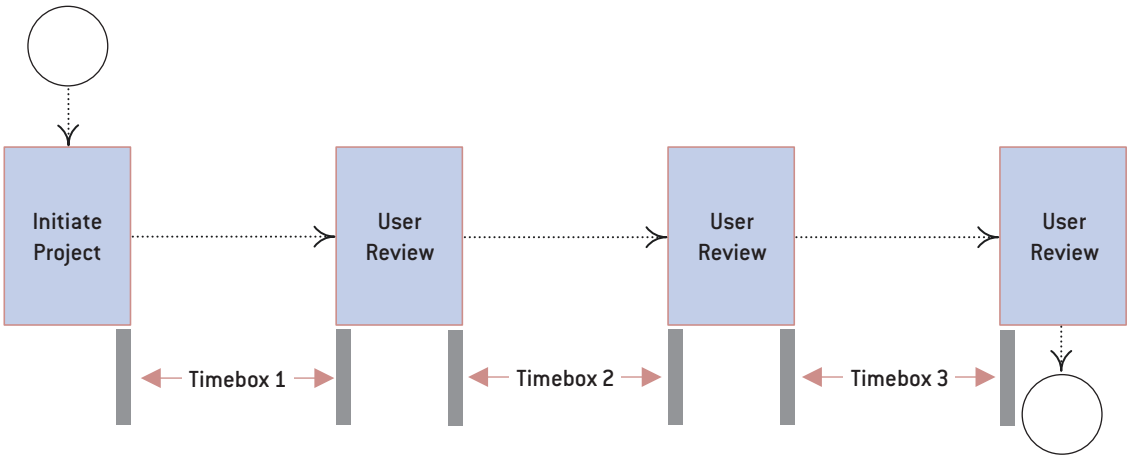


Figure 10.12 Timeboxing

10.6.3 Project organisation

Project organisation How to structure staff activities to ensure maximum effectiveness.

Project organisation concerns how to organise staff so that they produce the desired output. Essentially there are three alternatives in organising staff: around projects, roles or a combination of the two. Figure 10.13 illustrates how these different forms of organisation affect an information systems development project.

In terms of projects, staff are organised within project boundaries. This form of organisation encourages quick decision-making, minimises interfaces between staff

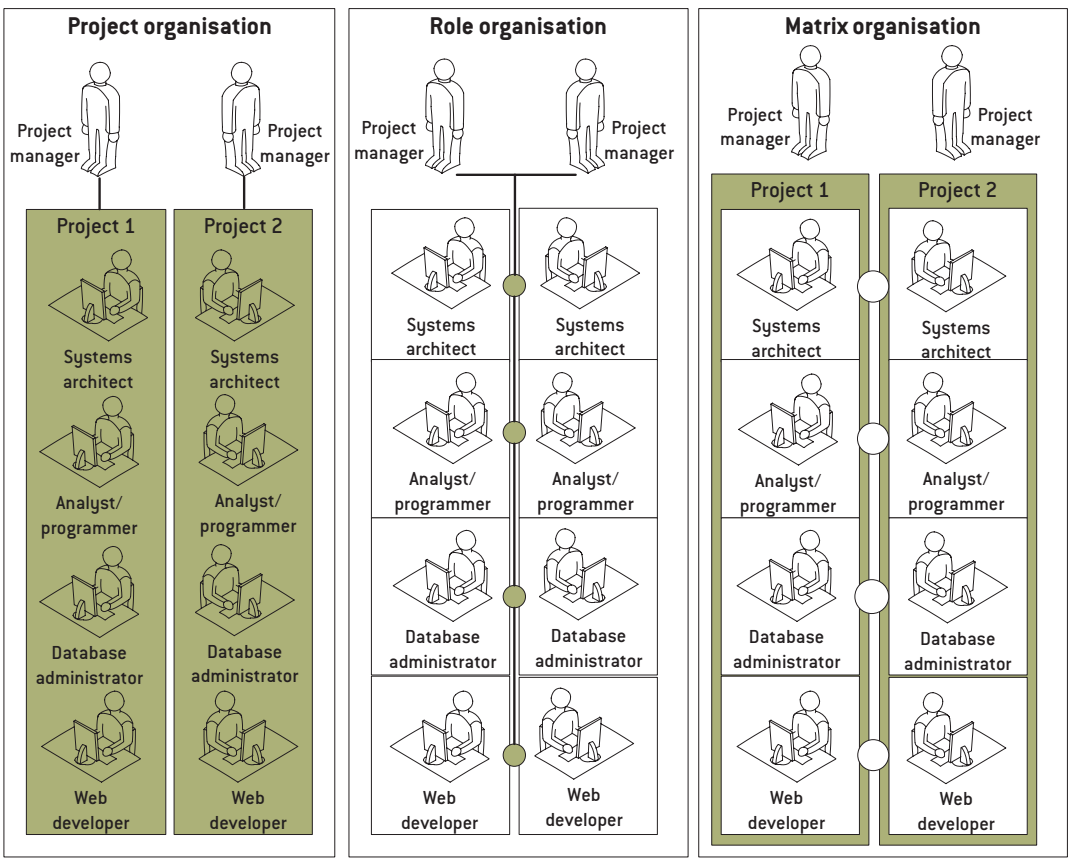


Figure 10.13 Types of project team organisation

and generates high identification with projects among staff members. The disadvantages are that it works well only for small projects, the economies of scale are low, and the sharing of expertise across projects is minimal.

In terms of roles, staff are organised according to development roles, each role supporting a number of different projects. This form of organisation generates economies of scale, promotes the growth of specialists, and reduces the effects of staff turnover. It is probably the most common type of project organisation in large development centres. The disadvantages are that it generates lots of communication across projects, decreases the number of people with a general feel for a project and reduces the cohesion of projects.

In a matrix organisation, staff are mixed across projects and roles. The basic organisation is based around development roles, but a project organisation is imposed under a series of project managers. The advantages of this approach are that short-term objectives (the success of a project) are maximised via the project organisation whereas long-term objectives (such as promoting specialism among designers) are maximised via division around roles. The major disadvantage is that the needs of a project and of the developer roles might conflict.

10.6.4 Project control

Project control
Ensuring that a project remains on schedule, within budget and produces the desired output.

Project control is a type of formative evaluation (see Chapter 11). Its aim is to ensure that schedules are met, that the project stays within budget and appropriate standards are maintained. The most important objective of project control is to focus attention on problems in sufficient time for something to be done about them. This calls for continual monitoring of progress.

In activity-based project management the primary document used for the evaluation of progress is a progress report (Figure 10.14). This contains information on time estimated for each activity plotted against actual time spent. Another useful measure is an estimate of the percentage of completeness. Time actually spent on a project is usually collected via regular time sheets, which indicate the tasks performed by development staff and their duration. They are also useful in highlighting time spent on unplanned work.

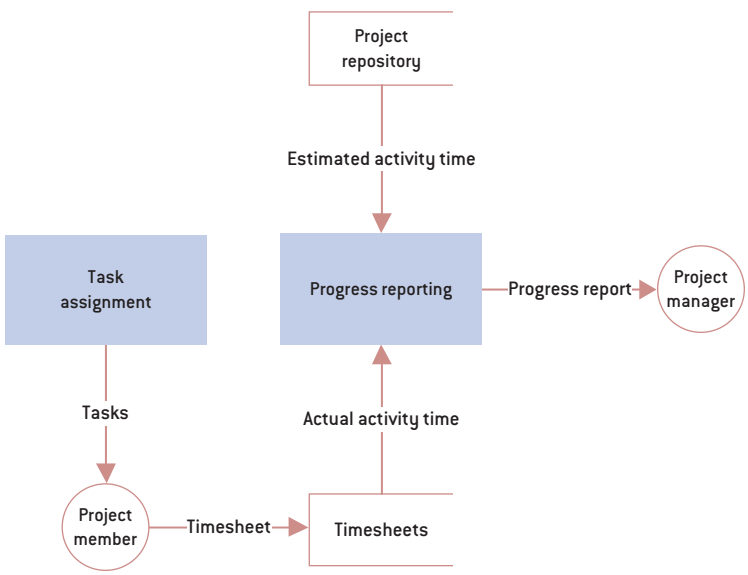


Figure 10.14 Progress reporting

Progress reports can be used by either management reviews or project audits. Management reviews are scheduled opportunities for project managers to consider the accomplishments and problems associated with a project. Project audits are formal events scheduled into the life cycle of a project, in which an independent audit team examines the documentation and interviews key team members. The process of activity-based project control is illustrated in Figure 10.14.

In product-based project management, project control is normally exercised through task boards and review sessions. Product-based project management is popular within so-called agile software development projects (Section 12.4.4) which use an iterative approach to software development. One popular approach to undertaking such projects is **Scrum**. The term *scrum* is taken from the game of rugby and refers to a formation used to restart the game after some event has occurred, such as an infringement. Scrum assumes that a particular software product can be broken down into a number of distinct features which can be implemented in a *timebox*. The main problem of the project manager (often referred to as the Scrum manager or Scrum master) is to effectively allocate various tasks performed in relation to a particular software feature among a limited set of defined members of the software development team. It is with this coordination problem in mind that task or feature cards are articulated upon a task board, such as the one illustrated in Figure 10.15. This involves melding some of the principles of Kanban pull-production philosophy (see Section 4.2.3) into agile software production – a fusion which Ladas (2009) refers to as Scrumban.

Scrum
An approach to agile software development.

Vertically, the task board is divided into five major parts of an iterative software development process. Each part comprises a list of one or more cards, up to a maximum defined limit for each list. Feature or task cards are moved across these sections of the

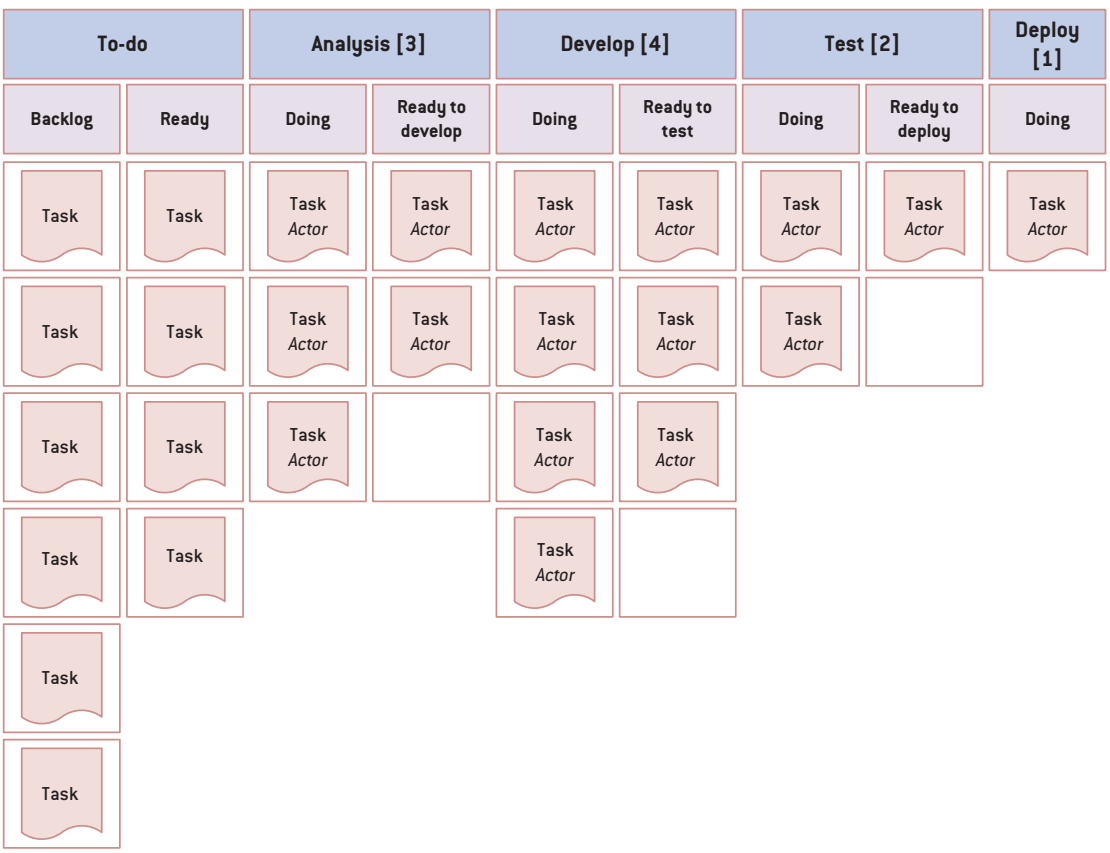


Figure 10.15 Scrumban task board

board to represent the allocation of work. The to-do section is used to represent the tasks or features that have to be built. When a new feature is first determined it is added to the backlog list. When it becomes available for development it is added to the to-do ready list. The four other sections of the flow board represent to the Scrum team when a feature is being analysed, developed, tested or deployed. A feature can be being done or ready to move into the next stage of this process. When a task is being done, a named Scrumban actor is indicated upon the card. When a task is in a ready state, no actor is indicated as allocated to the feature/task.

Workers within the software development team will inspect the task board at least twice during the working day – probably at the start of the working day during a *start-up* session and at the end of the working day during a *wash-up* session. At such times particular actors will be seen to pick a Scrumban card from one list upon the task board and place this card in another list upon the task board. This serves to communicate that a particular task of development has been completed and that some other person within the development team needs to pick up the next phase of work for the task.

10.6.5 Programme management

Programme management
The management of a suite of linked projects.

Recently organisations have started to distinguish between **programme management** and project management. Whereas a project is a coherent piece of usually one-off work of definite duration, a programme is an ongoing or continuous piece of work implemented in a business to consistently achieve certain results. In this sense, informatics planning, management and operations are all examples of coherent programmes of work associated with informatics infrastructure.

Programme and project management are related in that a programme is frequently organised as a set of interdependent projects for the purposes of effective organisational control, so programme management can be seen as a higher-level layer above project management. This is the position taken in the PRINCE2 method.

10.7 PRINCE2

CASE

The acronym PRINCE stands for PRojects IN Controlled Environments. PRINCE is a structured method for project management, originally developed from a UK government-sponsored initiative in the 1970s which resulted in the method known as PROMPT. PRINCE2 was introduced in 1996, and the most recent version at the time of writing was released in 2017. PRINCE2 is now used in many countries around the world.

PRINCE2 assumes that a customer and supplier will work together to complete a project. These two groups will frequently come from separately managed areas and often from separate organisations. Customers specify the desired outcomes, make use of the final product and in most cases fund the project. Suppliers provide resources to create the intended outcome.

PRINCE2 includes a method for defining the organisation structure for a project as well as a definition of the host company. This ensures that both business interests and technical concerns are covered. It outlines the structure and content of project planning, and defines a set of controls and reports that can be used to monitor whether a project is proceeding to plan. It also defines procedures for dealing with exceptions to the plan. As such it actively encourages the monitoring of quality.

PRINCE2 considers a project as a system or process consisting of a number of generic subprocesses or activities: starting up a project, initiating a project, planning, directing a project, controlling a stage, managing product delivery, managing stage boundaries and closing a project (see Figure 10.16). The arrows on the figure indicate necessary data flows between subactivities.

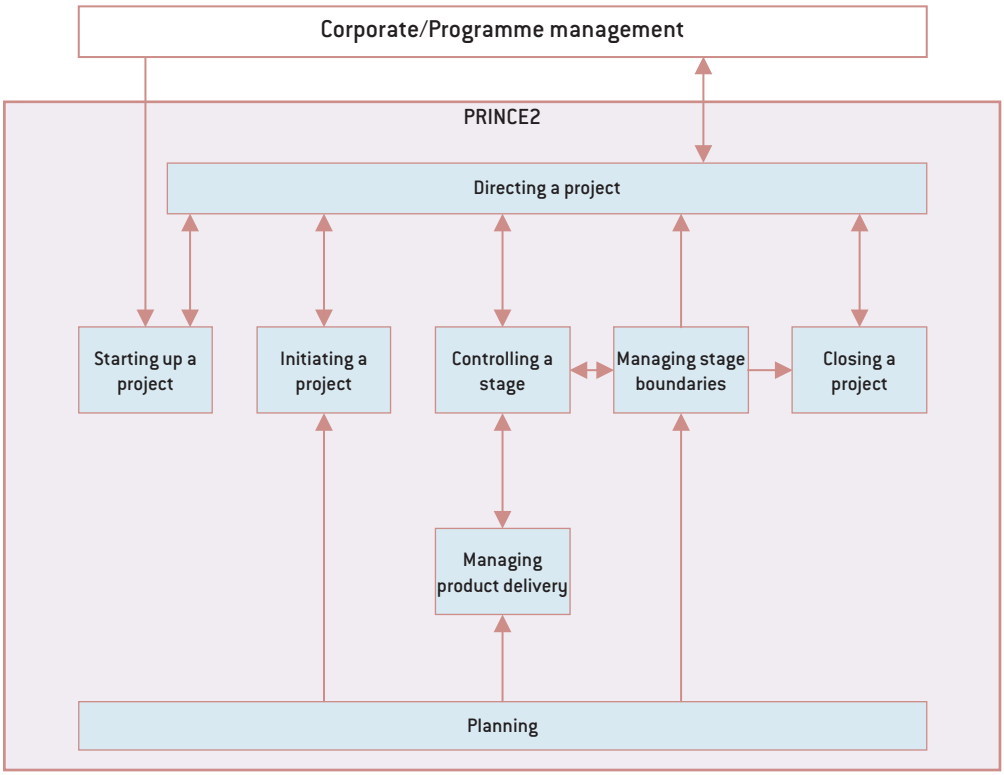


Figure 10.16 PRINCE2 as an activity system

CASE
continued…

PRINCE2
A structured method for project management.

In starting a project, a project board and project management team are appointed. The project board is given overall responsibility for project governance. The project manager and project management team are given overall responsibility for implementing the project. The main objective of this subprocess is to produce a project brief. This describes, in outline, what the project is attempting to achieve and the business justification. In addition, the overall approach to be taken is decided and the next stage of the project is planned. A decision point is then reached in which the project board is asked to authorise the next stage, initiating the project.

Planning is an overarching and repeatable subprocess which plays an important role in other processes. The application of **PRINCE2** revolves around identifying the products that are to be created by a project, rather than the more usual concentration on the tasks to be completed. Identifying products leads to identifying the activities needed to produce them, as well as the dependencies between activities. Once the activities have been identified it is possible to estimate the effort required for each activity, and schedule activities into a plan. The risk associated with completion of activities is analysed. Finally, a process for completing a project is agreed.

Initiating a project follows start-up activity and involves shaping the brief for the project into a coherent business case. The approach taken to ensure quality on the project is agreed together with the overall approach to controlling the project itself. Project files are also created, as is an overall plan for the project and a plan for the next stage of the project. This information can be put before the project board for them to authorise the project.

PRINCE2 suggests that projects should be broken down into stages. Controlling a stage is therefore a subprocess that dictates how each individual stage should be controlled. This includes the way in which work packages are authorised and received for each stage. It also specifies the way in which progress should be monitored and how summaries of progress should be reported to the project board. The method suggests means for capturing and assessing project issues together with the way in which corrective action should be taken. It also lays down the approach by which project issues should be referred to the project board when necessary.

CASE
continued…

Managing project delivery specifies how a work package should be accepted, executed and delivered. Managing stage boundaries dictates what should be done towards the end of a stage. In particular, the next stage should be planned and the overall project plan, risk log and business case amended as necessary. The subactivity also details what should be done in the case of a stage that has gone outside its tolerance levels. Finally, the process dictates how the end of the stage should be reported.

Directing a project is an overarching subactivity which enables the project board to control the overall project. It runs from project start-up to project close-down. The project board uses reports generated from other subprocesses at a number of decision points. It authorises project initiation and close-down as well as the plans for each stage of a project. It can also authorise additional resource for a stage following slippage or other unforeseen circumstances.

The subactivity – closing a project – details activities that should be done at the end of a project. The project should be formally decommissioned and resources freed up for allocation to other activities. A series of follow-on actions should be identified and the project itself needs to be formally evaluated.

10.8 CONCLUSION

Organisation for us is a complex adaptive system. The institution of organisation emerges from patterns of action that serve to constitute organisation. Organisations as systems can achieve their goals in a number of different ways. This means that there are likely to be a multitude of different patterns of organisation that meet the same defined objectives or goals. The consequence of this way of thinking is that we should approach organisation in terms of a design orientation. In other words, we should be able to *design* different patterns of organisation and then evaluate which is the most appropriate pattern for resolving aspects of some problem situation.

There are a lot of different ways of thinking about design as an activity. Some divide it up two ways, such as problem-setting and problem-solving. Problem-setting means establishing the problem to be engaged with. Problem-setting is often the most difficult part of design because it typically involves determining not only the boundaries of the problem to be solved but the purpose to be served by any solution. This demands that the problem situation is investigated or analysed using participation, conversation, observation and documentation. It also means determining the motivation for making changes to existing problem situations. Problem-solving involves specifying changes to patterns of action, particularly by visualising how the new proposed sociotechnical system will pan out as a narrative or story. This means suggesting what happens, when and where things happen, who makes things happen and how, and finally why things happen.

Within business analysis and design, activity is typically organised as projects. Project management can be divided into project planning, project organisation and project control. Project planning involves determining as clearly as possible the likely parameters associated with a particular project. Project organisation concerns how to structure staff activities to ensure maximum effectiveness. Project control involves ensuring that a project remains on schedule, within budget and produces the desired output.

In Chapter 11 we come to the conclusion that what we analyse and design through projects is a model of organisation – which we refer to as a business model. This idea of a business model allows us to relate together a number of topics important to the management of organisations such as strategy, motivation, change and evaluation.

10.9 REVIEW TEST

10.1 _____ involves thinking differently.

Fill in the blank term below.

1 mark

10.2 Design science is a science of what might be.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

10.3 Design theory tells you how to design particular 'things'.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

10.4 Design artefacts are the output of applying design theory.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

10.5 Types of design artefact include …

Select all that apply by placing an X in the box.

- ☐ Symbols
- ☐ Products
- ☐ Interactions
- ☐ Infrastructure
- ☐ Systems of action

4 marks

10.6 Digital innovation involves designing _____ ICT.

Fill in the blank term below.

1 mark

10.7 ICT is a key _____ in contemporary systems of action.

Fill in the blank term below.

1 mark

10.10 EXERCISES

- Produce a rich picture of a problem situation known to you.
- Conduct a short brainstorming session on a small problem and identify issues and affinities.
- Interviews are a structured form of discourse. Investigate what structured means here.
- Think about the ways in which co-creation can be fostered through design workshops.

- Investigate the term 'design science' and see if you can find at least three definitions for this form of science.
- At what point do you think a critical mass is reached in project group size?
- Discuss three of the main problems arising in the management of large project groups.
- Which form of organisation do you think is most prevalent in the informatics service: project organisation, functional organisation or matrix organisation?
- What sort of timings, effort and resource information should be kept in an organisation's project experience base?
- Even the most carefully planned of projects fail. Suggest some reasons.

10.11 PROJECTS

- Investigate how the design orientation is currently being taught across business schools worldwide.
- Take one public sector service and try to analyse it as a system of action.
- Use the six honest serving men to establish whether you have a coherent story for this pattern or system of action.
- Establish in an essay how a design orientation might be appropriate to one of the grand challenges mentioned, such as overpopulation.
- Investigate how the idea of visualising systems of action as comics differs from process modelling.
- Investigate the link between suboptimisation and the failure of information systems.
- Automation through ICT is frequently justified in terms of a theory X view of management. Investigate whether this statement is true.
- Good project management practices have been around for many years but information systems projects still fail frequently. Investigate the limitations of project management with respect to this problem.
- Investigate the range of project planning techniques and how frequently they are applied in information system projects in one large organisation or across a small number of organisations. Would you describe their project management practices to planning as activity-based or product-based?

10.12 FURTHER READING

Eva, Hindle and Rollason have produced a third edition (2014) of the BCS viewpoint on business analysis. Simon's (1996) classic text – The sciences of the artificial – is still a very good introduction to the notion of design science. Richard Buchanan (1992) proposes four types of business artefact in an interesting design issue article. Boland and Collopy (2004) provide a set of readings on the design orientation in management. Wastell (2010) discusses business design particularly with information systems in mind. Hevner et al.'s (2004) article discusses design science in relation to information systems work. Checkland's idea of problems situations and rich pictures are discussed in a retrospective on his method (1999). A specific text on rich pictures is provided by Bell et al. (2016). In terms of project management and PRINCE2, Bentley's (2009) book is still one of the best, although he has also published a number of more recent specific variants of this material.

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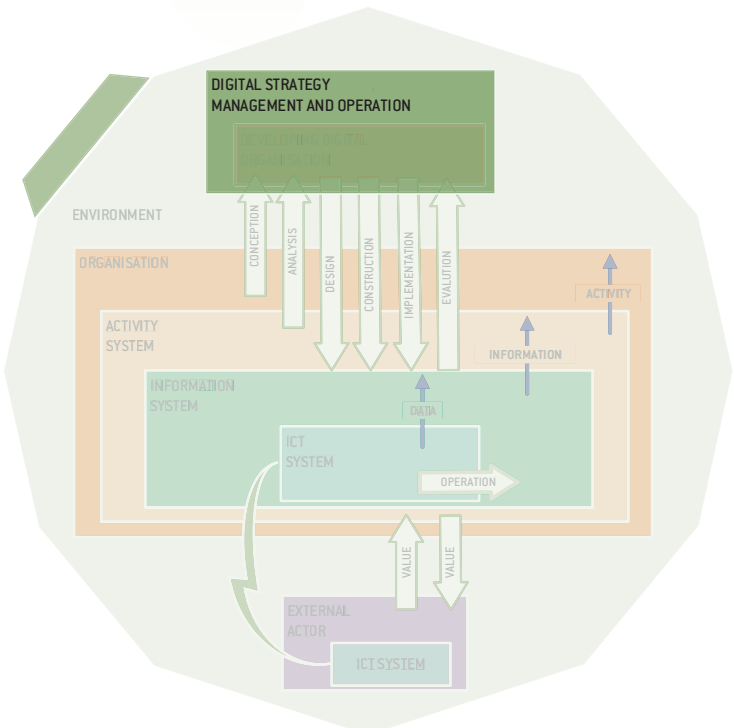
11 DIGITAL INNOVATION AND DIGITAL STRATEGY

'Civilisation advances by extending the number of important operations we can perform without thinking about them.'
– Alfred North Whitehead (1867–1947)

LEARNING OUTCOMES	PRINCIPLES
Understand the concept of a business model and how it relates to innovation.	Business models are models. They are stories that explain how an organisation works. The concept of a business model has become a popular way of thinking about business change, particularly when such change involves technological innovation.
Describe how change can be managed in terms of business models.	Change has to be managed through phases of unfreezing (analysis), doing things differently (design) and refreezing (implementation). The development of as-is, as-if and to-be business models facilitates change management.
Explain how the motivation for change should be described.	Business motivation expresses why things should change – why we should move from a business model as is to a business model as it might be. Motivation is best expressed in terms of desired ends and necessary means.
Define how digital innovation relates to business models and change.	Much modern innovation is digital innovation – innovation with and through ICT. To innovate successfully with ICT we have to think of such technology as a participant actor within some system of action.
Relate digital strategy to change in business models.	Strategy involves optimising the selection among as-if business models. Digital strategy is very much embedded in contemporary business strategy because ICT infrastructure is so critical to business change.
Explain why it is important to evaluate change to business models.	It is important for organisations to evaluate their ICT systems and their impact upon activity systems – formatively, summatively and strategically.

CHAPTER OUTLINE

11.1 Introduction
11.2 Business models
11.3 Business change
11.4 Business motivation
11.5 Business strategy
11.6 Business innovation
11.7 Business motivation and business strategy
11.8 Business evaluation
11.9 Conclusion
11.10 Review test
11.11 Exercises
11.12 Projects
11.13 Further reading
11.14 Bibliography



11.1 INTRODUCTION

As we have seen in Chapter 2 we should not see organisation as something static and unchanging but instead as in a process of continuous change. In this chapter we consider several related topics that all centre around organisational change – motivation, strategy, innovation and evaluation. The notion of organisation as a complex and adaptive system, which we have promoted throughout this book, is inherently one which accommodates change. Organising is a continuous accomplishment performed by actors which continually produce and reproduce organisation. Therefore, the chapter builds upon material discussed in earlier chapters, particularly Chapter 10.

This book is all about innovation and, in particular, digital innovation – introducing change with or through ICT. In this chapter we consider how to do digital innovation effectively. We first consider the nature of digital innovation and the potential for much failure in this area. Crucial to managing change and innovation is the concept of a business model. In Chapter 10 we discussed a necessary design orientation to the nature of organisation which takes on board the systemic and action-oriented view promoted in this book. In this chapter we extend this discussion by considering the concept of a business model and its relevance to digital business.

Strategy and innovation are clearly related. Strategy is about deciding what change is necessary and what steps will be taken to achieve such change. Change is normally conducted to innovate – to make a difference – to introduce a new way of doing. This helps us link together within this chapter issues of both digital innovation and digital strategy through the mediating concept of a digital business model.

11.2 BUSINESS MODELS

Business model
An organisation's core logic for creating value. A model of the action appropriate to some particular business domain.

The concept of a **business model** has been much considered in recent literature. The term 'business model' is also important to much recent management discourse which attempts to make sense of strategy in times of rapid technological change. Not surprisingly, business models have been particularly used as a way of understanding the impact of innovation with ICT upon business practices – an area referred to traditionally as electronic business and electronic commerce but more recently as digital business (see Chapter 7). Within this chapter we develop an account of a business model which brings together the important features identified for this concept within the business literature but show how they are relevant to digital innovation. In this sense we cover material on what is described in the ICT systems literature as business process modelling.

So, what is a business model? It is evident that the notion of a business model implicitly uses a framing of organisation based on the idea of an open system (see Chapter 2) – sometimes a complex, adaptive system. The equifinality characteristic of open systems implies that different systems of organising can be designed to fulfil the same purpose (see Chapter 10). This begs the question as to how they should be designed – and it is as an aid in this task that the concept of a business model is seen to be useful. With the rise of digital business such design options multiply.

From an analysis of the literature it is evident that a business model has several important features:

- Business models are models. They are abstractions used to model some domain of organisation.

- Business models are narratives or stories that explain how organisation works. They are not motivation models which explain how some way of organising needs to change.
- Business models are different from but related to business strategy. A business model describes how things work, while a business strategy details how things will change.
- Business models outline the patterns of action necessary for the achievement of certain goals.
- The concept of a business model has become popular as a way of thinking about business change, particularly change that involves some form of technological innovation.
- Business models are useful for understanding and explaining how things currently are. They are also useful for explaining how things might be. As such they are crucial to both business analysis and to business design (Chapter 10).

These features clearly closely align to our notion of organisation as a sociotechnical system (see Chapter 2) and more precisely to elements of design thinking outlined in Chapter 10. A business model is a way of expressing the core design for some value-creating system. This design must outline the system of action necessary for the achievement of the goals of organisation. We have seen that there are three layers of action that make up organisation as a system, and serve interdependently to create value, the central goal of organisation.

As a system, organisation consists of three interrelated patterns of action which can be described as narratives or stories of ways of organising. A coordination pattern (activity) consists of sequences of coordinated, instrumental activity. A communication (information) pattern consists of sequences of communicative acts. A data pattern consists of sequences of articulation of data structures. All three patterns or subsystems are needed to express a business model, as well as some notion of how these patterns interrelate (Figure 11.1).

DID YOU KNOW?

Although the term business model was mentioned within academic literature way back in the 1950s its persistent use only developed with the rise of electronic commerce in the 1990s as business tried to grapple with the best ways of doing business online.

11.2.1 As-is, as-if and to-be

Business motivation
A specification of the rationale for moving from a current business model to a new business model.

Herbert Simon (1996) defined design as '*courses of action aimed at changing existing situations into preferred ones*'. We can analyse some existing domain of organisation and build a business model which expresses how things work currently – this we refer to as an *as-is* business model. We can also express a business model as a design: as how we would like things to be – as an *as-if* model. Because of equifinality there is potentially a large range of as-if business models for any one as-is business model. Each of these as-if models may be able to achieve the same purpose, but clearly in different ways. To enact change, one of these as-if models must be chosen as a *to-be* model. This then becomes a design for a new domain of organisation that will hopefully be implemented in practice (Figure 11.2).

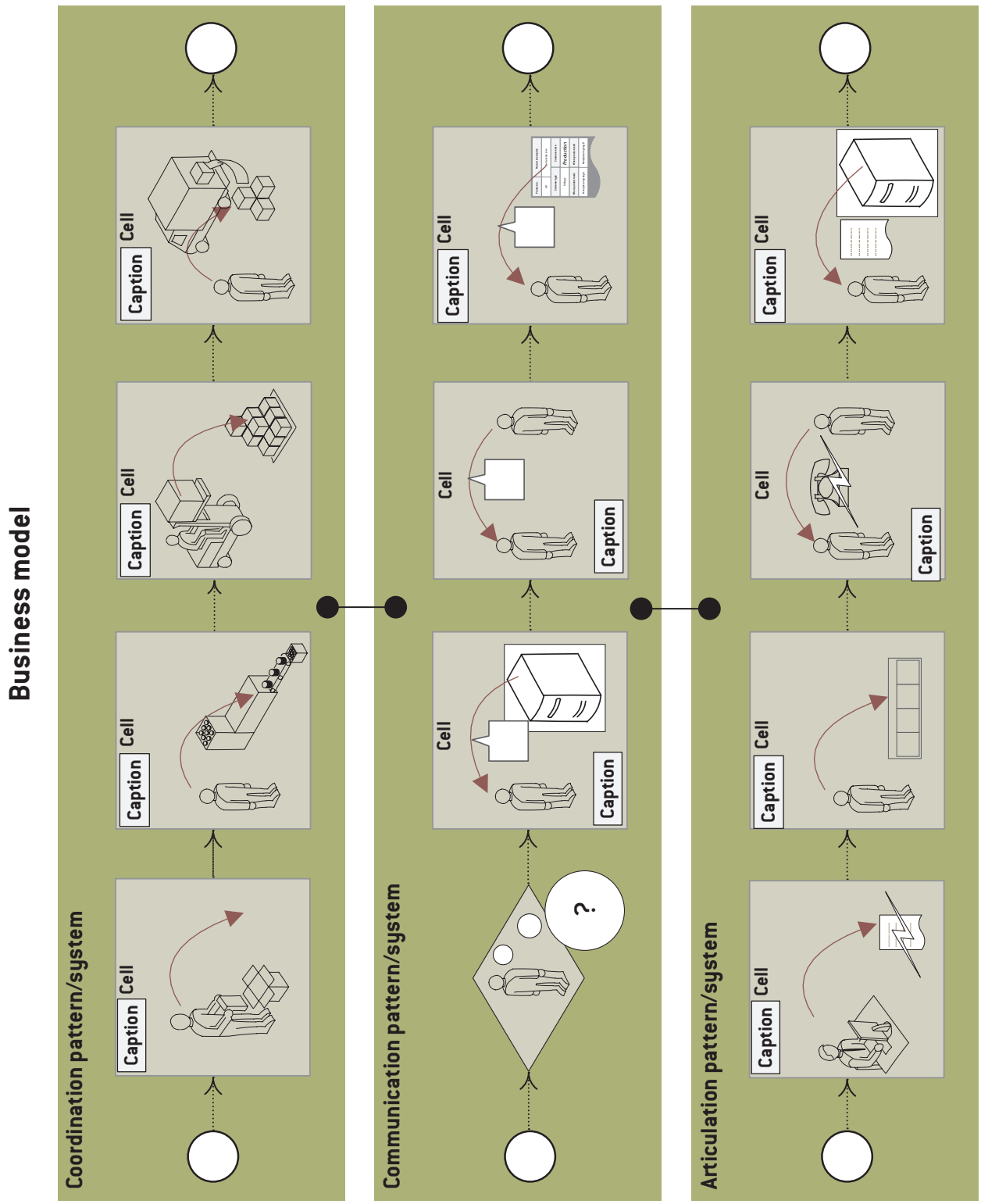


Figure 11.1 A business model as coupled patterns of action

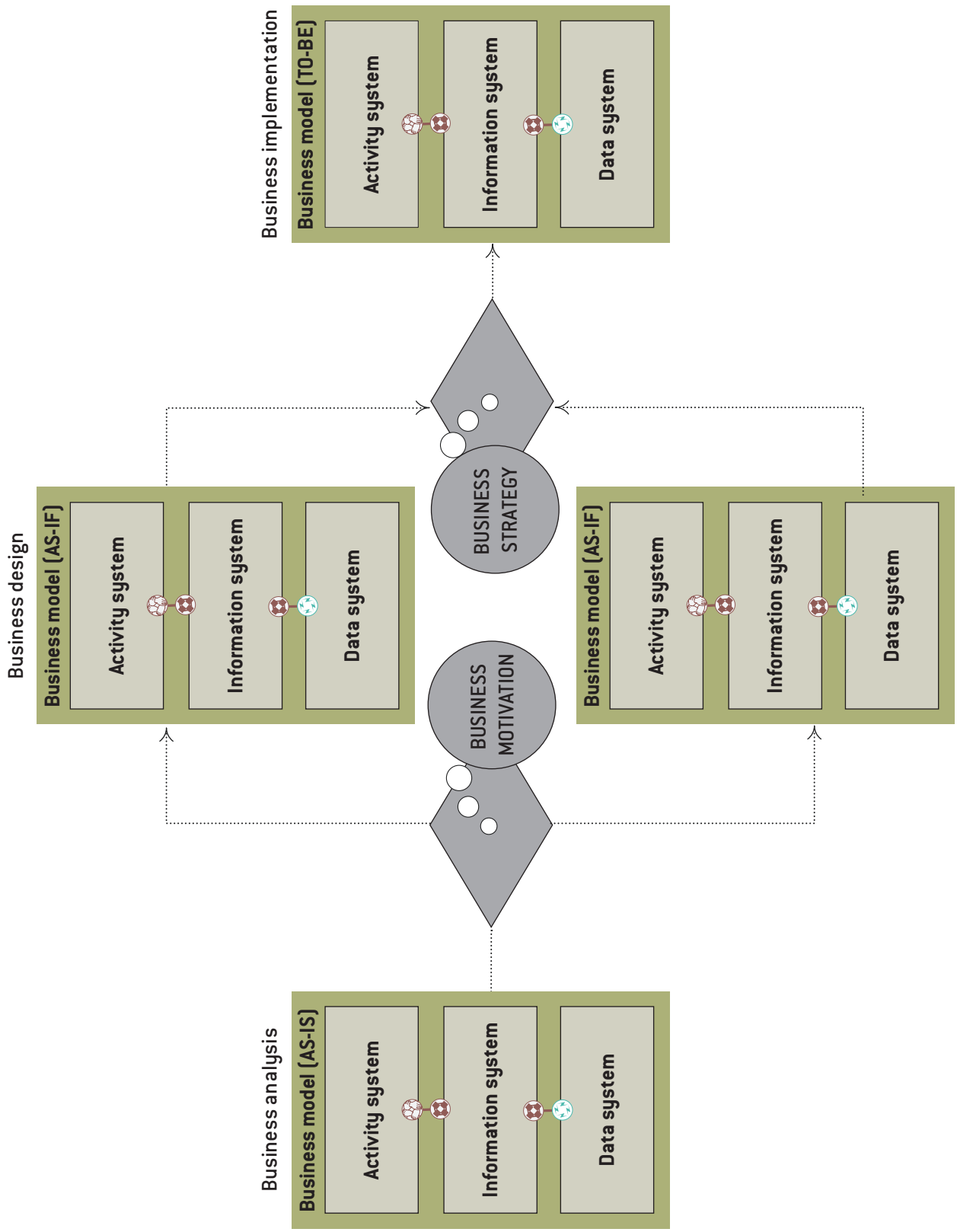


Figure 11.2 As-is, as-if and to-be business models

Business strategy Optimising the selection among as-if models and specifying courses of action to implement a new (to-be) business model for the chosen domain.

The diagram also illustrates some of the distinctions made between business motivation, business model and business strategy, which we shall make in this chapter. Business motivation involves the need to document explicit reasons for changing an existing (as-is) business model, such as enhancing revenue or better adapting to market changes. The equifinality of business models as open systems means that more than one envisaged (as-if) business model may fulfil one or more aspects of expressed motivation. **Business strategy** involves optimising the selection among as-if models and specifying courses of action to implement a new (to-be) business model for the chosen domain.

11.2.2 The as-is model of Cwmni

CASE

Consider the current business model applicable to one company – Cwmni. Cwmni, which means in Welsh both *company* and *our valley*, was established as a private enterprise by the Welsh regional administration to offer advice and support in relation to digital business to SMEs based within Wales. Funding for the operations of Cwmni was provided jointly by the regional administration and the European Union. Several private sector companies also participated in funding its work.

In the first phase of its operation, advice and support was offered through a network of business advisors situated around the region and responsible for all the SMEs lying within a specific geographical area of Wales. A central call centre was established to manage the process of contacting businesses and arranging visits by business advisors. Advice and support were provided in face-to-face meetings between business advisors and SME managers or other employees at such visits.

The support service provided by Cwmni consisted of a digital business review, grant aid and implementation support.

- Digital business review. A network of advisors was trained and accredited by Cwmni and provided the main point of contact with client firms. Approximately two days of an advisor's time were allocated to each SME client. This was a free service to the company and consisted typically of half a day spent at the SME identifying business problems and analysing business needs. This was followed by a day and a half writing a digital business review for the SME concerned. The digital business review consisted of an 8 to 10-page personalised report, written according to an agreed format and ending with a series of recommendations on what an SME should do in the area of digital business. The personalised content was usually supplemented by supporting material, written by Cwmni describing technologies or issues. This ensured that high-quality, standardised material could be distributed to SMEs.
- Grant aid. In the initial phase of operation, clients who wished to implement the advisor's recommendation became eligible for financial support from Cwmni. This support was designed to help businesses acquire the products and services needed to progress their adoption of digital business.
- Implementation support. Should an SME express the wish for support in implementing the recommendations contained in the digital business review, further help was available in the form of implementation support. Cwmni advisors would not take over and implement a solution for the SME. Instead, they acted as a mentor that would advise the SME as they implemented solutions. A small daily fee was charged for this work. SMEs typically would take two or three days of implementation support.

The as-is activity system at Cwmni is illustrated in Figure 11.3.

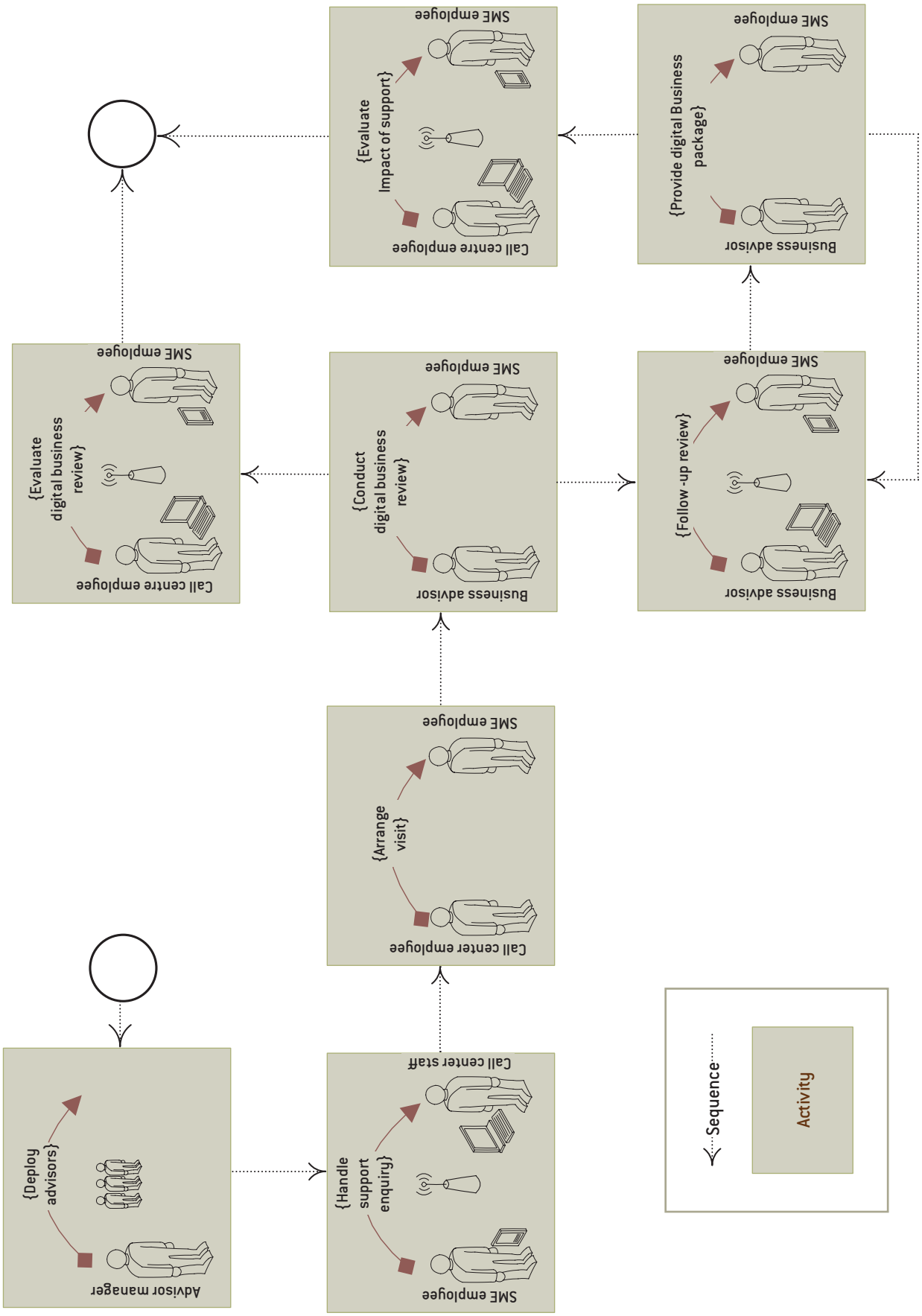


Figure 11.3 The as-is activity system at Cwmni

CASE
continued …

After three years of operating in this manner an evaluation was conducted of this support organisation by an external consultant, who was tasked with investigating not only the level of satisfaction experienced by business organisations with the service provided by Cwmni, but also to provide an assessment of the efficiency of the operations of the company. Feedback provided by supported organisations suggested that many found the advice and support offered was rather general and not tailored enough to their specific needs. Also, the process of visitation itself was sometimes disorganised in that much time was spent in repeating details provided initially to the call centre to the business advisor. Therefore, many SMEs suggested that common and low-level bits of advice and support would be better provided via a website. This would mean that more time could be spent by business advisors in identifying need and tailoring their input to the visited organisation itself.

Following this evaluation, a basic website was produced, with static pages of content on such topics as producing a business plan, accessing sources of funding etc. The work of the call centre was also reconfigured around use of a customer resource management system. As well as collecting basic data about the organisation, such as main contact, number of employees and annual turnover, this system now enabled the collection of issue-based data which were passed on to business advisors prior to their first meeting with the supported company. The CRM system was also used by call centre staff to input the results of three evaluations conducted at three points during the interaction with the support client.

After a further three years of operating in this manner Cwmni applied for an extension to its funding. Further funding was contingent on changes to the nature of support. The regional authority asked Cwmni to concentrate the focus of extensive digital business support upon a narrower range of potentially high-performing companies. It was also required to consider widening its base of operations from digital business and electronic commerce support to more general business support. Such environmental turbulence meant that Cwmni needed to radically redesign both its organisation and technology to meet the revised and increased range of objectives and targets.

REFLECT

So what would the to-be activity system for Cwmni look like? What changes to the as-is activity system are required?

RECAP

Business models are models. They are narratives or stories that explain how organisation works. Business models are different from but related to business strategy. Business models outline the patterns of action necessary for the achievement of certain goals. The concept of a business model has become popular as a way of thinking about business change, particularly change that involves some form of technological innovation. Business models are useful for understanding and explaining how things currently are (as-is). They are also useful for explaining how things might be (as-if and to-be).

11.3 BUSINESS CHANGE

As we discovered in an earlier chapter, the ancient Greek philosopher Heraclitus summed up the nature of change when he said that, '*No man ever steps in the same river twice, for it is not the same river and he is not the same man*.' This is because both a river and a

human are examples of complex systems and as such are in a state of continual flux. A human is effectively a collection of billions of cells that die and regenerate, at least for a finite number of cycles. A river is effectively a continuously changing assemblage of moving water.

In Chapter 2 we defined the idea of organisation as a complex system of action. Actions undertaken by humans, machines and artefacts continually create and recreate patterns of organisation. But such action is also the motor for organisational change. In a typical organisation the predictability of organisational action is reliant upon defined patterns as well as the roles involved in such patterning (see Chapter 10). In the process of performing their roles and enacting patterns of action, actors recreate organisation. However, innovation in action always occurs, and is particularly evident in times of environmental disturbance. At such times, organisational action by actors must change or adapt to environmental change if it is to remain viable.

Just like the organisation itself the environment of some organisation is also clearly not static. The environment is in a state of continual flux – it is a 'heaving landscape'. The actions making up or constituting organisation affects this landscape. In turn the organisation changes to improve its 'fitness' with the environmental landscape. For instance, implementing a certain business strategy within some organisation may change the competitive landscape of a designated economic market. The way in which competitors adjust to this activity will cause the organisation to reflect on its strategy and probably implement further change to adjust to the competition.

Business analysis and design (see Chapter 10) is inherently concerned with business change. The very idea of setting or defining problems and designing solutions to such problems suggests change to existing systems. But implementing change effectively is notoriously difficult. We have promoted an idea of organisation in this book as a continuing accomplishment by actors. If organisation is considered a continuing accomplishment, then change is an inherent part of organisation. Even if you are happy with the way things are, you must make effort to make sure that existing ways of working continue to be current ways of working.

In practice, however, when business analysts and designers refer to change they mean planned change. This is a coherent attempt to change existing ways of doing things on a small or large scale. In terms of the approach discussed in this book such change will typically involve the implementation of a new form of sociotechnical organisation for some domain. Such a plan typically involves detailing how an existing business model should be replaced with a new business model.

11.3.1 Unfreezing, changing and refreezing

Unfreezing
One of the three stages of planned change, involving breaking down or 'unfreezing' patterns of habitual action.

Refreezing
Establishing new patterns of action.

The social psychologist Kurt Lewin famously talked of three key stages in any planned change to organisation which he referred to as **unfreezing**, changing and **refreezing**. Niccolo Machiavelli, in his famous treatise *The Prince*, advised that, '*There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success than to take the lead in the introduction of a new order of things*'. Introducing any change to organisation is not easy. This is frequently because in the very nature of patterns of organisation, people and technologies are habituated and 'programmed' to certain ways of doing things – of performing, communicating and representing.

Breaking down or 'unfreezing' patterns of habitual action first involves thinking differently. We have described various ways of attempting to do this in Chapter 10 such

as setting up workshops, drawing storyboards of action and thinking through problem situations. What Lewin calls change we might refer to as design (see Section 10.2). On the basis of a close analysis of existing patterns of action, new ways of organising have to be designed and represented. We have suggested that this is best achieved by drafting patterns of coordination, communication and articulation relevant to the domain of organisation under focus. The third clear step is to implement change – to get actors within some domain of organisation to act differently. This last stage, which Lewin refers to as refreezing, is perhaps the most difficult to achieve. So what are good ways of implementing new patterns of organisation and ensuring that they sustain themselves?

But how do we know that change has been successful? This suggests we should add a further step to the change process – that of evaluation. At some specified time after the change has been implemented we need to examine the new patterns of sociotechnical organisation and see if they match up to the motivation expressed for them.

11.3.2 Managing change

Change management
That range of activities involved in the implementation of new systems, particularly ICT systems.

The term **change management** is normally used to denote that range of activities involved in the implementation of new systems, particularly ICT systems. The assumption here is that it is possible to manage change, particularly as a defined project or programme of work (see Chapter 10). In other words, change should be managed as a project with defined team members, just like other activities such as investigation, analysis and design. The persons responsible for seeing such programmes or projects of change through to completion are sometimes referred to as *change agents*.

As-if business model
A model of how things might be in some domain of organisation.

As-is business model
A model of how things are in some domain of organisation.

To-be business model
A model of how things will be. An as-if model selected for implementation as a new business model.

We have emphasised the importance of using models to identify not only how existing systems work but how new systems should work. Implicit in this idea is that drawing an **as-if** or to-be model and relating it back to the **as-is model** for the domain in question is a good way of managing change. A key advantage of a defined motivation model, as we shall see, is that it can form the basis for communicating to participating actors as well as numerous stakeholders about the reasons for the expected change. Business motivation will particularly express the purpose of changing things – why changes need to be made to business action and the goals they relate to.

A to-be model gives change agents a map to use to implement changes to both work and technology. A **to-be business model** can be used as a clear basis for defined changes to roles and responsibilities (job and task design). Such a to-be business model will also be used by technical staff to help build new or adapt existing technical systems.

Implementing a new business model can take place in several ways: direct conversion, parallel implementation, modular implementation and phased implementation. Direct conversion is sometimes called 'big bang' implementation. This is a confident approach, in which the new business model directly replaces the old business model. There is no overlap between the implementation of the new way of working and the system it replaces. In parallel implementation, two business models – the old and the new – run in parallel for a defined period of time. This is a cautious approach in that if there are problems with the new system, the organisation can revert to the old system until they are resolved. Eventually the organisation should be happy enough with the new system for the old system to be terminated and the new business model adopted. Because change is difficult it is best to plan for phased implementation wherever possible. Perhaps piloting change in one unit, then evaluating lessons before releasing across the organisation. Finally, it may be feasible to decompose a large business model into

smaller elements or modules. Hybrid implementation involves introducing modules in a phased manner as replacements. It is an evolutionary approach in the sense that the impact of implementation is distributed more evenly over time than in direct conversion.

RECAP

Business analysis and design is inherently concerned with business change. Change has to be managed through phases of unfreezing (analysis), changing (design) and refreezing (implementation). The development of as-is, as-if and to-be business models facilitates such change.

11.4 BUSINESS MOTIVATION

The transition between business analysis and business design implies some interest in business change (Figure 11.2). But why should things change? Clearly, since one or more stakeholders in the domain of organisation under examination are motivated to change things, they are what we called in Chapter 10 *would-be improvers* of some problem situation. But although such stakeholders may know themselves why change is necessary, such motivation is frequently left informal and unspecified. There are key benefits in making any motivation that is explicitly examined documented. This is mainly because the establishment of business motivation forms the context for the development of business models. Within this section we utilise the idea that business motivation is best expressed in terms of desired ends and the means necessary to achieve them. This allows us to better relate topics such as business vision, business mission and business strategy, which although discussed in the literature are done so in a rather confusing fashion.

REFLECT

From the description of the Cwmni case, how would you describe the key motivation for business change?

What does this tell you about the strategy of Cwmni at this time?

11.4.1 Environmental analysis

PESTLE
PESTLE analysis considers the environment as a series of necessary systems that must be considered when contemplating any form of organisational change. These include the political system (P), the economic system (E), the social system (S), the technological system (T), the legal system (L) and the environmental system (E).

In previous chapters we portrayed an organisation as a value-creating system positioned within a wider environment. By *environment* we normally mean anything outside the organisation with which the organisation interacts. This way of considering organisation and environment is familiar in a technique known variously as PEST or PESTLE analysis. A **PESTLE** analysis is a high-level way of investigating in strategic terms the environment of an organisation. Such environmental analysis may offer some critical insight as to why things should change. What issues within the wider environment of an organisation will require it to adapt its patterns of action of the short-, medium- and long-term future?

PESTLE analysis considers the environment as a series of necessary systems that must be considered when contemplating any form of organisational change. These include the political system (P), the economic system (E), the social system (S), the technological system (T), the legal system (L) and the environmental system (E).

It is possible to collapse this commonplace approach into a fivefold analysis of the environment of some domain of organisation. From our point of view, the environment of most organisations can be considered in terms of four major interdependent systems: an economic system, social system, political system and physical system. In this sense,

the external environment can be seen to be made up of a network of activities and relationships in each of these systems between the organisation and other actors, both human and technological.

An economic system consists of the way in which groups of humans arrange their material provisioning and essentially involves the coordination of activities concerned with such provisioning. An organisation's *economic environment* is defined by activities and relationships between economic actors or agencies and the organisation. The economic environment is particularly concerned with the performance of national and international commerce and trade, and is influenced by such factors as levels of taxation, inflation rates and economic growth.

The *social environment* of an organisation concerns its position in the cultural life of some grouping, such as the nation-state. The social system can be seen to be made up of a series of social networks consisting of activities and relationships that serve to bind various social groupings together.

The *political environment* or system concerns issues of power. Political systems consist of sets of activities and relationships concerned with power and its exercise. The political environment is particularly concerned with government and legal frameworks within nation-states and is a major constraining force on organisational behaviour.

The *physical environment* constitutes the eco-sphere surrounding organisational activity. In recent years growing concerns have been raised regarding organisational impact on the physical environment, such as the negative effect CO2 emissions are having on the atmosphere and the way this process contributes to global warming. As a consequence, business organisations are increasingly expected to take action to reduce their 'ecological footprint'.

The *technological environment* involves the infrastructures of current and future technology that are likely to affect the organisation and cause it to change. The information and communication technology infrastructure is a particularly important area of concern because of the way it affects systems of action within organisations.

For instance, a PESTLE analysis conducted of an ambulance service might find that its social environment is undergoing change as an aging population places more demands on its services. Its political environment is set within the context of the UK National Health Service, the strategic policy of which is set by government. This means that its financial resources are allocated and determined within public sector planning and are impacted upon by times of economic austerity. Technologically, more people are seeking health advice online. Good design of such services and effective integration with other aspects of healthcare may help alleviate aspects of increasing demand.

11.4.2 Business ends

Business ends
Part of a motivation model. A convenient way of expressing a desired future is in terms of end points or end states.

A convenient way of expressing a desired future is in terms of endpoints or endstates – *ends* for short. An endpoint or an **business end** may be considered an information class with two subclasses. This means that ends can be typically expressed either as a business vision or as an expression of the results desired from this vision. In turn, a desired result is typically expressed either as a goal or as an objective (see Figure 11.4).

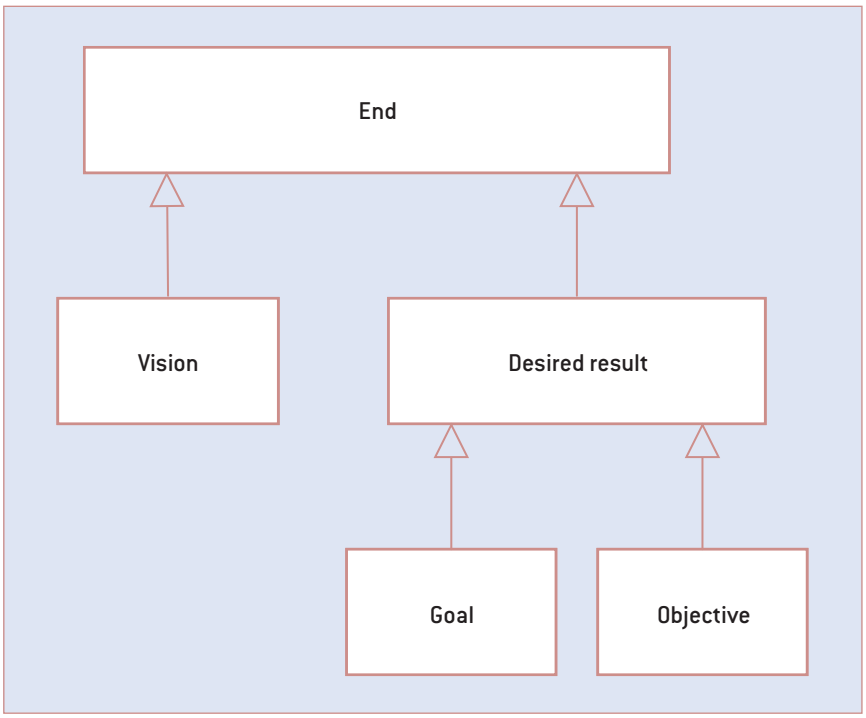


Figure 11.4 Business ends

11.4.3 Vision statements

Vision statement
A short list of key strategic objectives for an organisation.

Future thinking is normally documented in an organisation's **vision statement**, sometimes expressed as its mission statement. This comprises a short list of statements of future intention. For instance, a car rental company might express part of its vision as a statement: *to be the car rental brand of choice for business users in the countries within which we operate*. In contrast, a pharmaceutical supplier might document part of its vision in the following terms: *to be the lowest cost pharmaceutical supplier with the best customer service*.

A vision is realised through desirable results. Desired results come in two forms: goals and objectives. Goals are specific, long-term desired results. Objectives are steps towards achieving goals and hence constitute shorter term desired results. For instance, a car rental company might express three main goals linked to its vision:

- To provide industry-leading customer service.
- To provide well-maintained cars.
- To have vehicles available for rental when and where customers want them.

Each of these goals might be expressed in more detail as a series of objectives. Hence, to meet its goal of improving customer service, the car rental company might express an objective that *by end of current year to score 85% on the company's quarterly customer satisfaction survey*. Likewise, to achieve the goal of having well-maintained cars the car rental might express a shorter term objective that *during the 4th quarter of the current year, no more than 1% of rentals need the car to be replaced because of mechanical breakdown (excluding accidents)*.

REFLECT

Consider one of the cases or examples discussed in this book, such as Goronwy Galvanising or the emergency ambulance service. Generate a likely statement from the vision of one of these cases. What might be likely goals and objectives in relation to this mission?

11.4.4 SMART goals

SMART goal
A goal that is specific, measurable, achievable, realistic and timely.

Both goals and objectives are best expressed in **SMART** terms. This acronym expresses the fact that each goal or objective should be specific, measurable, achievable, realistic and timely.

- Specific: each goal or objective should be clear and focused.
- Measurable: it should be clear how achieving the particular goal or objective can be measured.
- Achievable: the goal or objective should be achievable with organisational resources.
- Realistic: the goal or objective should be realistic in terms of organisational constraints.
- Timely: the goal or objective should specify a duration by which it will be achieved.

As we indicated in Chapter 10 one has to be careful with the way in which goals are turned into targets. It is something of a truism that if an organisation measures the wrong things then things are likely to go wrong. There are numerous examples of organisations attempting to implement poorly designed performance measures. For example, a major division of a telecommunications operator started out measuring the time it took operators to answer phones. They stopped this practice when they discovered that managers would instruct operators to make their phones ring engaged if the target figures looked bad. A major retail bank implemented the measure of the percentage of customer enquiries that were answered within 60 seconds. It stopped using this measure when it discovered that operators cut customers off after 59 seconds if their problem had not been solved. The senior managers of a cross-channel ferry company measured the number of customer complaints responded to by their customer service team within five working days. They stopped using this measure when they found out that the team were only meeting targets by issuing full refunds to everyone who wrote in with a complaint.

Criticisms of performance measures are that they are historical in focus, that they encourage short termism and that they often result in local optimisation. The trick is to design both a goal and an accompanying performance measure that will encourage positive rather than dysfunctional behaviours, such as the ones we have described.

11.4.5 Critical success factors

Critical success factor
A factor which is deemed crucial to the success of a business.

One approach to identifying goals or objectives is to think of **critical success factors** (CSFs) appropriate to the entire organisation or a specific activity system within the organisation. A CSF is a factor which is deemed crucial to the success of a business. Consequently, CSFs are those areas that must be given special attention by management. They also represent critical points of leverage for achieving competitive advantage. There are normally only a few CSFs – perhaps between three and eight – for each organisation. CSFs follow the 80/20 rule – that only a few issues really count in terms of organisational effectiveness.

CSFs are usually contrasted with CFFs or critical failure factors. A CFF is an aspect of the organisation, the poor management of which is likely to precipitate organisational failure.

A CSF for a chain of high street jewellers is likely to be location of its outlets. A CSF for a health authority is likely to be the quality or standard of service it gives to its customers – patients. A CFF for the high street jeweller chain is likely to be a high amount of shrinkage in consumer demand. A CFF for a health authority might be poor coordination of its staff, particularly subcontracted staff.

11.4.6 SWOT analysis

SWOT
SWOT is an acronym standing for Strengths, Weaknesses, Opportunities and Threats.

Another way of establishing goals is to conduct a **SWOT** analysis. SWOT is an acronym standing for Strengths, Weaknesses, Opportunities and Threats. This leads clearly to four questions that can help guide thinking about forming vision:

- What do we do well?
- What do we do badly?
- What areas or potential areas exist for expansion of our activity?
- What areas are particularly likely to damage us if we do not correct them?

11.4.7 Business means

Business means
Part of a motivation model. Courses of action design to achieve particular means.

Ends always should be linked to means. Ends without means are merely dreams. Ends with means are motivations or plans for achieving change. Means directed by ends are what some domain of organisation has decided to do in order to become what it wants to be. Means can be thought of as an information class with three possible subclasses: mission, courses of action and directives. This is illustrated in Figure 11.5.

A vision expresses or defines some future state which is desired. A mission specifies the ongoing operational activities of some enterprise designed to achieve its vision. For example, a car rental company might express part of its mission as being *to provide a car rental service across Europe and North America to business and personal customers*.

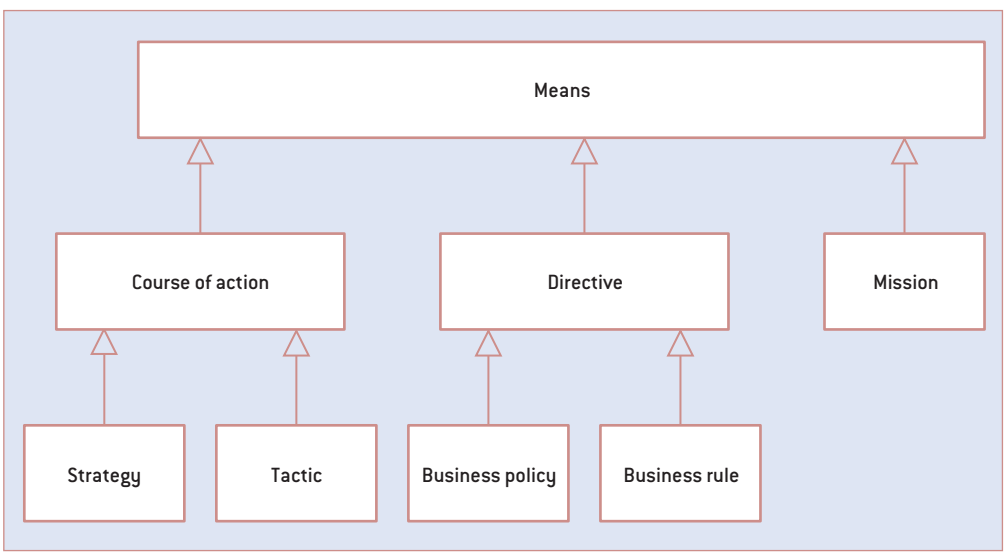


Figure 11.5 Business means

Alternatively, a consultancy might express part of its mission as being *to provide management consultancy services to companies in North America*.

Courses of action are what the organisation has decided to do; a way of configuring some aspect of the enterprise to channel efforts towards desired results. Courses of action are specified as strategies or tactics. Directives are business policies or business rules. Business policies exist to govern strategy and tactics. A business rule is an actionable element of business policy.

There is clearly an inherent linkage between business motivation and business change. Business motivation expresses and documents the need for change both in terms of ends and means. Business policies and rules typically try to implement 'carrots' and 'sticks' to attempt to habituate the new patterns of action that make up a new business model.

A 'carrot' is an incentive for doing things in a certain way. Bonus schemes are classic examples of business carrots. Targets are set for individuals, groups, departments and divisions. If such targets are met then a financial bonus is awarded, typically on an annual basis. A 'stick' is a punishment or more likely a threat of punishment. Performance appraisals within organisations typically are linked not only to career progression, but they may be linked to career demotion. The ultimate sanction or stick would be losing one's job.

But the analyst should not get into a mindset that change is always necessary. Change is notoriously difficult. Any planned change inevitably introduces unforeseen and unexpected consequences. A classic example here is the introduction of rabbits into Australia by the first immigrants from the UK. With few natural predators on this continent the population of this mammal exploded and caused untold damage to agriculture. Various attempts were made to control the population including building a rabbit-proof fence across Western Australia. Eventually, the myxoma virus, which causes myxomatosis, was introduced into the rabbit population, which had a severe impact upon population growth.

RECAP

Business motivation expresses why things should change – why we should move from a business model as is to a business model as it might be. Business motivation is best expressed in terms of desired ends and the means necessary to achieve them. Ends include vision and goals while means include mission and strategy.

11.5 BUSINESS STRATEGY

The Chinese general Sun Tzu in his text *The Art of War* states that '*to conquer the enemy without war is the most desirable. The highest form of general-ship is to conquer the enemy by strategy*.' The term strategy has historical roots in military operations. According to the *Oxford English Dictionary*, strategy is the art of a commander-in-chief; the art of projecting and directing larger military movements and operations in a campaign. It is not the same as tactics, which concern the mechanical movement of bodies set in motion by strategy. Therefore, strategies are a long-term course of action with wide scope; tactics are short-term courses of action of narrow scope.

For instance, part of the strategy of a car rental company might be *to operate nationwide at major airports in each country within the European Union and to compete effectively with other premium car rental companies at such locations*. In contrast, tactical statements might be *to issue each member of the sales force with a tablet device able to access central pricing and booking systems*.

Since the 1970s, strategy has been of much interest to business academics and the wider business community. Michael Porter, for instance, has written much about the need for business organisations to develop a coherent and explicit strategy to gain a competitive advantage in the marketplace. In such terms, strategy has a number of inherent features and such features relate directly to our view of organisation as a value-creating system.

- Goals: strategy involves some assessment of goals, of the value created (now or in the future) by the company.
- Future: strategy is not only about deciding what business the firm is in but what business it will seek to enter.
- Viability: strategy must involve an appreciation of the viability of the internal value chain to achieve required goals.
- Sustainability: strategy must involve an assessment of the sustainability of the organisation in relation to its wider value network.
- Design: the notion of strategy inherently assumes that we can change things – that we can design different ways of doing things.

11.5.1 Strategic decisions

Strategy is clearly about making decisions and decisions are always about the future. Ansoff (1965) defines strategic decisions as primarily concerned with external rather than internal problems of the firm, and specifically with selection of the product mix (what the firm will produce) and the market to which it will sell. Given the discussion in previous chapters, we might generalise from this and say that strategy is about deciding the nature of the value proposition for some organisation and how such value will be both created and distributed within the wider value network. Strategic decisions are concerned with establishing an 'impedance match' between the firm and its environment. In other words, they focus on deciding what business the firm is in and what kinds of business it will seek to do. In systems terms, strategy involves the attempt to ensure both the current viability and future sustainability of some domain of organisation (see Chapter 2).

For the private sector organisation, the environment is the wider market or economy. Strategy for such forms of organisation is therefore usually expressed in terms of the firm's ability to compete, sometimes expressed as competitive advantage. Porter has argued that there are three major ways in which private sector organisations gain competitive advantage: cost advantage, differentiation and location. These can be thought of as particular types of organisational strategy:

- Cost advantage. A commercial organisation can gain competitive advantage or leadership by establishing itself as a low-cost leader in the market. Cost advantage is usually achieved by doing things more efficiently.
- Differentiation. It can gain competitive advantage by differentiating its product in the marketplace. This generally involves persuading consumers that it offers something special in the way of a product or service. There are two parts to this, of course: having a unique and desirable offering to sell, and persuading consumers that this is so.
- Location. Finally, a commercial organisation can gain competitive advantage by finding a niche in the marketplace for its value: its product or service. This can be achieved in a number of ways. It might offer an entirely new product or service, for example, or offer its product or service to a previously untapped group of customers, perhaps through an innovative access channel.

11.5.2 Digital strategy

Digital strategy
Traditionally, digital strategy is seen to involve aligning technological (ICT) infrastructure with activity infrastructure.

Traditionally, **digital strategy** is seen to involve aligning technological (ICT) infrastructure with activity infrastructure. Organisation planning is seen to lead to the development of organisation strategy, which then directs the development of digital strategy (proposed change to ICT infrastructure). But this viewpoint tends to ignore the embeddedness of ICT within modern organisation, which we have emphasised time and again in this book. We shall first have a look at this notion of strategic alignment, but then emphasise that the design of ICT infrastructure is inherently a part of business innovation within the modern organisation (Figure 11.6).

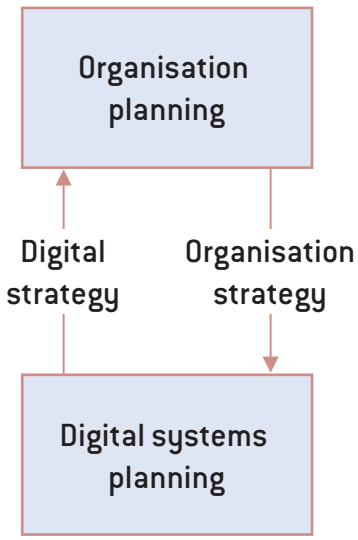


Figure 11.6 Organisation and digital strategy

RECAP

The notion of strategy inherently assumes that we can change things – that we can design different ways of doing things. Strategy involves some assessment of goals – not only of what business the firm is in but what business it will seek to enter. Strategy must involve an appreciation of the viability of the internal value chain and the sustainability of the organisation in relation to its wider value network.

11.5.3 Alignment of ICT infrastructure

Alignment
The degree to which ICT systems are coupled to our information needs and how closely coupled our information systems are with our activity systems.

One benefit of the concept of infrastructure is that we can think about strategy in terms of a closer fit or **alignment** between the various systems making up organisation both horizontally and vertically. In other words, we can think about how closely coupled our ICT systems are to our information needs and how closely coupled our information systems are with our activity systems. This is vertical alignment. But we also need to think about how alignment is evident across the various activity systems of the organisation and consequently how the information systems and data system also line up.

Take for example a chain of supermarkets, such as Tesco. In each supermarket there are checkouts operating electronic point of sale (EPOS) equipment, which allows checkout staff to record sales by scanning barcodes and transmitting details of each sale electronically to a database. The sales data automatically update data on shelf levels,

which are compared against periodic stock checks by staff, and the system generates a report prompting staff to replenish the shelves from the supermarket's own storeroom. The same thing happens with the storeroom: when stock falls to a fixed level, purchase orders are generated and sent electronically to the central supplies division. Data on sales, shelf and stock levels are also used by management to decide on marketing strategies: which goods to promote, how to site products on shelves and so on. In this example we would probably say that the ICT infrastructure is closely aligned with its activity systems. But why is this the case? How can we measure the level of alignment within a particular pattern of organisation? Four aspects of, or properties of, infrastructure can be measured and used to determine elements of fit: the levels of fragmentation, redundancy, inconsistency and interoperability.

Poor alignment is evident when data are fragmented across separate data systems. This usually happens because data systems emulate structural divisions within the organisation and organisational units put up barriers of ownership around key data sets. Fragmentation can also be evident in processing, when data have to be transferred (sometimes manually) between separate data systems.

Another example of lack of alignment is when large amounts of data are unnecessarily replicated. This usually happens because there are no interfaces between data systems, so the same data are entered many times over. Redundancy also occurs when separate systems perform the same effective articulation on data.

Poor fit is evident when the same data are held differently in different systems or articulated differently by different systems, leading to inconsistencies in the ways in which data are produced, stored and disseminated.

The property of interoperability is related to the other three criteria. Generally speaking, systems that are fragmented, redundant and inconsistent are likely to suffer from poor levels of interoperability. This refers to the level at which systems are coupled, such that the data produced communicate effectively leading to effective coordination of activity.

11.6 BUSINESS INNOVATION

Innovation
Thinking differently with the aim of doing things differently, to hopefully make a difference.

Change to sociotechnical organisation, as well as discussions of digital strategy, are typically linked to notions of **innovation**. However, although the term is used frequently in relation to both organisation and technology it is actually quite difficult to pin down what innovation actually is. Following on from the discussion in previous chapters we therefore pitch a definition of innovation at an area intersected by creativity, design and changes to action. Innovation for us involves thinking differently with the aim of doing things differently, to hopefully make a difference.

Innovation is potentially a creative act. Edward de Bono believes that '*creativity involves breaking out of established patterns in order to look at things in a different way*'. But Martin Heidegger cautions, '*if the only tool you have is a hammer you tend to see every problem as a nail*'. These quotes suggest that there are a number of facets to innovation. Thinking differently is at the heart of being creative. Creativity involves challenging existing convention. The 'tools' you employ for thinking determine what you end up doing. Looking at things differently can suggest points of innovation.

Design is also closely coupled to innovation. Design is an exercise in change. In engaging with change, designers attempt to innovate – to do things differently or make something different.

As we have seen, innovation is clearly linked to changing ways of doing things with the aim of improving things. Some have considered innovation as necessarily

destructive or disruptive. According to the economist Joseph Schumpeter, '*creative destruction is the essential fact about capitalism … [which] … incessantly revolutionises the economic structure from within, incessantly destroying the old one, incessantly creating a new one*'.

DID YOU KNOW?

Prior to the 1950s the average lifespan of companies based within the United States was 60 years. Currently the average lifespan is around 20 years. Many analysts put this acceleration of business decline down to the disruptive catalyst of technology.

11.6.1 Thinking differently

Innovation involves thinking differently, but this is difficult because we all tend to think conventionally. A useful adage for what is frequently needed within innovation is *digging up the cowpaths*! During the business process redesign or reengineering movement of the 1990s, this saying was used to describe a key problem with many ways of organising things. The reasoning runs as follows. Cows tend to traverse a landscape using paths that have been made persistent through the simple practice of one cow following another. Humans created the first roads in countries such as the UK by paving over the cowpaths (or sheep-paths if you live in the South Wales valleys as I do!). In other words, the analogy being made here is that people keep doing things because they have always done things in certain ways – they are part of the conventional activity, communication and representation of organisations. To break with convention you first have to dig up the cowpaths and establish new directions. This is not easy.

We normally think in conventional or habitual ways. Conventional thinking is analogous to the tricks of perception familiar in optical illusions. For instance, how many triangles do you see in Figure 11.7? The correct answer of course should be none. Your eye, and the mind behind it, sees this image conventionally as two triangles, when triangles do not exist in this representation. In a similar way, frequently the conventional

Figure 11.7 An optical illusion

view of sociotechnical organisation is based upon habitual modes of perception. We tend to think of business only in terms of familiar patterns of organisation – what we have always done.

REFLECT

The sociologist, or more precisely the ethnomethodologist, Harold Garfinkel (1967), used a number of devices to help his students understand how people accomplish everyday action through employing arbitrary conventions of behaviour. One such device involved getting his students to go home during the Christmas holiday and to act like strangers in their own home. Imagine how their parents reacted!

Can you think of any ways such devices might be useful as a technique to employ within design workshops? How would you set up such 'experiments' and what would be their objective?

11.6.2 Digital innovation

Digital innovation
Much modern innovation is clearly digital innovation – innovation with and through ICT.

Much modern innovation is clearly **digital innovation** – innovation with and through ICT. ICT has been applied in various domains of organisation to do things differently, and as such these examples of innovation are prime instances of disruptive innovation or creative destruction. For instance, the way in which the book, newspaper/magazine, music and movie industry has changed in recent times is largely down to digital innovation.

There is an inherent assumption that ICT can be employed within innovation relatively seamlessly and that such innovation will inherently introduce improvements in organisational performance. But there have been numerous instances in which ICT has been introduced and has failed to deliver benefit. Some digital innovation has caused the collapse of the organisation in which it is applied.

To innovate successfully with ICT we have to look rather differently at ICT; we have to challenge conventional ways of thinking about ICT. Traditionally, technology (such as ICT) is seen as something separate from business activity, but which supports such activity. This viewpoint suggests that to undertake digital innovation you should design changes to activity first and then design ICT systems to support activity change. Throughout this book we have suggested thinking differently about ICT as a participant actor within contemporary ways of organising, alongside humans.

So what role does ICT typically play within the design of organisation? We summarise the key principles discussed in previous chapters here. An ICT system is best viewed as a data system. It is primarily devoted to the articulation of data, used in turn to accomplish information (communication). An ICT system is best viewed as a 'machine' for the articulation of data structures, making it a key communicative actor engaged in facilitating coordination of dispersed work.

Take an example from manufacturing where an actor A1, located at L1 and at time T1 creates a stock movement record in the production ICT system. This is an act of articulation (Chapter 3). At location L2 and at time T2 actor A2 reads the stock movement record from the ICT system – another act of articulation. But this reading of a data structure informs him to take certain action – directing him to move stillage S2 to location Y. This is an act of communication. Finally, at location L2 and at time T3 actor A2 moves production container (stillage) S2 to a particular pallet for dispatch to the customer (Figure 11.8).

ICT systems as 'machines' are key actors in contemporary organisation. It therefore makes sense to think of the role such technology plays or should play within a particular

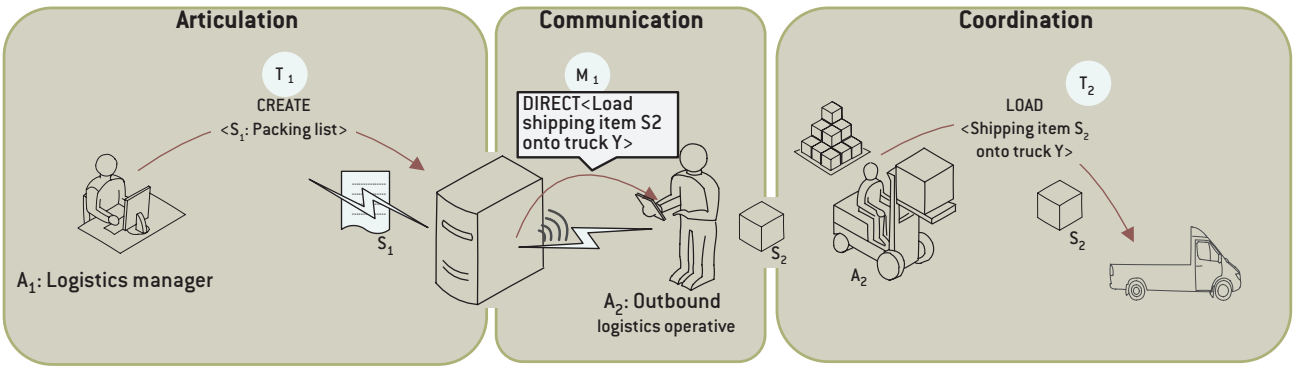


Figure 11.8 Interrelated domains of innovation

domain of action. Generally speaking, there are three distinct roles that ICT can play within some domain of organisation:

- ICT can be used to support the communication system of the domain in question. This implies that digital computing and communication is applied mainly to automate aspects of the action of articulation within the domain – particularly the manipulation of records as forms of persistent communication.
- ICT can be used to supplant aspects of some communication system. This implies that certain aspects of the communication system become automated in the sense that the logic of the ICT system replaces human decision-making and communicative action.
- ICT can be used to innovate new activity systems for organisations. This is the most radical use of ICT in the sense that new activity, information and data systems are brought into existence through the application of ICT.

Consider the way in which credit-rating of customers occurs as an activity of interest to financial institutions. In the past, ICT would be used typically to support the work of human actors in assigning a particular credit rating to a particular customer. These days, for most straightforward cases of credit-rating and associated credit-checking, ICT systems may work relatively autonomously. There are some suggestions in this case as to places where ICT systems tend to move from a support role to a supplant role. What do you think this next case suggests about the typical migration of ICT as an actor within domains of organisation?

11.6.3 The case of the UK national identity card

CASE

In this case we shall examine a major case of attempted digital innovation which failed. In September of 2001 the UK Home Secretary, David Blunkett, was facing pressure to do something constructive to combat the threat of increased terrorism. He indicated that the introduction of identity cards was one of a series of measures that the government was considering in the wake of the terror attack on the United States. Figure 11.9 presents the national identity card case as a problem situation. Within this case there are clear examples of stakeholders holding differing perspectives as to what constitutes the 'problem' and whether technologies for personal identity management are an appropriate solution to such problems.

CASE
continued…

Britain had a national identity card during and immediately following the two world wars. Such identity cards were used as authentication tokens – to prove to relevant authorities that someone was who they said they were. National identity cards are widely used across Europe and in other parts of the globe. Many countries have introduced such cards with the aim of providing a common form of identification for individuals. Some such cards are compulsory, some optional. Some compulsory cards must be carried at all times and checked by the authorities at any time. Possession of an identity card serves to identify someone as a citizen and hence serves to prescribe that the person possessing the card can participate in the activities associated with citizenship. Not having an identity card proscribes or prevents someone from enrolling in the activities of a citizen.

The UK government of the time and its agencies saw an identity card as a tool contributing to the battle against terrorism, illegal working and identity fraud. The private sector and law enforcement agencies were also generally supportive of the government's intentions and were keen to use aspects of this personal identity management infrastructure to help combat identity-related crime. The ICT sector saw significant work opportunities in the programme and relished the prospect of a change programme raising the skills profile of the UK in personal identity management technologies.

There was, however, significant opposition to the UK government's intentions from a number of stakeholder groups. Various civil liberty groups perceived the national identity card as a major threat to data privacy and civic freedom. This was supported by the watchdog appointed by the UK government to control data protection (Information Commissioner). The Information Commissioner in particular viewed the identity card as a symptom of increasing surveillance in UK society. Various other commentators, including a number from the ICT industry, queried the costs and benefits associated with the scheme. Not surprisingly, opposition political parties in the UK indicated their intention to scrap the identity cards scheme if they came to power.

Following touting of the idea in 2002, draft legislation was produced which described the intention to create a national identity management infrastructure for the UK. This draft legislation was consulted on for two years. In the autumn of 2005 an *Identity Cards Bill* was placed before both Houses of Parliament and in March 2006 an *Identity Cards Act* became law. In November 2006 a strategic action plan was published for the implementation of a national identity card infrastructure.

This infrastructure involved collecting a data set and issuing cards to every person registered as entitled to remain in the UK for longer than three months. These cards would be used as the key to enrolment in public sector services. There was also provision for use of the national identity card as an authentication token in accessing private sector products and services. The national identity card would be supported by a national identity register which would store both identity and attribute data as individual records for the 67.5 million UK residents aged 16 or over at the time. Each person entered on the register was to be assigned a unique number known as the National Identity Registration number. The register would also hold core data about the individual, such as name, residential address, date of birth, place of birth, sex, nationality and two or three forms of physical characteristic or biometric such as a photographic image, fingerprint and/or an iris scan.

In May 2010 a Conservative/Liberal Democrat coalition government was formed and as part of the coalition's manifesto pledge the new Home Secretary Theresa May introduced a bill through the Houses of Parliament to scrap the national personal identity management infrastructure. The actual cost of attempting to implement this infrastructure is unknown, but probably approaches many millions of pounds sterling.

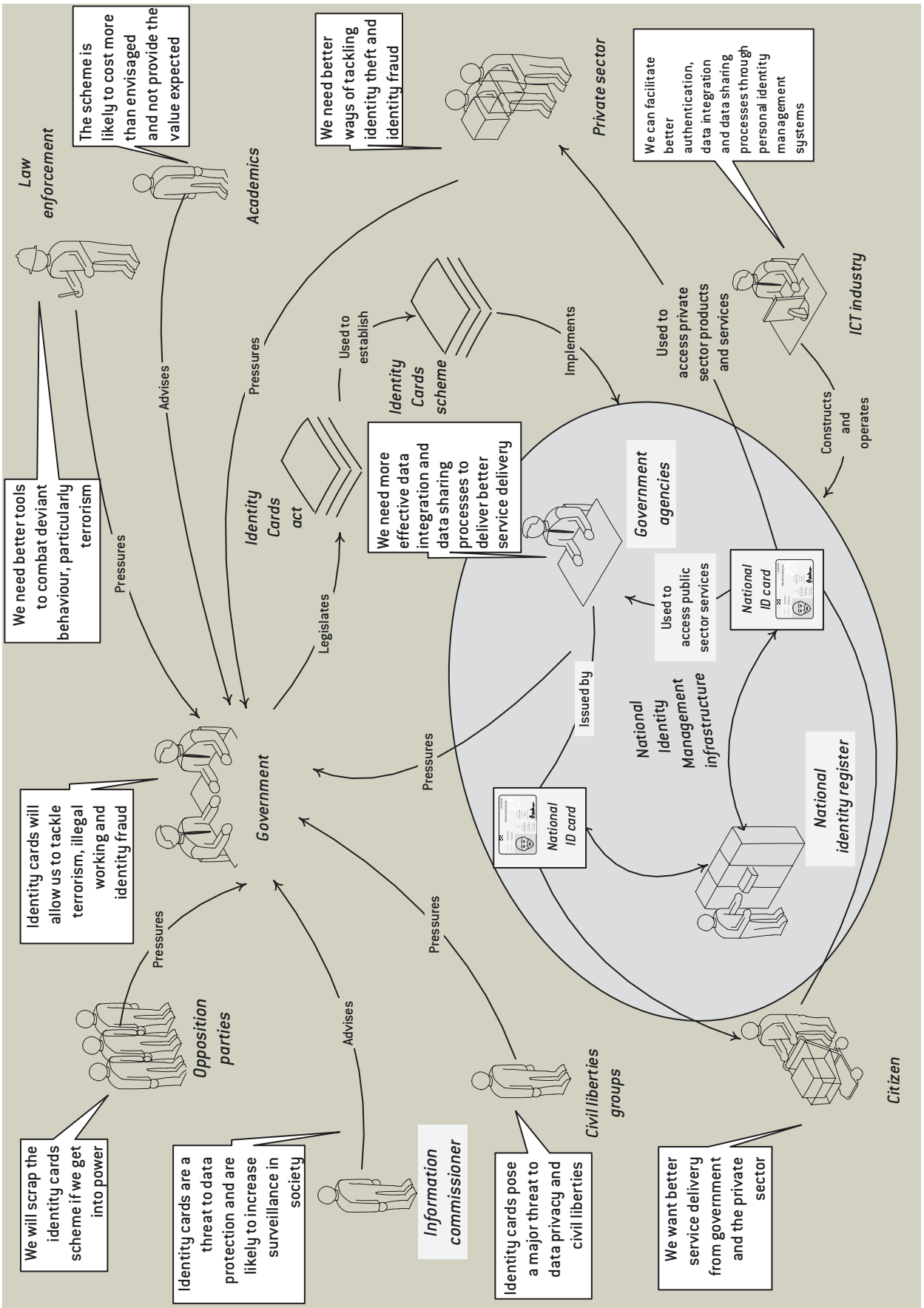


Figure 11.9 A rich picture of the UK national identity card

11.6.4 Change and performance management

We normally only think about changing how some part of an organisation works. There may be a problem of efficacy, if the current system of action is not achieving its goals. There may be a problem of efficiency if the current system of action is achieving its goals but is wasting resource. There may be a problem of effectiveness if the current system of action is not contributing sufficiently to its super-system.

For instance, in terms of emergency response, are we delivering healthcare at the point of incident properly (efficacy)? Are we utilising all our resources in the best manner (efficiency)? Are we producing positive patient outcomes from our healthcare interventions in terms of the continued health and treatment of the patient (effectiveness)?

If business change is deemed necessary then we first need to establish, if we have not done so already, what our current business model is. This model of our current state is an as-if model. We also need to express the need for changing this as-is business model – this we refer to as a model of motivation. The motivation model documents our reasons for change and where we would like to end up.

For example, here are two problems faced by the emergency ambulance service. Problem 1: a substantial number of incidents responded to turn out to be non-emergencies that do not require transit to hospital. Problem 2: to meet their response targets, control centre frequently send out two or more resources to the same incident – a paramedic on a motorbike, a paramedic in a car or a paramedic in an ambulance. Only the ambulance is able to deliver the patient into further care within a general hospital.

These problems provide motivation for change as to how the emergency response service responds to healthcare incidents. These changes normally demand changes to all three patterns of action – change to activity, to information and to data. So one change initiated in response to Problem 1 is to keep records of both past callers and patients and to use these records within triage. This means that persistent callers and patients who request emergency care when it is not necessary can be quickly identified. In terms of Problem 2, one change is to give call-takers much more time to assess the category of incident, which determines whether an ambulance is dispatched. Another change would be to change the performance management measure – to stop the clock ticking on measuring response time only when an appropriate response has been made, which is usually an ambulance in critical cases.

RECAP

Innovation involves thinking and doing things differently – 'digging up the cowpaths'. Much modern innovation is clearly digital innovation – innovation with and through ICT. To innovate successfully with ICT we have to think differently about ICT as a participant actor within contemporary ways of organising, alongside humans. This is important to mitigating the likelihood of digital failure.

11.7 BUSINESS MOTIVATION AND BUSINESS STRATEGY

The equifinality of organisations as value-creating systems means that more than one envisaged (as-if) business model may fulfil one or more aspects of expressed motivation. As-if models document possible future states for a system of action. Business motivation for us involves documenting the rationale for building one or more as-if models.

In contrast, business strategy involves optimising the selection among as-if models and specifying a course of action to implement a new (to-be) business model for the chosen domain. A to-be model documents the intended future. It specifies the changes to be made to some system of action.

11.7.1 Patterns of online grocery

Consider digital strategy, business motivation and business models in relation to one particular domain of organisation: online grocery. Traditionally, the business model of grocery retail (expressed as a high-level activity system) looks like that illustrated in Figure 11.10.

Online grocery is clearly a form of B2C eCommerce. It started when the UK supermarket chain Tesco launched its tesco.com domain name in 2000. Since the millennium many other grocery retailers have taken the strategic decision to get into online grocery. Online grocery sales account for approximately 5% of grocery retail currently in the UK, but are predicted to grow to something like 10% in a short period. Traditional offline operators such as Tesco, Sainsbury's, Waitrose and Asda have moved into online as so-called clicks-and-mortar businesses. Certain other businesses such as Ocado have only offered online grocery as their business model. These are click-only businesses. Certain other businesses such as Lidl and Marks & Spencer have taken strategic decisions to stay out of online grocery.

The motivation for getting into online grocery is clear. There are certain features of grocery retail in a country like the UK that make online grocery attractive to some operators. We have highlighted the growth in digital natives among advanced economies. The digital generation have different expectations about how to do shopping from their predecessors. The UK is experiencing a growing elderly population. Like many Western nations the age skew in the population is getting worse. Delivering groceries to the home on a regular basis is particularly attractive to the elderly for a number of reasons. Many workers are money-rich but time-poor, meaning that they do not have time to do a weekly shop or prefer to spend their valuable leisure time doing something different than shopping. The demographic density of a country such as the UK makes it attractive for online grocery. Mainland UK is very crowded with urban conurbations close together, and in places like London most people do not own a car.

There are a number of business models that can achieve the goal of providing online grocery to customers. Let us consider just two alternative business models. When Tesco first built online grocery they adopted a stock-from-store model. Part of their motivation for doing this was that it allowed expansion into this new market without heavy investment in new infrastructure. The communication pattern for stock-from-store is illustrated in Figure 11.11. Groceries are ordered through the grocery website. Goods are picked from the nearest supermarket store by operatives and packed into crates. Crates are delivered to households at specific times in vans.

In contrast, the retailer Ocado has always operated a stock-from-warehouse model, as illustrated as a communication pattern in Figure 11.11. Groceries are ordered through the website. Goods are picked from the warehouse. Crates are delivered to households at specified times.

There are clear elements of similarity and difference between these two business models for online grocery. Both involve ordering through a website and delivery via a fleet of vans. Stock-from-store, however, effectively does picking and packing by creating virtual customers who walk around the supermarket stores for the customer. Stock-from-warehouse does away with the offline store and the costs associated with maintaining this offline network.

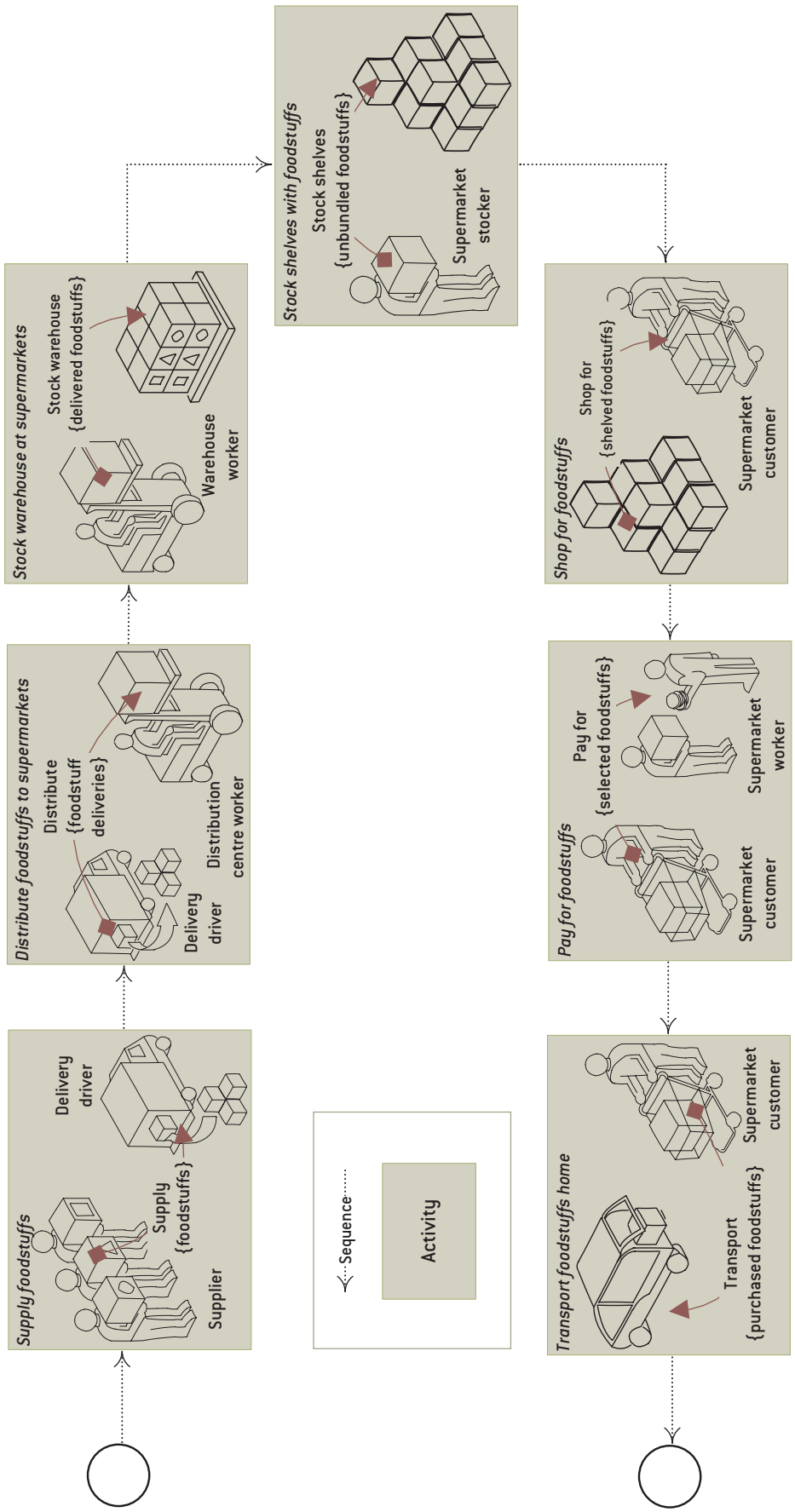


Figure 11.10 The traditional activity system of supermarket retail

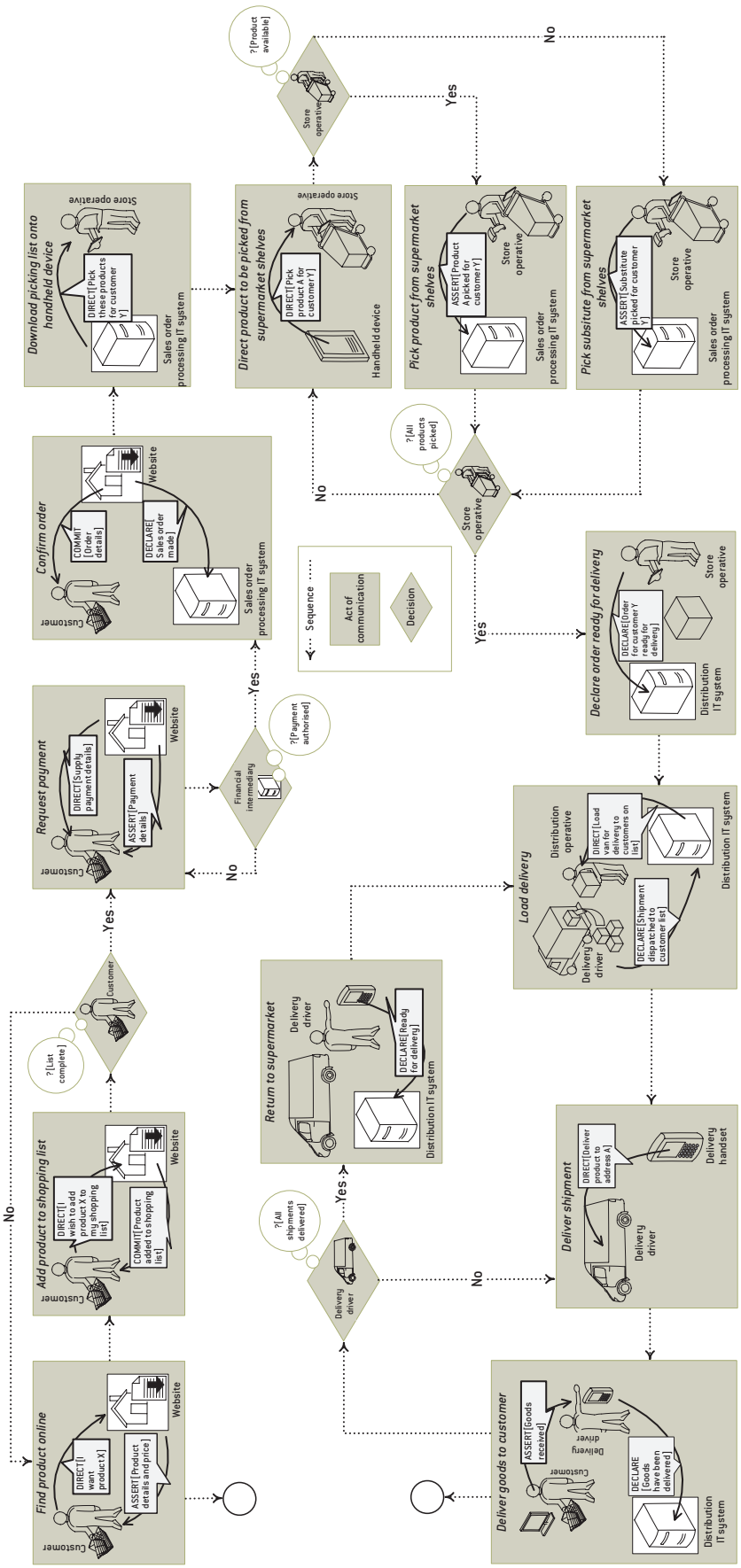


Figure 11.11 One communication pattern for online retail

11.7.2 Benchmarking and reuse

Benchmarking
Sometimes called competitive practices benchmarking. The process of comparing performance against other comparable organisations or processes.

The similarities between the way in which particular organisations work allow us to use this design approach to handle issues of **benchmarking** and pattern reuse more easily. Finding similarities and differences between business patterns allows the designer to place patterns in taxonomy – a hierarchy of similar patterns. The designer can then identify where a particular organisation lies in such taxonomy, and perhaps develop strategy to change this positioning. Or perhaps the designer can compare the performance of some as-is pattern with other patterns evident in some domain of organisation. This is benchmarking.

11.7.3 Change and evaluation

The inventor of the notion of human rights, Thomas Paine, once said that '*when we are planning for posterity, we ought to remember that virtue is not hereditary*'. By this he clearly meant that to be virtuous or to act ethically we must be continuously vigilant. Likewise, we should not expect change to stick by itself. Changes to ways of doing things will need to be continually monitored and evaluated for some time after first implementation. Changed ways of doing things need continual effort until such change becomes habituated into the life of the organisation domain. As Lewis Carroll has one of his characters utter in *Through the Looking Glass*, '*it takes all the running you can do, to keep in the same place*'. You must of course be careful in continuously evaluating whether you are still doing the right thing. If you are running to stay still it sometimes pays to get off the running machine and take a jog in the fresh air!

RECAP

Strategy is establishing where you as an organisation want to go. Motivation is expressing why you need to change. Business models can express current state (as-is) and future state (as-if) of activities, communication and data. Strategy involves optimising the selection among as-if business models. Digital strategy is very much embedded in contemporary business strategy because ICT infrastructure is so critical to business change.

11.8 BUSINESS EVALUATION

Business evaluation
The activity of assessing the worth of some business action.

The English philosopher Bertrand Russell once wrote in his consideration of the work of the great Ancient Greek philosopher that '*Aristotle maintained that women had fewer teeth than men; although he was twice married. It never occurred to him to verify this statement by examining his wives' mouths*'. The validation of statements such as that made by Aristotle is critical to the idea of empiricism upon which much of the scientific method is based. Empiricism is the principle that the statements about the world that we make should be supported by evidence – by empirical verification.

Validation, along with other processes such as verification, is actually part of a wider type of action which is best termed 'evaluation'. The clue to the proper meaning of evaluation lies in its use of the same word root as one we have seen before. In a previous chapter we equated worth with value. Value is a term we used to describe the worth of something to somebody. Evaluation is the assessment of the worth of something by somebody. In terms of the example cited above we are interested in assessing the worth of the statement made by Aristotle – in relation to some definition of truth such as that truth is justified belief. Aristotle clearly held the belief that women have less teeth than men, but this belief is not justified – it is contradicted by the evidence; it cannot be verified.

In this book the thing of value we wish to assess the worth of is a business model. We particularly wish to validate that we are building or have built the right thing in terms of this model of organisation. We also wish to verify that we are building or constructing the thing right in making changes to some domain of organisation.

Therefore, we generally wish to assess worth at various points in the life cycle of some business analysis project. First, we wish to establish whether we should change our current business model. This is what we call strategic evaluation and this type of evaluation clearly overlaps with the discussion of business motivation. Second, we wish to establish that the change we are enacting is going according to plan. This type of evaluation, known as formative evaluation, clearly overlaps with the management of business change. Third, we wish to establish whether change has been worth it. This type of evaluation, known as summative evaluation, considers the effects of a change to organisation and particularly analyses whether the benefits as expressed in the original motivation for change have been realised. Fourth, we particularly wish to evaluate why things go wrong. Using the analogy of a medical post-mortem this post-mortem evaluation is a subtype of summative evaluation particularly directed at analysing failures to sociotechnical change.

We look at all four types of evaluation in this chapter, but particularly focus upon summative evaluation. For all four types of evaluation we will need to utilise some techniques of business investigation, as discussed in Chapter 10.

11.8.1 The nature of evaluation

Within the context of business analysis, evaluation can be defined as the attempt to assess the success or failure of some domain of sociotechnical organisation and the associated process by which it is developed and implemented.

Systematic evaluation within business analysis is important for a number of reasons. First, since business analysis is likely to be a finite resource, we need some way to assess and prioritise investment in doing business analysis. Second, since business analysis is likely to be a significant investment, we need some way to control the costs of doing business analysis. Third, we need to make sure that we have made a wise investment in doing business analysis – that the results expected in engaging in a project in business analysis actually materialise in practice. Hence we need ways of determining the value arising from changes made to business organisation. Fourth and finally, we need to learn lessons from the conduct of business analysis itself. Systematic evaluation is likely to suggest strategies for the better management and execution of future exercises in business analysis. Hence evaluation is important not only as an exercise in professional learning but also in organisational learning.

Figure 11.12 makes a distinction between four types of evaluation activity appropriate in relation to business analysis, which we call strategic evaluation, formative evaluation, summative evaluation and post-mortem evaluation. These types of business analysis evaluation take place at various points within business analysis projects: during the conception phase of business analysis, while we are analysing, designing, constructing and implementing a new domain of organisation, after a new form of sociotechnical organisation has been in operation for a period of time, or when a particular business analysis project has failed.

Strategic evaluation
The evaluation of the strategic benefit of some information system.

11.8.2 Strategic evaluation

Most organisations conduct some form of **strategic evaluation** of projects that aim to change sociotechnical organisation. This type of evaluation involves assessing or

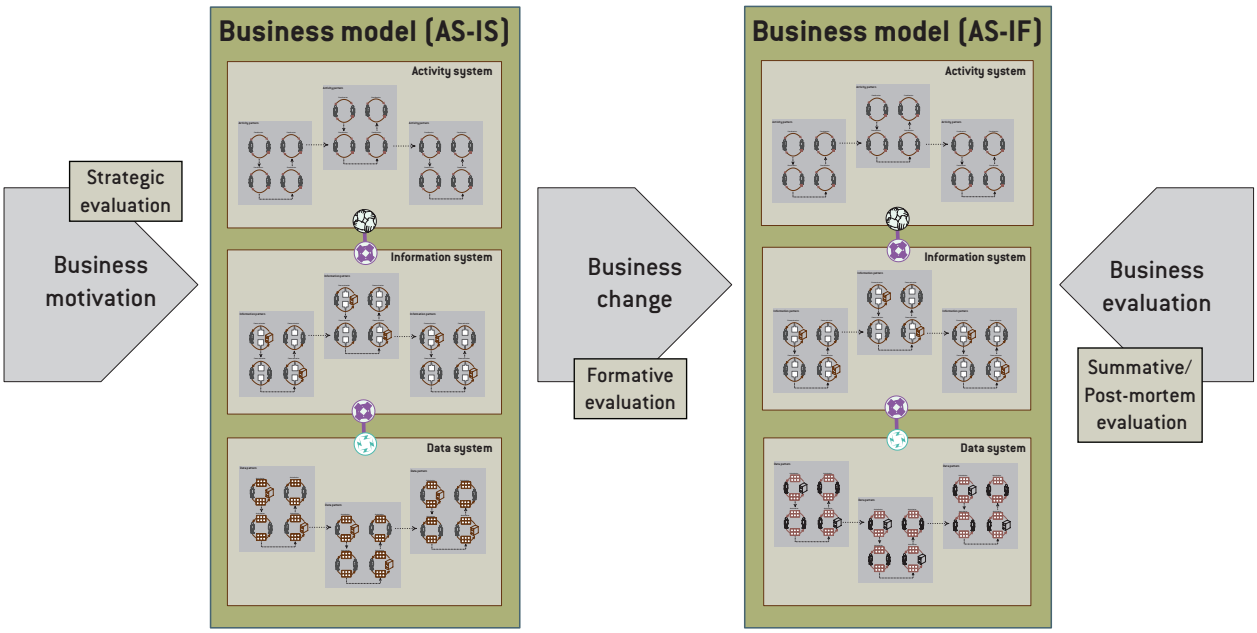


Figure 11.12 Types of business evaluation

appraising an investment in sociotechnical change. This is usually achieved by assessing the balance of costs and benefits of an intended project. In terms of any one project such an assessment will be used to go ahead with the work or to abandon the idea. Assessments of this nature may also be used to prioritise among a number of potential investments in business analysis.

The costs of a business analysis project consist of the value an organisation has to expend in doing a concerted piece of business analysis work. It is actually useful to make a distinction between two types of costs associated with business analysis projects: tangible or visible costs and intangible or invisible costs.

Tangible costs are frequently referred to as visible costs because they are reasonably straightforward to measure and to express in monetary terms. Intangible costs are frequently referred to as invisible costs because most organisations experience difficulty in assigning actual measurable quantities to such costs.

REFLECT

Try to classify each of the following costs associated with a new business model as either tangible or intangible:

- Salary costs
- Software costs
- Training costs
- Costs of staff turnover
- Security costs

The benefits associated with a business analysis project concern the value that the organisation gains from an exercise in business analysis. This normally consists of the benefits of having a new business model in operation. Again, we may distinguish between tangible and intangible benefits. As we have seen, a new business model is frequently introduced with the objective of gaining tangible benefits, such as reducing staff count or increasing productivity. In performance terms then, tangible benefits are generally associated with issues of organisational efficiency.

More recently, people have started to argue that intangible benefits gained from new business models, such as increasing customer satisfaction or building better links with suppliers, have equal relevance in investment decisions. In performance terms, intangible benefits are more generally concerned with the efficacy of some domain of organisation or with organisational effectiveness.

REFLECT

Try to classify each of the following benefits associated with a new business model as either tangible or intangible:

- Increased quality of service
- Greater job satisfaction
- Greater communication between employees
- Reduction in staffing
- Lowering the costs of production

Cost-benefit analysis
Cost-benefit analysis is critical to assessing whether or not the process of developing an IS (information system) is a worthwhile investment.

We then have to have some coherent way of assessing the balance of costs and benefits in any one particular case. **Cost-benefit analysis** is critical to assessing whether or not the process of developing a new business model is a worthwhile investment.

Most of the established techniques for evaluating information system investments focus on tangible costs and benefits and thus are directed primarily at assessments of efficiency gain. Two of the most popular are return on investment and payback period.

The return on investment (RoI) associated with a business analysis project is calculated using the following equation:

RoI = average (annual net income/annual investment amount)

Hence to calculate the return on investment of a particular project one must be able to estimate the income accruing from the introduction of a new business model and the cost associated with operating this new business model for a period into the future. The average of this ratio of annual costs to benefits is then taken to indicate the value of the new business model to the organisation.

The idea of payback period is typically used in an assessment of RoI. Payback period assumes that one is able to estimate the benefit of the introduction of a new business model for a number of years ahead. Benefit is measured in terms of the amount of cash inflow resulting from the new business model. Payback is then calculated on the basis of:

Payback = Investment – cumulative benefit (cash inflow)

The payback period is equal to the number of months or years for this payback figure to reach zero. Clearly the assumption here is that those systems that accrue financial benefits the quickest are the most successful.

11.8.3 Formative evaluation

Formative evaluation
Assessing the shape of an information system within the development process itself.

Formative evaluation involves assessing the shape of a business model within the process of business change itself. This form of assessment is clearly an inherent part of the process of any good project management. To control projects managers continually need to evaluate achievement against objectives. If divergence is evident between these two things then some form of corrective action needs to be taken. In iterative approaches to the development of some business model, formative evaluation can be

used to make crucial changes to the design of a model of sociotechnical organisation. In more linear approaches a project may be reconfigured or more resource may be deployed.

But formative evaluation is also critical to spotting potential dangers in any project, which some refer to as project escalation. Project escalation involves situations in which there is a continued commitment to a project in the face of continual negative assessments, perhaps coming from exercises in formative evaluation. This is a form of paralysis in decision-making evident in many large projects. The stake invested in the success of a project by its stakeholders can be as much a problem as a catalyst for change. Major stakeholders might be reluctant to withdraw support when it would be reasonable to do so. This is because a heavy investment in personnel and other resources would be lost if a project was terminated.

11.8.4 Summative evaluation

In very broad terms, assessments of worth focus on considerations of the success or failure of some business model and associated domain of organisation. But how do we judge the success or failure of an instance of sociotechnical organisation?

Summative evaluation
Assessing a delivered information system against its strategic evaluation.

Even if a project of business change reaches completion, it might fail in some sense when it is delivered. Therefore, at a suitable time after delivery the organisation should engage in a **summative evaluation** of the new business model. This is sometimes called post-implementation evaluation. Ideally, summative evaluation involves returning to the tangible costs and benefits established in strategic evaluation after a period of use. Evaluation is really a specialised form of the analysis process previously discussed in Chapter 9. This means that any summative analysis is likely to involve the use of various investigation techniques (Chapter 5) to determine actual costs and benefits incurred with the introduction of a new form of organisation.

But intangible costs and benefits may also need to be assessed in some manner, such as levels of stakeholder satisfaction with the new business model. The issue of satisfaction with something typically has a heavy emotional component. It is therefore not surprising that assessments of this form typically attempt to tap into the investigation of emotional communication as hinted at in an earlier chapter. For instance, marketing people now frequently use facial expressions to evaluate satisfaction with business communication. Subjects are asked to rank the emotional content of particular advertisements in terms of the six standard facial expressions discussed in Chapter 2. This approach is clearly adaptable to assessing satisfaction with new patterns of introduced action.

Summative evaluation might also be achieved through a 'lessons learned' meeting or workshop, which is typically called to compile and to document what has been learned from some project. Participants are asked to be open and to avoid assigning blame. They are then asked to list the successes associated with a project as well as any failures. They are also asked to make recommendations for improving future projects of business analysis.

It must be emphasised that no domain of organisation is ever complete. A summative evaluation is likely to suggest a number of ways in which it could be modified or extended. Hence evaluation is likely to act as the stimulus to further projects in business analysis.

11.8.5 Post-mortem evaluation

If a project of business change is abandoned prior to implementation or after a period of use, then a variant of summative evaluation needs to be performed on the project not

Post-mortem evaluation
Examining the reasons for some information systems failure.

only to determine the reasons for failure, but to consider and suggest changes to organisational practice. This is known as **post-mortem evaluation**.

It is important to recognise that success or failure is relative. This is because assessments of failure and success are frequently intersubjective, not objective concepts. In other words, their definition depends on the position and perspective of the definer. This is because a particular new form of sociotechnical organisation may meet the expectations of certain stakeholders but fall below the expectations set by others. This underlines the importance of conducting an effective stakeholder analysis early on in a business analysis project. Stakeholders need not only to be defined before a project starts in earnest, their expectations and desires will help direct assessments of worth later.

The results from any post-mortem analysis are important for suggesting ways in which the organisation might improve its practice. Thus the report of this analysis needs to be disseminated to senior management, project management and members of the project team. As mentioned in terms of a lessons learned meeting, to ensure that this is done effectively, it is important to assure all project participants that there will be no recriminations. Ideally, the analysis should be conducted by a reputable senior executive not involved in any way with the project. Alternatively, it should be undertaken by an external body or consultant.

REFLECT

Many organisations choose to bury their failures rather than analyse them. Try to jot down some reasons why this might be the case. What might be done to persuade managers of the importance of summative evaluation?

11.9 CONCLUSION

The notion of the organisation as a complex and adaptive system is inherently one which accommodates change. Organising is a continuous accomplishment performed by actors which continually produces and reproduces organisation. This means that change is an inherent part of what organisation means and business organisations must continually innovate to remain viable. Therefore, this book is all about innovation and, in particular, digital innovation – innovating with or through ICT.

Strategy and innovation tend to be discussed in relation to planned change and are clearly related. Strategy is about deciding what change is necessary and what steps will be taken to achieve such change. But change is normally conducted in order to innovate – to make a difference. This helps us relate together issues of both digital innovation and digital strategy through the mediating concept of a digital business model.

To help develop strategy and innovate successfully the concept of a business model is important and can be used in a number of different ways. First, we can analyse some existing domain of organisation and build a business model which expresses how things work currently – this we referred to as an *as-is* business model. Second, we can express a business model as a design: as how we would like things to be – as an *as-if* model. Because of the nature of organisation as a system there is potentially a large range of as-if business models for any one as-is business model. Each of these as-if models may be able to achieve the same purpose, but clearly in different ways. Clearly, to enact change, one of these as-if models must be chosen as a *to-be* model. This then becomes a business model that can be implemented in practice. This means that the concept of a business model also allows us to distinguish between business motivation

and business strategy. Business motivation involves the need to document explicit reasons for changing an existing (as-is) business model. Business strategy involves optimising the selection among as-if models and specifying courses of action to implement a new (to-be) business model for the chosen domain.

Digital business models clearly are important for establishing the digital infrastructure for some organisation. In the next chapter we consider a number of issues associated with operating and managing such infrastructure.

11.10 REVIEW TEST

11.1 Business strategy is …

Select all the statements that apply by placing an X in the box.

- ☐ … some assessment of the goal(s) of the business
- ☐ … an appreciation of how well the internal value chain achieves goals
- ☐ … some assessment of the sustainability of the business within its wider value network
- ☐ … the tactics relevant to some area
- ☐ … a decision about what a business seeks to enter

4 marks

11.2 A business model is …

Select the one most appropriate statement by placing an X in the box.

- ☐ … the motivation for change
- ☐ … the value proposition of some business
- ☐ … a way of expressing the core 'design' for some value-creating system

1 mark

11.3 An as-if business model is …

Select the one most appropriate statement by placing an X in the box.

- ☐ … a design for some future system of action
- ☐ … a design for some current system of action
- ☐ … a design for some past system of action

1 mark

11.4 A motivation model documents the reasons for changing some system of action.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

11.5 A to-be business model documents some current system of action.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

11.6 A documented business model has the potential to be reused in some other domain.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

11.11 EXERCISES

- What comprises the business model of the emergency ambulance service?
- Porter thinks of business strategy as attempts at differentiation, location or cost advantage. Choose one high-profile company and see if you can determine how ICT infrastructure may affect each of these strategies for the business.
- Find the mission statement of one large company on its website. Try to unpack this in terms of the notion of ends discussed in this chapter.
- As a digital innovation describe whether the national identity card project failed for technological or social reasons and detail why.
- ICT has a major role to play in reducing coordination costs for companies. Determine how the issue of a coordination cost fits with the idea of strategy.
- In terms of strategic, summative and formative evaluation, what are we evaluating: usability, functionality or utility?
- Provide an example of strategic, formative and summative evaluation.
- Try to estimate the percentage of projects in an organisation known to you that are regarded as successes. What percentage are regarded as failures? What are seen as the major reasons for failure? What are seen to be the major features of success?

11.12 PROJECTS

- Investigate how the term 'business model' is used in business literature. Develop a list of common features assigned to the term.
- The way we have approached the concept in this chapter the idea of a business model is as equally relevant to the voluntary or public sector organisation as it is to the private sector organisation. Determine the business model of a voluntary sector organisation such as Citizens Advice or a public sector organisation such as GCHQ.
- Visit the website of a large global company of your choice. See if you can determine how the company's general business strategy is aligned with its digital strategy.
- Consider one particular organisation and its desire for change. Can its motivation for change be expressed conveniently in terms of ends and means analysis proposed in this chapter?
- Have a close look at some ongoing digital innovation being undertaken in some market sector such as online grocery. Try to develop an account of the differences between at least two different business models for the digital innovation.
- Consider a university known to you, perhaps the one you are currently attending. Investigate whether it has an explicit documentation of its strategy. If not, try to determine this from the publicly available literature such as its annual report. Is there any suggestion of digital strategy expressed and if not what might this be?

11.13 FURTHER READING

The paper by Baden-Fuller and Haefliger (2013) establishes some of the parameters for what a business model is and is not. The paper by Beynon-Davies (2017) expresses the solid background for the idea of a digital business model expressed in this chapter. The whole area of business strategy was really set by the works of Porter (e.g., 1985, 2001). Hammer (1990) was the first to coin the phrase reengineering in relation to business model transformation. My national identity card article (Beynon-Davies, 2011) reviews the notion of ICT failure while Beynon-Davies et al. (2004) provides more detail on the various forms of information systems evaluation.

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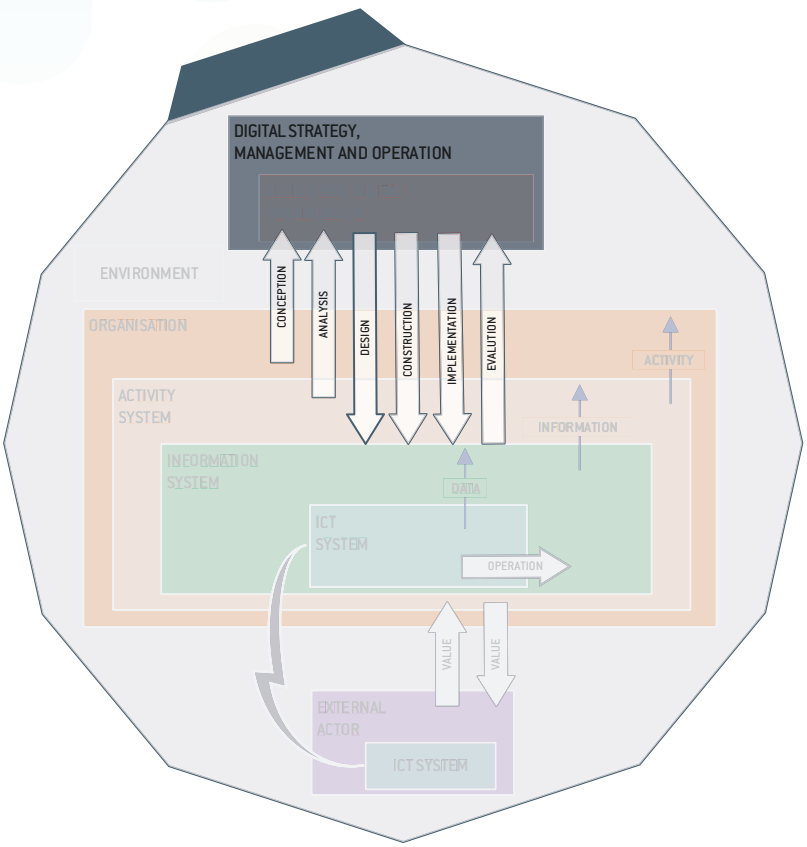
12 DEVELOPING, MANAGING AND OPERATING DIGITAL INFRASTRUCTURE

> **'Tis hard to fight with anger, but the prudent man keeps it under control.'**
> – Democritus (460–370 BC)

LEARNING OUTCOMES	PRINCIPLES
Understand the structure of the ICT industry.	The ICT industry is made up of providers and consumers of ICT.
Explain the organisation of the ICT service.	In most organisations information systems and ICT are a critical strategic service supplied to the organisation in support of other activity.
Describe information systems development as one of the important activities of the ICT service.	Information systems development is one of the key organisational activity systems within modern-day organisations, involving a number of activities arranged in a life cycle.
Outline the key activities involved in operating ICT infrastructure.	Operating ICT infrastructure involves activity systems such as service strategy, service support, service improvement and service delivery.
Understand the rationale and practices of green ICT.	Green ICT is a collection of initiatives which aim to directly reduce the carbon footprint of some organisation.

CHAPTER OUTLINE

12.1 Introduction
12.2 The ICT industry
12.3 The ICT infrastructure service
12.4 Information systems development
12.5 ICT governance
12.6 Operating ICT infrastructure
12.7 Green ICT
12.8 Conclusion
12.9 Review test
12.10 Exercises
12.11 Projects
12.12 Further reading
12.13 Bibliography



12.1 INTRODUCTION

As we have established in previous chapters, in organisational terms a service is the activity equivalent of a good. It typically involves an activity performed by the actors of some organisation for an external actor such as a customer (see Chapter 7). The vocabulary of servers and services is familiar in the ICT infrastructure of organisations. Service-oriented architecture, for instance, is seen as a means of improving the interoperability of systems (Chapter 5). This chapter considers the term *services* in another light: the ways in which information systems and ICT as an organisational function is delivered as a service, or more accurately, as a collection of services.

Since ICT is embedded within and throughout modern organisational life as well as in the wider environment, not surprisingly ICT is a vast industry of both producers and consumers, which forms an important part of the service sector in an economy. In consuming organisations there is normally a function charged with developing, maintaining and operating the ICT infrastructure in support of information systems, which we shall refer to for convenience as the ICT service. One of the most critical of the services supplied by this function is the development of new information systems for the organisation.

Technology has enabled organisations to transform such a service as it has transformed other organisational functions. The outsourcing of various aspects of ICT infrastructure, and how to manage this effectively, are therefore critical issues for modern organisations.

Finally, we consider the way in which ICT can be managed and operated sustainably. This is sometimes referred to as green ICT.

12.2 THE ICT INDUSTRY

Information systems and their associated technologies are essential for the effective working of modern economies, societies and polities (Chapter 6). Therefore, not surprisingly, a vast industry has developed worldwide to service the data and information needs of organisations, groups and individuals. Many people are now employed in industries in which data is the fundamental value created (Chapter 7), and these are heavily reliant on efficient and effective ICT systems and associated information systems.

The ICT industry is primarily part of the service sector of the economy. One of the notable facets of the change in employment patterns in many countries over the last 70 years has been the rise in the service sector. The most rapid growth in employment has been in office-based private services such as financial, business and professional services.

Information technologists work either for a producer of information systems and ICT, or for an established user of information systems and technology (what we might call informatics consumers). Providers produce elements of information systems and consumers use them for organisational purposes.

12.2.1 Providers

Provider of ICT
A producer of hardware, software or communication technology.

Providers of ICT can be divided into:

- Hardware providers, organisations that produce computing devices, input devices, output devices, storage devices and communication devices. Representative organisations are Dell, Intel and Apple.
- Software providers, organisations that produce software such as office software and enterprise software. Representative organisations are Oracle and Microsoft.

- Application providers, a special type of software provider offering integrated package solutions to ICT infrastructure problems. A representative company is SAP AG.
- Communication infrastructure providers, companies that build, maintain and support the physical telecommunication infrastructure of organisations, regions and countries. Representative companies are BT (British Telecom) and Deutsche Telefon.
- Internet service providers, companies that provide access to the Internet for individuals, groups and organisations. Representative companies are America Online (AOL) and BTInternet.
- While application providers provide software applications for purchase by companies, application service providers are companies that operate and maintain aspects of an organisation's ICT infrastructure through the provision of applications as services. They are similar to what used to be known as service bureaux. A representative company is Storagetek (Oracle).
- ICT consultancies, companies that provide ICT services particularly in the areas of business analysis, business design and ICT implementation. A representative company is PricewaterhouseCoopers.
- Outsourcing vendors, companies that offer ICT outsourcing solutions either in whole or in part to companies. Representative companies are HP Enterprise Services (previously EDS) and CapGemini.

REFLECT

How much of a typical Western economy do you think the ICT industry makes up? How much does it contribute to the gross domestic product?

12.2.2 Consumers

Consumer of ICT
A consumer of some aspect of ICT infrastructure such as hardware or software.

There are ICT consumers in almost all industrial sectors, such as manufacturing, agriculture, process industries such as petrochemicals, transport, financial services, retail, and local and central government. Some sectors are much more advanced in ICT use than others. For instance, the financial services sector continues to invest heavily in ICT, but the agriculture sector is relatively much less of an investor.

ICT consumers can also be divided into large, medium, small and micro enterprises. Within the European Union there has been a focus on small- and medium-sized enterprises (SMEs), companies with less than 250 employees. They are seen as the major seedbed for innovation in industrial economies. There have been several major initiatives to stimulate their adoption of ICT, as well as digital innovation.

12.2.3 Careers in ICT

ICT professionals work for either ICT providers or ICT consumers, and have become an increasing part of the workforce of developed countries. This is clearly an indicator of the growth in the digital society (Chapter 6).

ICT is an area of industrial practice that is subject to rapid change. Recruitment patterns tend to be driven by requirements for short-term technological skills, such as the ability to program in a certain programming language, rather than longer term transferable skills such as the ability to design effective and efficient programs. This has made it difficult to establish coherent and consistent career patterns across the industry.

Professional bodies such as the British Computer Society (BCS) have attempted to address some of these difficulties. For instance, the BCS developed an industry structure model in the late 1980s which tried to specify career paths for ICT professionals – classifying hundreds of roles into broad functional areas such as management, development, and maintenance and service delivery. This was remapped into the skills framework for the information age (SFIA). SFIA maps competencies in two dimensions – skills and seniority. The latest framework maps 86 specific skills and 290 tasks across various levels of autonomy, accountability and responsibility from unskilled entry through experienced practitioner to senior manager/director/consultant. Not all functions are performed across all levels of responsibility. Programming as a role, for instance, only involves the lower levels, whereas management involves the higher levels.

Because ICT is now central to most organisations, the demand for skilled ICT staff has remained steady, and in some sectors has grown significantly over the last decade, fuelled by growth in digital business in the private, public and voluntary sectors. Because there is a shortage of skilled ICT professionals in many countries, certain economies have looked to other countries worldwide to supply workers. Many US companies, for instance, have outsourced ICT activities such as the development and maintenance of ICT systems to the Indian subcontinent, particularly the Bangalore region. Countries such as the UK have included ICT workers in their list of preferred occupations, so that those who offer these skills get priority in immigration procedures.

REFLECT

There is a gender imbalance in people opting for a career in ICT: more male rather than female students take secondary, tertiary and higher level courses with an ICT component. Why do you think this is, and how would you begin to address this imbalance?

RECAP

The ICT industry is made up of providers and consumers of ICT. Providers produce elements of information systems using ICT, and consumers use them for organisational purposes. ICT is an area of industrial practice that is subject to rapid change and has experienced difficulties in terms of professionalisation and providing clear career structures.

12.3 THE ICT INFRASTRUCTURE SERVICE

ICT infrastructure service
That organisational function devoted to the delivery of ICT services.

As 'consumers' in the ICT industry, most medium- to large-scale organisations have people specifically employed in ICT infrastructure work. This section considers several important issues relating to the organisation of business units that do this work. Some organisations called this the ICT or IS (information system) department, or the DP (data processing) department. This chapter refers to it generically as the **ICT infrastructure service**, to emphasise that in most organisations information systems and ICT are a critical strategic service supplied to the organisation in support of other activity.

12.3.1 The structure of the ICT service

Some organisations, particularly small organisations, do not have a specific section or department specialising in ICT, but there is a specialist function in most medium- to large-scale organisations, in both the private and public sectors. It can be structured in several different ways. This section discusses its structuring by division of labour and location.

Division of labour refers to the way in which various jobs or roles are defined and structured in the ICT service. It used to involve rigid job specifications based around a hierarchy of control. Over the last 20 years or so pressures for change have caused the gradual fragmentation of this structure, and newer, more flexible structures for the ICT service have emerged.

Figure 12.1 shows the old structure, which derived from the day-to-day demands of building and running ICT on large, centralised mainframes. It had a hierarchy of clearly delineated jobs. At the bottom were operating staff, tasked with maintaining the operation of the centralised mainframe and the systems that ran on it. Next came programmers, organised typically into groups such as maintenance programmers and development programmers. Development programmers built new applications, while maintenance programmers repaired and extended existing applications. Systems analysts were the next rung in the hierarchy. These were professionals primarily involved in the analysis and design of information systems, who made contact with business users. Many organisations segmented staff further into project teams of analysts, programmers and sometimes operators, each headed by a project manager. The head of department was often called the data processing (DP) manager. In a large organisation there were frequently a number of middle-level managers such as operations managers, development managers and maintenance managers, each coordinating a particular aspect of informatics work.

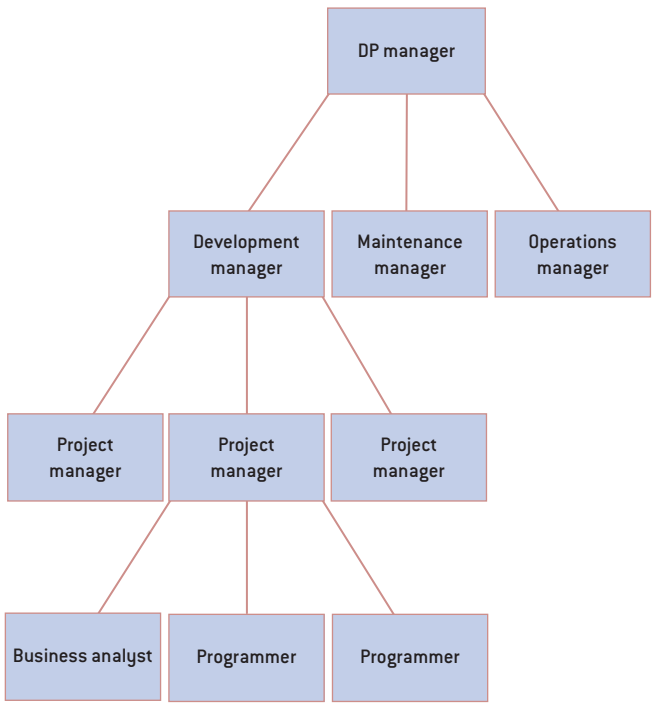


Figure 12.1 Traditional structure of the ICT service

The technical changes in the 1970s and 1980s which led to changes in this structure accelerated during the 1990s.

Desktop computers came to be used more and more, which meant that computing power could be sited wherever it was required. Desktop packages such as word-processing software and spreadsheets were specifically written for end users rather than ICT professionals, so they gained much more experience of computing and became

much more confident in expressing their requirements, sometimes even building applications themselves.

The developing use of databases meant that organisations began to plan for and manage data at the corporate level. Organisations saw key added value from integrating information systems across sectors.

More and cheaper processing power and storage capacity meant that these resources no longer needed to be centralised. Processing and storage could be distributed around the organisation on diverse sets of hardware platforms and diverse software-enabled applications to cooperate across local and wide area networks.

In response to these pressures and others, the ICT service recast itself in different forms. One was the information centre, a body of expertise whose role was to service other departments, which handled a large proportion of their ICT work themselves. So, unlike the traditional ICT department, the information centre no longer had a monopoly over organisational ICT.

This in turn led to a greater diversification of ICT staff. Roles such as hybrid managers, analysts/programmers, database administrators, data analysts, business analysts and systems integrators took shape. One particularly notable trend was the growth in support or operations staff – staff tasked not directly with developing new information systems, but with installing and integrating existing ICT, operating corporate information systems and helping end users in the use of technology and systems.

In recent years the increasing importance of the ICT infrastructure to organisations, coupled with its increasing complexity, has led to changes in the conception of the ICT service. Over the last decade particularly, service management practices have been applied to ICT. In this philosophy the informatics service is seen as a strategic business partner rather than a purely technology function.

Wedded to this change, organisations started to create a senior management role with responsibility for digital infrastructure, often designated the chief information officer (CIO), following the US terminology of chief executive officer (CEO). Because of the importance of ICT to organisational performance, and the need to integrate digital strategy with business strategy (see Chapter 10), many have argued that the CIO should be a main board member.

12.3.2 The location of the ICT service

The rise of new organisational forms such as the information centre is partly the result of an increased number of options for the location of the ICT service.

A centralised service is the traditional model in which informatics provides one service with single access. The ICT service is located in one large office, with all other organisational units relying on it for their ICT provision.

In a decentralised model the ICT service is structured around a number of smaller units, each providing single access. Under this model the ICT service still forms a logical whole, but the various functions it provides, such as planning, management, development, maintenance and operations, are segmented off into separate organisational units.

Within a distributed model the ICT service is made up of a set of connected functions, each providing multiple services. This is because in large-scale organisations such as multinationals it may prove impossible to provide any one function on a centralised basis. Each country might have its own ICT services function, providing all the activities to their national units.

A devolved model also has a distributed framework, but each informatics unit is not independent. Instead, the ICT service is made up of a matrix of units each sited close to the point of need and falling under direct business unit control.

Because many organisations were not satisfied with the ICT service provided in any of these ways, many have recently pursued an outsourcing strategy. Here, the ICT service is provided in whole or in part by external contractors.

Each of these forms of location has advantages and disadvantages, which can be illustrated by comparing a centralised and a decentralised service.

The advantages of a centralised ICT service revolve around the issue of control. Fundamentally, centralisation makes it possible to exercise greater control over the management and operation of ICT resources. For instance, recruiting and maintaining ICT skills becomes easier, and there can be economies of scale in procuring hardware and software. Duplication of effort is more easily avoided and greater standardisation and compatibility of systems can be achieved. Overall, speedier and more consistent strategic decision-making is possible, particularly for issues such as integration of systems and the development of large infrastructure projects.

Disadvantages tend to centre on the fact that a centralised ICT service is more likely to be divorced from the 'coalface' of the business. It can prove less able to adapt quickly to changes in the business environment and technology. Business units sometimes become dissatisfied with the level of personal attention they are given and the speed of response to their needs. Some diseconomies may also be evident such as high backup costs.

12.3.3 Activity systems of the ICT service

Depending on the size of the function, the ICT service may engage in a vast range of activities. Essentially, however, actors within every ICT service undertake six major roles (Figure 12.2):

- ICT infrastructure planning
- ICT infrastructure management
- Project management
- ICT systems development
- ICT systems maintenance
- ICT infrastructure operations

Planning involves formulating strategy for information, information systems and ICT infrastructure in an organisation. Digital strategy must include plans for changing aspects of the ICT systems infrastructure, so it produces a portfolio of system development work.

Management involves both implementing plans for future infrastructure and controlling existing ICT infrastructure. As such it involves continual evaluation of the investment in information systems, and monitoring the success of development, maintenance and operations projects as well as the service itself. Other management roles are recruiting and organising ICT personnel, and maintaining staff development programmes.

Concrete work in ICT is likely to be organised as projects of development, maintenance or operations activity, so effective project management is a critical aspect of the ICT service. Development is the activity of constructing and delivering new application systems: analysing, designing, producing, testing and implementing them. Maintenance is the activity devoted to fine-tuning aspects of the ICT infrastructure to make sure it works effectively. Operations is an area of the ICT service that runs and supports the use of information systems throughout the organisation.

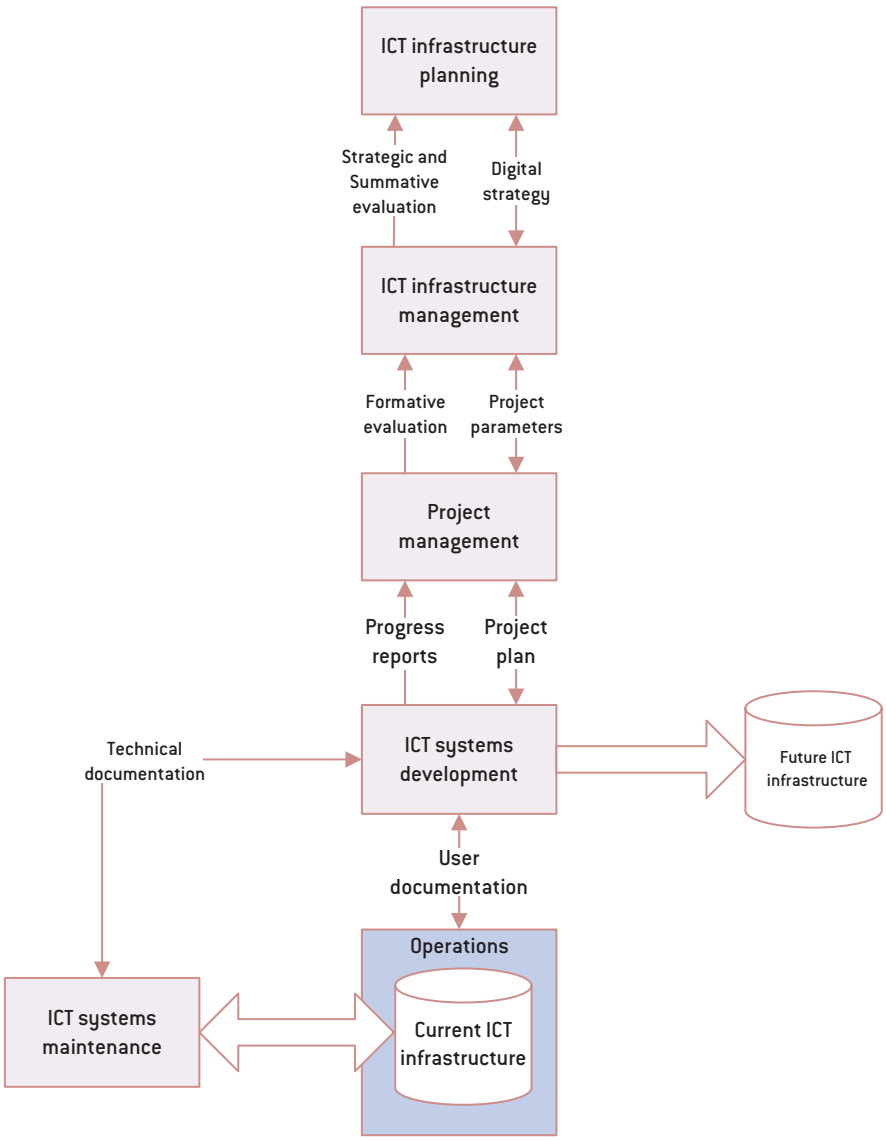


Figure 12.2 Key activity systems of the ICT service

12.3.4 Strategy of the ICT service

An important part of any digital strategy is a strategy for the ICT service itself. This will consider issues such as the size and location of the service and which activities to outsource or maintain in-house.

Each of the different possibilities for the structure of the informatics service discussed in previous sections reflects historical features of the environment of commercial computing. In their global, historical study of the commercial information systems industry, Friedman and Cornford identified three phases in the history of commercial computing which the authors projected up to the late 1990s. Each phase is dominated by a different set of constraints and so determining a different strategy for the informatics service.

The period up to the mid-1960s was subject to hardware constraints: high hardware costs and limitations in the capacity and reliability of equipment dominated commercial computing. Not surprisingly, the shape of the informatics service reflected the need to

maintain large corporate data centres. Much of the strategy for the informatics service in this phase was dominated by a concern with controlling costs and maintaining effective allocation of the limited computing resource.

During the period between the mid-1960s and the mid-1980s hardware costs declined substantially. Therefore, this phase was dominated by software constraints in the sense that the focus was dominated by the productivity of systems developers and difficulties of delivering systems on time and within budget. Here the emphasis shifted from strategies focused around hardware to strategies focused around the need to manage the information systems development process more effectively.

Between the mid-1980s and early 1990s software concerns moved from centre stage with the increasing availability of packaged software. This phase became dominated by user relations constraints focused around system quality problems. It was argued that many informatics services had an inadequate perception of user demands and were inadequate in servicing user needs. In this phase the information centre was born as a way of attempting to satisfy concerns over the benefit the informatics service was providing to companies.

Since the early 1990s commercial computing has entered a fourth phase dominated by organisational and environmental constraints. The particular focus of this phase is the search for ways in which information systems and ICT can improve the position of the organisation in its environment. Some have argued that a key emphasis of this phase, which still continues, is the need for close alignment of business with informatics strategy. As we argued in Chapter 11, in many organisations business strategy is being subsumed within digital strategy.

12.3.5 Funding the ICT service

Since ICT is normally a service function, a crucial feature of any strategy for the ICT service is a clear specification of how it is funded. The options include free service, profit centre, separate company and outsourced arrangements.

Traditionally an internal ICT service was farmed out free of charge to other departments or functions. Each business unit had its budget top-sliced in some way to finance ICT work. In the profit centre model, the ICT service bills other departments for its work using service-level agreements (SLAs), which specify a fixed fee for a specified number of services for a given contract duration. An excess fee is usually negotiated for additional services. This is the philosophy underlying the move to ICT service management, described below.

One step removed from the profit centre is the concept of the ICT service run as a separate company, a subsidiary which contracts its services to the parent company and potentially to external customers as well. Finally, in outsourcing the service, ICT infrastructure is given over either in whole or part to an unrelated specialist company.

12.3.6 Outsourcing the informatics service

Although information systems and ICT are now seen to be central to the performance of most organisations, the ICT service has traditionally experienced great difficulty in quantifying its benefits to the organisation. For this reason, many organisations have decided to outsource their ICT service. Outsourcing is the use of external agents to perform one or more organisational activities. A contract is negotiated with an external supplier, normally in the form of a service-level agreement.

There are a number of types of ICT outsourcing:

- Body shop outsourcing, where contract programmers are brought in to supplement in-house ICT personnel, particularly for development or maintenance work.
- Project outsourcing, where outside vendors are used to develop new ICT systems.
- Support outsourcing, in which vendors are contracted to maintain and support a designated ICT system.
- Hardware outsourcing, where organisations outsource hardware operations, disaster recovery and management of the communication network.
- 'Keys to the kingdom', the most radical form: outsourcing the entire ICT service including development, operation, management and control.

There are a number of claimed benefits for outsourcing. For instance, scale and specialisation enable vendors to deliver the same value for less money than insourcing. More effective control of vendors is also claimed to lead to a better quality of service, and fixed-price contracts and service-level guarantees eliminate uncertainty for the business. Business growth can be accommodated without quantum changes in infrastructure, and scarce and costly ICT talent can be refocused on higher value activity.

During the 1990s, Lacity and Hirschheim (1993) conducted a major research of ICT outsourcing strategies in the United States. Their results questioned many of these benefits and in particular three dominant assumptions:

- Organisations initiate outsourcing for reasons of efficiency. The researchers argued that organisations may initiate outsourcing for a variety of other reasons, such as to acquire or justify additional resources, to react to positive media reports of outsourcing, to reduce personal risk to management associated with uncertainty and to enhance the personal credibility of CIOs.
- An outsourcing vendor is inherently more efficient than an internal ICT service through economies of scale. They found that an internal informatics service can frequently supply a service as efficiently as an external vendor.
- Vendors are partners. If a company decides to outsource, the contract is the only mechanism to ensure that expectations are realised, so 'partnership' in this area needs to be heavily controlled.

These assumptions were later revisited by Lacity and Wilcocks (2008).

RECAP

In most organisations information systems and ICT are a critical strategic service supplied to the organisation in support of other activity. Such a service can be structured in several different ways and located centrally, decentrally or outsourced in various ways to external suppliers. The key activities of such a service include ICT infrastructure management, project management, ICT systems development, ICT systems maintenance and ICT infrastructure operations.

12.4 INFORMATION SYSTEMS DEVELOPMENT

Information systems development
That activity system devoted to the creation of a new information system or the maintenance of an existing information system.

Many in the practical world of information systems lament the death of the term *programmer* and its replacement with what is thought the poorer and vaguer term, *developer*. In a sense they are right. Developer is much less specific than programmer, and deliberately so. This is because modern development as an activity is much larger than simply programming. Indeed, much of the activity of modern **information systems development** in organisations does not produce any traditional program code whatsoever.

This section considers the issue of development, a term which has traditionally been associated solely with the building of ICT systems. However, here information systems development is seen as one of the key organisational activity systems for modern-day organisations. This means that, following the definition of an information system as a sociotechnical system (Chapter 4), this activity must necessarily consider the joint development of both ICT (data) systems and activity systems within and between organisations. This is the key point made in both Chapter 10 and Chapter 11.

12.4.1 The activity system of information systems development

Information systems development is the system of action concerned with the design, construction, implementation and maintenance of key aspects of an organisation's information systems and ICT infrastructure. This critical system for modern business is represented in Figure 12.3. The key inputs into the system are ICT resources and developer resources. ICT resources can be hardware and communication technology as well as construction tools or software packages. Developer resources include not only people but also a toolkit of methods, techniques and tools available to the development team.

The key outputs from this process are an ICT system and its associated activity system. Information system is used here as the anchor term for both these constructs. Information systems in themselves are sociotechnical systems since they include both an ICT system and a system of use. Hence ideally the activity system and the ICT system should be designed in parallel (Chapter 10) through an information system. The ICT system might be a bespoke system or a configured/tailored software package.

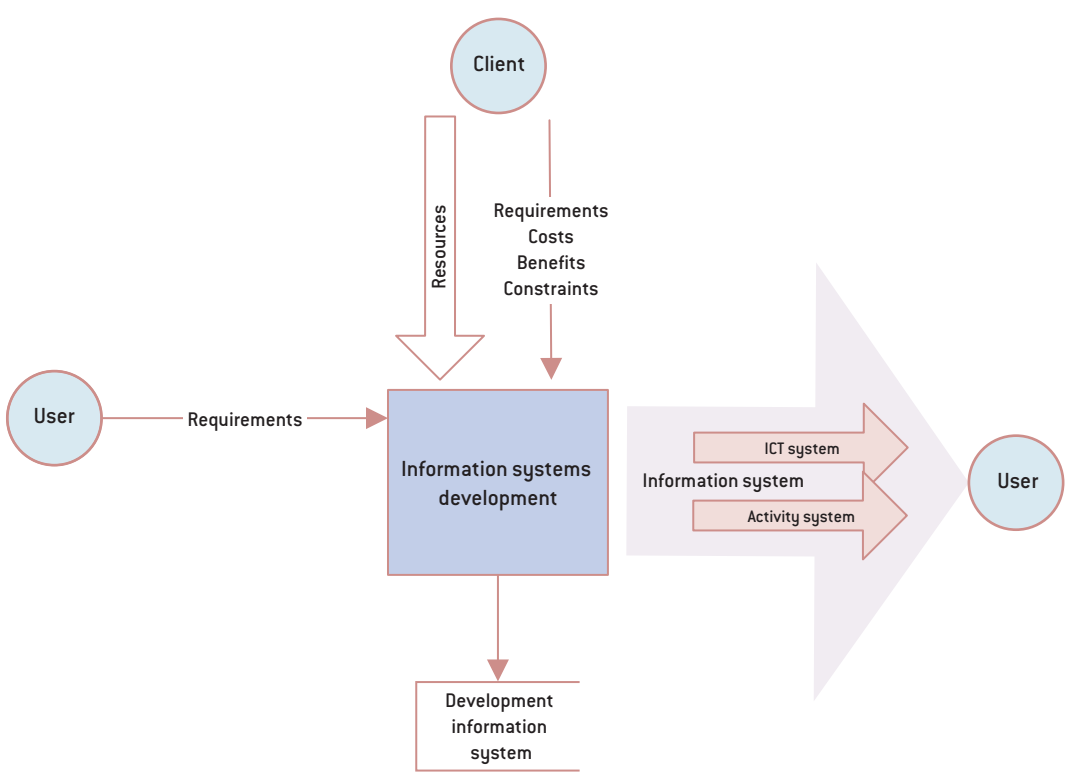


Figure 12.3 The activity system of information systems development

12.4.2 The life cycle of information systems development

The activity system of information systems development involves a series of activities arranged in what is frequently referred to as a life cycle of development (see Figure 12.4). This can be seen to have much similarity as an activity pattern with that considered for business analysis and design in Chapter 11. The activities in a typical information systems development project provide project managers with a blueprint for controlling the project.

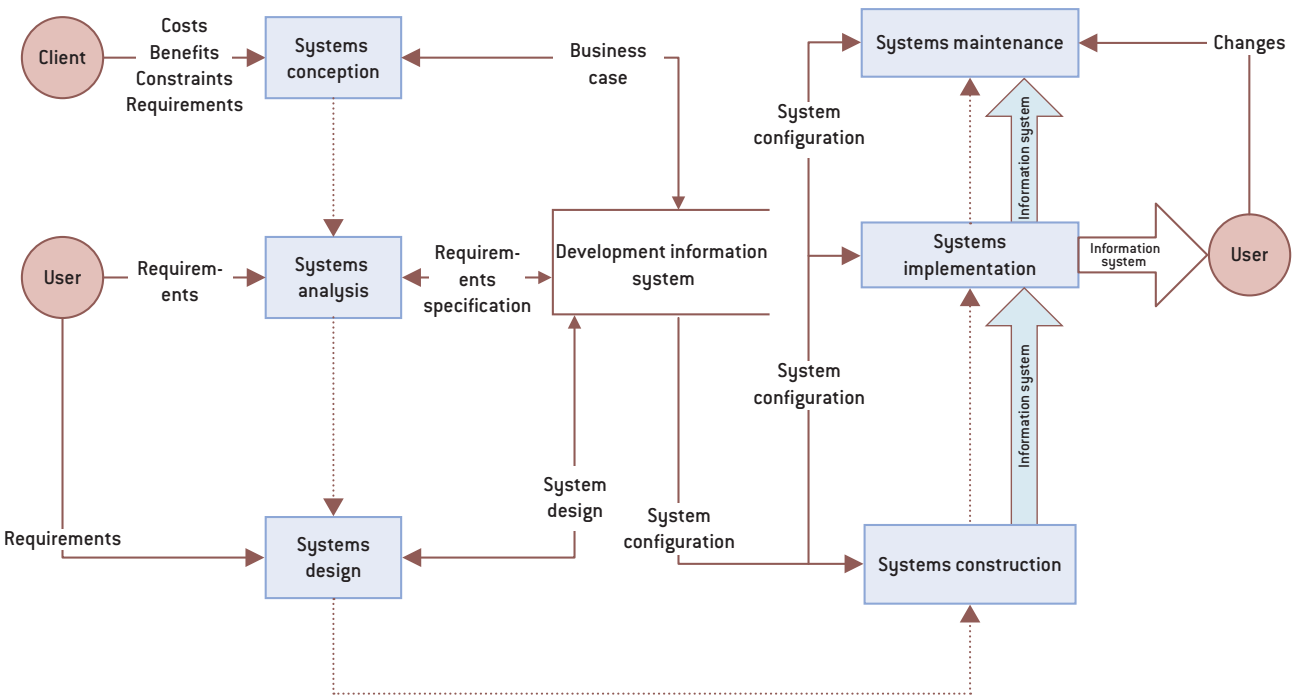


Figure 12.4 The life cycle of information systems development

Conception is the first phase in the development process. In this phase the development team produce the key business case for an information system, an evaluation of the system in strategic terms (see Chapter 11). The team also attempt to estimate the degree of risk associated with the project. Finally, they consider the feasibility of the information system project in terms of organisational resources. A project that passes the strategic evaluation, risk analysis and feasibility tests goes on to a process of systems analysis.

Information systems analysis involves two interrelated activities: elicitation and specification. Requirements elicitation is the process of identifying requirements. Requirements specification is the process of representing them in various ways. Generally, information systems analysis benefits from forms of stakeholder participation, especially in the process of elicitation.

Systems analysis provides the major input into systems design. Design is the process of planning a technical artefact to meet requirements established by analysis, as well as the use context into which it will be placed. It involves consideration of requirements and constraints, and selection from among design alternatives. The sociotechnical design of ICT systems and associated activity systems benefits from the participation of system stakeholders. A design or system specification acts as a blueprint for systems construction.

Construction involves building the information system to its specification. Traditionally, ICT system construction involves the three related processes of programming, testing and documentation. This is done either by an internal team or by an outside or outsourced contractor. Many information systems are now bought in as a package and tailored to organisational requirements. Construction also involves the introduction of new job specifications and procedures associated with the intended use of the ICT system.

The process of systems implementation (sometimes called systems delivery) follows on from systems construction. Systems implementation involves delivering an information system into its context of use. Since an information system is a sociotechnical system, its implementation involves the parallel implementation of both an information system and an associated activity system. Once a system is delivered into its context of use it will be subject to the processes of operation and systems maintenance. Operation is not included in the development life cycle since it is an issue of use and management rather than a direct concern for the development team.

Systems maintenance follows on from systems implementation. Maintenance is the process of making necessary changes to the functionality and/or usability of an information system. Information systems rarely stand still. They may change for a number of reasons. In the process of use, errors might be found or changes proposed. At some point in time a system might be abandoned or need to be reengineered to fit new organisational circumstances. Changes also occur over time in adjustments made to the way both the information system and its context of use work. Maintenance activity may also stimulate suggestions for new systems. Hence it may act as a key input into the process of systems conception and thus provides a form of feedback within the process of information systems development.

12.4.3 Developing an eCommerce website

Suppose a company wishes to set up an eCommerce website. We can map some of the actual activities in the plan for the development of this system against the phases of the development process described above:

- Conception is likely to involve building the business case for the new eCommerce site, registering the domain name for the site, producing a tender document, issuing the tender, reviewing submissions and awarding the contract.
- Analysis involves eliciting key requirements for the site from clients and users and producing key content and presentational requirements for the website.
- Design is the phase of producing key prototypes of content and presentation, considering changes to work practices and reviewing them with users.
- Construction involves registering the site, producing the final content (HTML pages and graphics), programming any integration with back-end systems such as databases, testing the pages individually and as an integrated set, and setting up new organisational structures and processes to ensure that content in the website remains current.
- Implementation consists of producing a marketing campaign to accompany release of the website, and updating stationery, as well as publishing the site on its appropriate server and putting new organisational processes into action.
- Maintenance involves measuring the performance of the site, managing the content on the site over time and reviewing organisational structures and processes where necessary.

12.4.4 Approaches to information systems development

There are a number of distinct approaches to information systems development. This section considers two major dimensions, the type of information system product and the form of sequencing of activities (Figure 12.5).

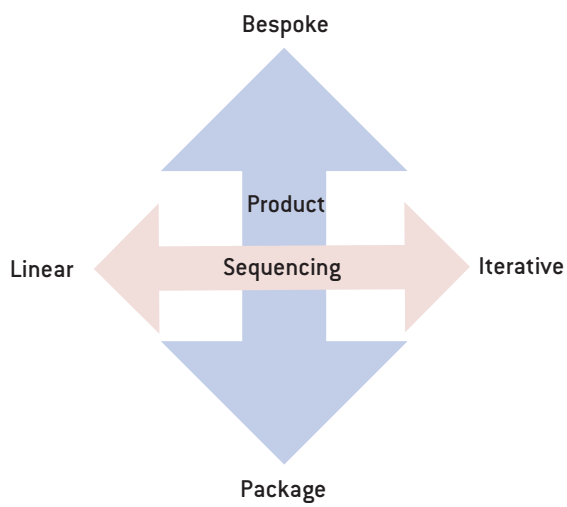


Figure 12.5 Approaches to information systems development

The product dimension contains two main types of development activity: bespoke development and package development.

Bespoke development
The development style in which an organisation produces a new information system to directly match the organisation's requirements.

In **bespoke development** an organisation builds an information system to directly match its requirements. This might involve programming the entire system, or building a system out of pre-established components. Bespoke development normally offers the organisation the opportunity to match closely the design of the information system to organisational processes. The main disadvantage is that the organisation must make a considerable investment in developing the information system. In particular, it has to maintain a suitably skilled internal ICT service or put the work out to tender and manage an external supplier.

Package development
In package development an organisation purchases a piece of software from a vendor organisation and tailors the package to a greater or lesser extent to the demands of a particular organisation.

In **package development** an organisation obtains an existing piece of software and tailors the package to a greater or lesser extent to meet its own demands. The packaged software might either be purchased from a software vendor, run under application service provision or obtained under some form of open source software licensing agreement.

A software package is a software application designed to provide the functionality needed to support activity in a generic business area. It might be customisable to a specific organisation's needs. In package development the usual relationship between system development and organisational processes is reversed. Traditionally, the ICT system is designed to meet the requirements of established or intended organisational activity systems. In package development, generally speaking, organisational activity has to be adapted to the package requirements.

It is not normally feasible for small- to medium-sized organisations to develop bespoke systems because this is so expensive, so they normally obtain a package or hire an external contractor to produce a system. Even for these alternative approaches to development, the key phases above have to be followed. For instance, it is critical that organisations make a business case for the use of a package just as they would if they were proposing to construct the system themselves.

Suppose we are the development team tasked with producing a new research information system for a university. The team has two major choices: it can develop the system itself or it can purchase a package from an external supplier. If it produces the entire information system itself, then it has the opportunity to build the system to match the needs of the university as closely as possible. However, this will take considerable effort and will tie up valuable ICT staff employed by this organisation for a considerable period of time. If it purchases a package, then it may become possible for the system to be up and running relatively quickly. However, it is likely that much time will be spent adapting the activities of the organisation to those demanded by the package.

REFLECT

Reflect on an organisation known to you. How many of the information systems do you think have been developed in a bespoke manner and how many in a package manner?

Linear development
The phases of development are strung out in a linear sequence with outputs from each phase triggering the start of the next phase.

Sequencing is the way the various phases of the development process are organised. There are two broad forms: linear and iterative.

The **linear** model of the development process is shown in Figure 12.6. Here the phases are strung out in order, with outputs from each phase triggering the start of the next phase. In the first three phases the key outputs are forms of system documentation. In the last three phases the outputs are elements of an information system.

The linear model has been particularly popular as a framework for large-scale development projects. This is mainly because a clear linear sequence makes for easier

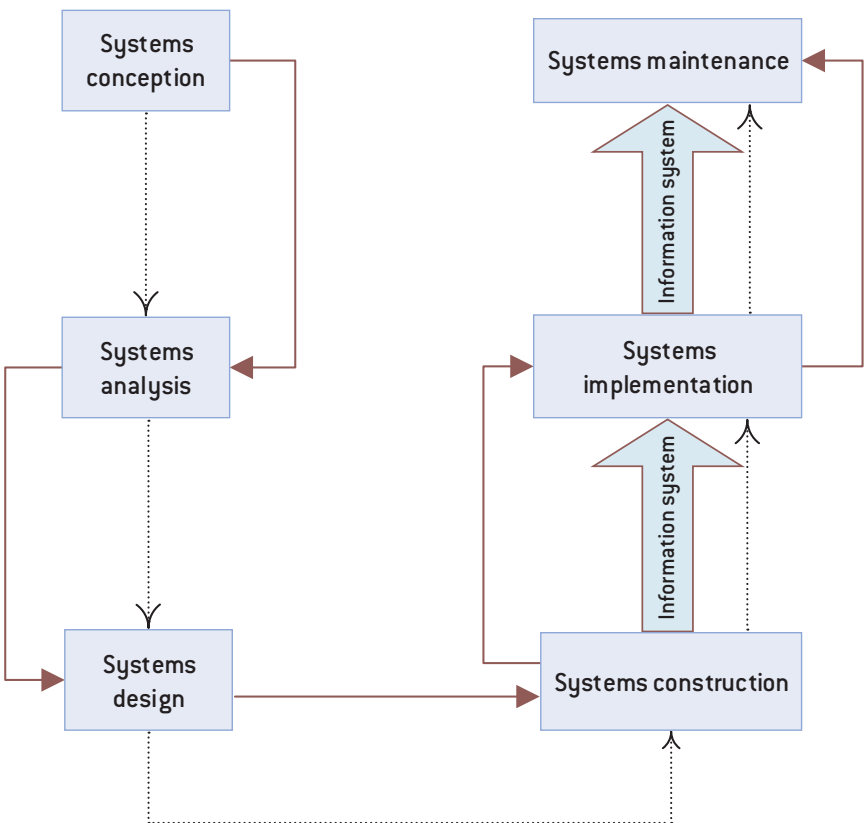


Figure 12.6 The linear model of information systems development

project planning and control. The major disadvantages lie in the difficulties associated with changing early analysis and design decisions late into a project.

The **iterative model of the development** process is illustrated in Figure 12.7. In this model systems conception triggers a cycle in which various versions of a system – known as prototypes – are analysed, designed, constructed and possibly implemented.

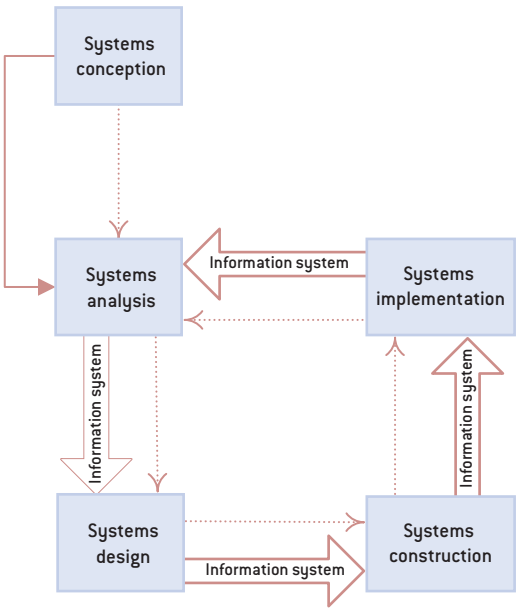


Figure 12.7 The iterative model of development

Iterative development
In this model systems conception triggers an iterative cycle in which various versions of a system (prototypes) are analysed, designed, constructed and possibly implemented.

The **iterative** model has been particularly popular for small- to medium-scale projects. Iteration, the construction of prototypes (prototyping) and significant amounts of user involvement, seems to reduce the risk associated with ICT innovations and generate stronger commitment from stakeholders. However, because it is frequently uncertain in an iterative approach how much resource will need to be devoted to the project, this approach can lead to more difficult project planning and management.

No one approach to development is applicable to all circumstances. Development projects are likely to use a range of approaches depending on development resources, the scale of the project and whether the systems work affects the front-end or back-end ICT infrastructure (Chapter 5). Generally speaking, large-scale, back-end information system projects, which often involve implementing a large corporate data management layer, are likely to use a linear, bespoke model of development. Major modules in an enterprise system are also likely to be tailored using a linear, package approach. In contrast, front-end ICT systems, particularly those that are web-based, are likely to adopt iterative approaches because of the time pressures associated with them, and the high levels of interactivity and hence user involvement required.

DID YOU KNOW?

Companies clearly vary in terms of how much they spend of their revenue on ICT infrastructure. Interestingly, smaller companies appear to spend approximately 7% of their revenue on average, while medium to large companies spend approximately 4%.

REFLECT

Besides those mentioned, what other advantages do you think there might be to using a linear as opposed to an iterative approach to information systems development?

RECAP

Information systems development is seen as one of the key organisational activity systems for modern-day organisations. This activity system involves a number of activities arranged in a life cycle of development. This life cycle may be linear or iterative and could produce an entirely new bespoke system or a package of components.

12.5 ICT GOVERNANCE

ICT governance
A subset of the discipline of corporate governance, focused on ICT systems and their performance.

IT or **ICT governance** is a subset of the discipline of corporate governance, focused on ICT systems and their performance. Its primary goals are to ensure that ICT investments generate business value and to mitigate the risks associated with ICT. This is achieved by implementing organisational structures and processes with well-defined roles and clear lines of responsibility for, or decision rights over, various aspects of information systems and ICT infrastructure.

There are three reasons for the contemporary interest in ICT governance:

- A growing acknowledgement that ICT is critical to the modern organisation and that therefore key decision-making in this area must be a responsibility at board level.
- An acknowledgement that ICT system projects easily get out of control and this can profoundly affect the performance of an organisation.
- The fact that certain organisations, particularly in the public sector, have to follow compliance rules such as the Sarbanes-Oxley Act in the United States and Basel II in Europe.

12.5.1 COBIT

CASE

COBIT
Control Objectives for Information and Related Technology – a method for ICT governance.

There are several frameworks for ICT governance. One of the most prominent internationally is Control Objectives for Information and Related Technology (COBIT). This is a framework of measures, indicators, processes and best practices for ICT management created by the Information Systems Audit and Control Association (ISACA), and the IT Governance Institute (ITGI). Originally created in 1992, COBIT assists managers, auditors and ICT users in achieving benefits through the use of ICT and developing appropriate control of the ICT infrastructure.

COBIT 5, which was released in 2012, is the latest version of the framework, although add-ons related to information security and assurance were added a year later. This has 34 high-level processes which cover 210 control objectives categorised in four domains: Planning and Organisation, Acquisition and Implementation, Delivery and Support, and Monitoring (Figure 12.8) These domains overlap with both the planning and management processes and the operational activities discussed.

- Plan and organise focuses on the use of ICT to achieve business goals. High-level control objectives for this domain include defining an ICT strategy and ICT infrastructure, managing ICT human resources and managing ICT projects.

CASE
continued…

- Acquire and implement focuses on identifying ICT requirements, acquiring technology and implementing ICT systems aligned with business processes. High-level control objectives for the domain include acquiring and maintaining application software, enabling operation and use, and managing change.
- Deliver and support focuses on ensuring the effective operation of ICT systems and support processes. High-level control objectives for the domain include defining and managing service levels, educating and training users, and managing operations.

Monitor and evaluate focuses on continually assessing needs and whether ICT infrastructure meets them. High-level control objectives for the domain include monitoring and evaluating ICT processes and ensuring regulatory compliance.

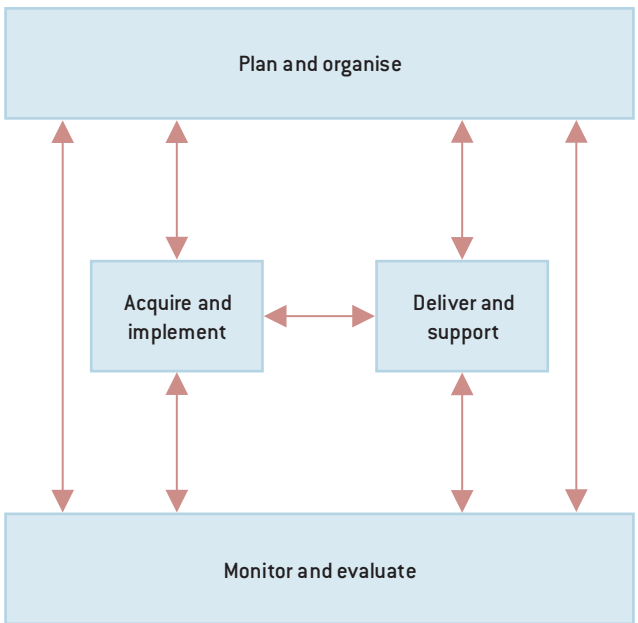


Figure 12.8 COBIT as an activity system

REFLECT

Will better ICT governance contribute to better governance of large corporations such as the financial institutions that played a major role in the financial crisis of 2008?

Some people argue that the discipline of ICT governance and frameworks such as COBIT might constrain ICT innovation in organisations. Why do you think this might be the case?

12.6 OPERATING ICT INFRASTRUCTURE

This section devotes its attention to the process of ICT operations. This is an area of the ICT service that is frequently forgotten and left unexplored in many accounts of ICT and organisations. However, an increasing range of ICT professionals are now involved in operations work rather than planning, management, development and maintenance work. This is not surprising in that once an organisation has invested in ICT infrastructure it needs a continuing commitment to ensuring it operates properly.

ICT infrastructure is clearly critical to the modern organisation. When major parts of the ICT infrastructure fail the activity of the private, public and voluntary sector organisation frequently comes to a halt.

We can frame operation of the ICT infrastructure using the philosophy of ICT service management. This means that the ICT infrastructure is considered as a set of defined services delivered to users in the organisation. Considering ICT infrastructure as a portfolio of services in this way encourages organisations to think of those services they need to provide internally and those that can be sourced externally.

Take email as a service provided by the ICT infrastructure. It is now a major communication medium, both inside and outside organisations, so its effective management has become a significant issue. Email management involves developing and operating procedures for ensuring that inbound and outbound email is stored and processed efficiently.

For emails from outside the organisation, procedures and technologies need to ensure they reach the appropriate person promptly, and responses are sent within a specified time frame. Frequently, auto-responders or mail-bots are used to notify the sender that their email is being processed. Various workflow technologies are used to aid processing by back-office staff. Outbound email may be a significant aspect of the eMarketing strategy (Chapter 8). For instance, outbound emails to customers might be sent as part of a marketing campaign, or on a more regular basis, such as an electronic newsletter.

Many organisations now impose constraints on employees' use of email, because of concern with the volume of internal emails generated and the dangers of their inappropriate use. For example, in flaming attacks emails are used to abuse or bully fellow employees. Many companies have trained staff in email etiquette, and some have even barred use of email for certain corporate communications.

12.6.1 ITIL

ITIL
Information Technology Infrastructure Library – a method for ICT services management.

A number of related approaches have been published for ICT service management, all based around an integrated process model. This section concentrates on an approach based on **ITIL**.

The Information Technology Infrastructure Library (ITIL) was established in 1989 by the former UK Central Computer and Telecommunications Agency (CCTA), and was managed by the UK Office of Government Commerce (OGC) for some time. In November 2000 the British Standards Institute published a new standard for IT service management, BS15000. This has been largely adopted as the ISO/IEC 20000 standard for IT service management. Both standards extend the original ITIL specification.

The description of ICT service management here is based on these standards but has been adapted in part to fit with the description of other key activity systems of the ICT service described both in this and other chapters. This approach generally sees ICT service management as several high-level activity systems such as ICT service strategy, ICT service support, ICT service improvement and ICT service delivery (Figure 12.9).

12.6.2 ICT service strategy

In the philosophy of ICT services management, an organisation must first define services relevant to its ICT infrastructure. The definitions can be based on functional requirements such as producing a service report or generating an invoice, or requirements such as providing service availability and information security. Service definitions then need to be published in a service catalogue, preferably as one central catalogue available to all potential users of ICT services.

ICT service strategy
Defining a strategy for the ICT service.

ICT service strategy also involves specifying an end user request model or subscription model for services. The request model enables the user to select services from the

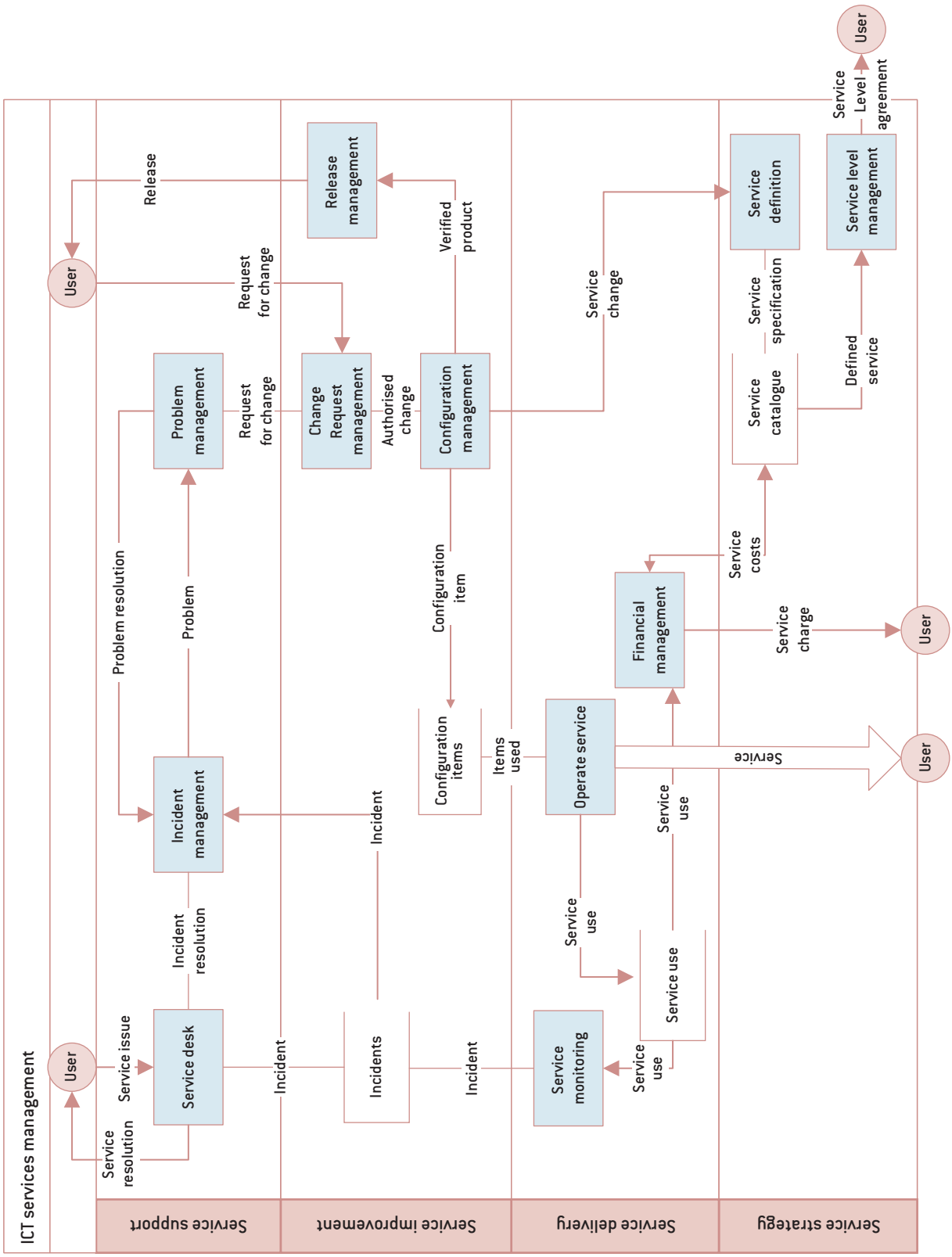


Figure 12.9 ICT services management

service catalogue. The subscription model automatically delivers a standard set of services according to a prearranged service-level agreement. For example, one service might be to create a new email account, and automatically create a request to subscribe a particular user to the email service.

Effective planning for ICT services relies on an effective grip on the significant investment made in ICT infrastructure. This investment is not solely associated with the acquisition of hardware (such as computers, printers and storage) and software (such as operating systems and enterprise software). Other costs include installation costs, environmental costs (wiring, furniture, air conditioning and so on), running costs (electricity, communication costs and so on), maintenance costs (on hardware and software), security costs (risk management and disaster recovery mechanisms), networking costs (network hardware, software and maintenance), training costs and wider organisational costs (new salary structures, management and the like).

The cost of running the ICT infrastructure is also not a one-off cost; it is an ongoing cost of ownership. Hardware, software and the skills of personnel, for instance, have to be upgraded regularly. Total cost of ownership (TCO) is a financial estimate designed to help informatics managers assess direct and indirect costs associated with operation of the informatics infrastructure. It is perhaps better called the total cost of operation. A TCO estimate ideally reflects not only the purchase costs of hardware, software, data and communication technology, but all costs involved in the use and maintenance of the equipment, devices or systems considered part of the infrastructure. This includes the costs of training support personnel and the users, costs associated with failure or outage, diminished performance, costs of security breaches, costs of disaster preparedness and recovery, floor space, electricity, development expenses, testing infrastructure and expenses, quality assurance, decommissioning equipment and eWaste handling.

Strategies for reducing TCO include the use of cloud computing, the adoption of open source software and the outsourcing of ICT operations.

12.6.3 ICT service support

ICT service support
Supporting users' use of the ICT service.

ICT service support can be considered as consisting of a number of interrelated subprocesses: running a service desk, incident management and problem management, change request management, configuration management and release management.

A service desk provides a single and first point of contact for the customer/user of defined services. It helps users with difficulties or queries, handles requests for changes and communicates with the user community, particularly releasing new versions of infrastructure to users.

End users require support in the operation of their ICT environment. This environment will differ depending on the hardware, software and communication facilities the user has access to, as well as the degree of sophistication needed to use them. The help desk helps solve problems end users face with their ICT environment. This can range from replacing a printer cartridge to producing reports from a corporate database. Because of the high degree to which ICT is embedded in modern organisations, the help desk is now a significant organisational function. Satisfaction with the help desk service frequently reflects on the overall satisfaction with the informatics service.

A key part of the help desk is ensuring that care is taken in managing user requests and solving them promptly. A common approach has a front-line interface to the help desk in which junior staff log problems and consult a stored knowledge base of common solutions. If they cannot solve the problem, it is passed on to appropriate technical experts. Not surprisingly, the help desk in a large organisation frequently overlaps with a training facility, because metrics generated from problem-logging are a useful means of identifying user training needs.

Service desk operation relies on effective incident and problem management. An incident is any deviation from the expected and defined operation of a service. Incident management is the process that restores normal service operation as quickly as possible by whatever means possible. A problem is a condition that has been identified and defined from incidents exhibiting common characteristics that have no known cause. The objective of problem management is to ensure the stability of ICT services by identifying and resolving known errors in the ICT infrastructure.

12.6.4 Service improvement

ICT service improvement
Managing the process of improving aspects of ICT infrastructure.

Incidents and problems are resolved through the operation of three interrelated processes of **ICT service improvement**: change request management, configuration management and release management. A configuration item is a component of the ICT infrastructure. Configuration management is the process involved in managing the ICT infrastructure by identifying, recording and controlling configuration items. A change is an action triggered by a request that results in a change of state for a configuration item. The objective of change request management is to effectively handle the recording, authorisation and control of all changes requested to ICT infrastructure. The objective of release management is to ensure that only authorised versions of ICT infrastructure, such as software and hardware, are made available to users.

Suppose some company is using a software package to manage sales orders across the country. In the continuous use of this package users experience a problem in retrieving customer details. These problems will be raised as incidents. Since this issue appears in a number of logged incidents a problem is identified and reported back to the software supplier. The software supplier eventually fixes the error and supplies a new version of the software module back to the company. This module will be a configuration item which will have a change request logged against it. Once this module has been tested effectively it will be authorised for release. An update to this software is then scheduled across the company, normally at an off-peak time to avoid disruption.

12.6.5 Service delivery

ICT service delivery
Delivering services, monitoring operation and costing services.

The **ICT service delivery** process consists of three subprocesses: service monitoring, service operation and financial management.

- Service monitoring ensures the continual review of agreed levels of services as required by the business.
- Service operation involves ensuring the effective delivery of services through capacity, availability and continuity management. Capacity management involves matching ICT resources to business demand. Availability management means ensuring ICT availability in order to support the business at a justifiable cost. Continuity management is concerned with the rapid restoration of ICT services in the event of disaster.
- Financial management involves costing the delivery of services and charging users for them.

Disaster recovery is a critical aspect of continuity management: restoring operations critical to the resumption of business after a disaster, either natural or human. For informatics this particularly involves regaining access to aspects of ICT infrastructure, particularly data and communication networks that support key business processes.

To achieve effective recovery, a well-established and thoroughly tested data recovery plan needs to be developed. It should include procedures for coping with the unexpected or sudden loss of communications and/or key personnel, but the focus here is on the recovery of data. This typically involves backing up data to off-site storage such as cloud data centres at regular intervals (preferably daily).

A more sophisticated approach is replication of data at an off-site location. Organisations such as online banks which demand high-availability systems might replicate both data and processing off-site, enabling continuous access if there is an on-site disaster. Many organisations outsource disaster recovery, using an external provider of a standby site and systems rather than their own remote facilities.

In addition to making plans to recover systems, organisations need to take precautionary measures to reduce the likelihood of disasters occurring. These include mirroring of systems and data, surge protectors to minimise the effect of power surges on delicate electronic equipment, uninterruptible power supplies to keep systems going in the event of a power failure, and anti-virus software and other security measures such as firewalls (see Chapter 6) to prevent data corruption and loss.

RECAP

The ICT infrastructure is considered as a set of defined services delivered to users in the organisation. This type of approach generally sees operating ICT infrastructure as consisting of a number of high-level activity systems such as service strategy, service support, service improvement and service delivery.

12.7 GREEN ICT

Green ICT
Considering and managing the impact ICT has upon sustainability.

Any activity, whether it be performed by individual actors or groups of actors working for organisations, has an impact upon the physical environment. As ICT has become more and more embedded within the activity of the modern business, an increasing focus has been given to the proper management of ICT to mitigate effects upon the ecological footprint of the business organisation.

The idea of an ecological footprint is an attempt to measure the impact of human activity upon the physical environment. Any human activity on this planet consumes resources of natural capital such as land, sea and the atmosphere. As a by-product of such activity humans also produce waste, which has the potential to contaminate the physical environment, thereby degrading resources of natural capital. As a measure, an ecological footprint is the amount of natural capital (expressed as a planet Earth) that it takes to supply resources for current human activity. In 2006 this was calculated as 1.4 planet Earths, while in 2016 this was 1.6. In other words, humanity is consuming physical resources 1.6 times faster than the Earth can renew such resources; clearly an unsustainable and potentially unviable system.

At the level of nation-states and business organisations, another related measure is typically used as a measure of environmental impact: that of a carbon footprint. This is the total amount of greenhouse gas (GHG) emissions caused by some actor such as an organisation, person, plant or machine. A GHG is a gas in the atmosphere that absorbs and emits radiation within the thermal infrared range. This property of such gases is the fundamental cause of the greenhouse effect which contributes to global warming. The primary greenhouse gases in the atmosphere are water vapour, carbon dioxide, methane, nitrous oxide and ozone. Greenhouse gases are emitted directly in various ways such as through transport, land clearance or industrial manufacture. Such gases are also an indirect consequence of the production and consumption of food, fuels,

manufactured goods and services. For simplicity of reporting, a carbon footprint is typically expressed in terms of the amount of carbon dioxide, or its equivalent, emitted by some activity system.

The ICT infrastructure of an organisation can impact on an organisation's carbon footprint in a number of ways. Consider, for instance, the life cycle of a typical piece of ICT hardware such as a personal computer (PC). To produce a typical PC and its associated monitor over 27 different materials are likely to be used. The extraction and production of these materials causes considerable GHG emissions. These materials then have to be transported to the site of manufacture, frequently from diverse parts of the globe, generating up to 5% of the GHG emissions associated with the entire life cycle. In the manufacture of a PC, crucial processes such as semiconductor manufacture use more than 1,000 hazardous substances. Once a PC is put into use its lifetime of electricity consumption typically amounts to 50% of its original purchase cost. At some point the hardware is disposed of, meaning that processes have to be devised for recycling as much of the original material as possible. It is currently possible to recycle as much a 75% of such materials.

What has become known as green IT is a collection of IT- or ICT-related initiatives which aim to directly reduce the carbon footprint of some organisation. There are many such initiatives, including: environmentally friendly printing, energy-efficient computing, sustainable data storage and cloud computing.

12.7.1 Environmentally friendly printing

Environmentally friendly printing involves the replacement of standalone printers dedicated to one PC with network-enabled printers that are shared between a number of personal computers. Such printers should also be configured to print in duplex mode (on both sides of the page) and on recycled paper for most internal business uses. Finally, such printers should never be left in standby mode for long periods of time, but turned off.

12.7.2 Energy-efficient computing

One of the most effective ways of improving the energy efficiency of computing infrastructure is through the replacement of desktop PCs with laptops. Laptop computers are designed as a matter of course with energy efficiency in mind because of the need to prolong battery life. Normally, for instance, such machines can be configured to go into hibernation mode when unused, consuming little energy. In this manner, the typical laptop can, if properly configured, consume as much as 85% less energy than the comparable desktop personal computer.

12.7.3 Sustainable data storage

Data storage devices consume large amounts of energy. Organisations can minimise their use of such a resource by reducing the amount of redundancy in their data resource. This involves actively searching for unnecessary duplication among files backed up to external storage and removing such duplication to reduce the size of stored data and consequently the amount of such storage needed.

12.7.4 Cloud computing

At first glance cloud computing does not appear a good idea in terms of its impact upon the physical environment. For instance, Google is said to operate a global network of

approximately 36 data centres needed to run its search engine. Microsoft's data centre in Chicago is reputed to need three electrical substations with a capacity of 198 megawatts to run effectively. The Environmental Protection Agency in the United States estimates that the 7,000 or so data centres that exist in the country consume 1.5% of the country's electricity consumption.

However, there are a number of environmental advantages proposed for cloud computing. From the point of view of the producer, infrastructure such as data centres can be located in areas with lower property costs, close to water (for cooling purposes) and within easy access of electricity supplies. This centralisation of resources may make it easier to mitigate the environmental impact of ICT infrastructure. For example, from the point of view of the consumer, cloud computing has the potential to make applications much more scalable. Hence, if a company expands its activities it does not need to purchase vast new communication and data resources, it merely extends its use of cloud services. Further, the application itself in terms of software and data can be separated from physical resources such as hardware. Hence, if more computing power is required to handle peak loads, additional cloud servers can be applied to the task on an as-needed basis. This on-demand use of computing resources may be more energy efficient than having vast communication and data resource managed by consuming organisations themselves.

12.8 CONCLUSION

ICT is primarily part of the service sector, and is an increasingly prominent part of many economies. The ICT industry can be divided into producers of informatics products and services, and their consumers. ICT in both producing and consuming organisations suffers from a lack of defined career paths. Professional bodies are attempting to address this problem through the introduction of clear skills profiles for various forms of informatics work.

The ICT service is that part of the organisation tasked with supporting information, information systems and ICT. It can be structured in various ways including outsourcing in whole or part. Its four main activities are planning, management, development and operations. It delivers services in support of the current ICT infrastructure, and project management and development services in support of the future ICT infrastructure.

The operation of ICT infrastructure is frequently forgotten in accounts of ICT and organisations, but an increasing range of ICT people work in operations, which is now typically packaged as ICT services management. There are a number of approaches to it, and it can be seen to consist of four high-level processes: service strategy, service delivery, service support and service improvement.

Any activity has a potential impact upon the physical environment. As ICT has become more and more embedded within the activity of the modern business, an increasing focus has been given to the proper management of ICT to mitigate effects upon the physical environment. The ICT infrastructure of an organisation can impact on an organisation's carbon footprint in a number of ways. Green ICT is a collection of ICT-related initiatives which aim to directly reduce the carbon footprint of some organisation, such as: environmentally friendly printing, energy-efficient computing, sustainable data storage, virtualisation, cloud computing and use of software as a service.

In the final chapter of this book we consider some of the important changes to ICT infrastructure that are likely to impact upon information systems in the future. We also develop a summary of the key lessons from this book and wrap this all up in a theory of information systems.

12.9 REVIEW TEST

12.1 The ICT industry is primarily part of the service sector of the economy.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

12.2 Actors within every ICT service undertake six major roles.

Select all the roles that apply by placing an X in the box.

- ☐ ICT infrastructure planning
- ☐ Operating manufacturing
- ☐ ICT infrastructure management
- ☐ Project management
- ☐ ICT systems development
- ☐ ICT systems maintenance
- ☐ ICT infrastructure operations

6 marks

12.3 Outsourcing is the use of external agents to perform one or more organisational activities.

True or false? (Select only one by placing an X in the box)

- ☐ True
- ☐ False

1 mark

12.4 Place the activities of information systems development in the order of the typical linear lifecycle.

Place the activities in sequence (1–6), with the first activity labelled (1).

- ☐ Analysis
- ☐ Construction
- ☐ Conception
- ☐ Maintenance
- ☐ Implementation
- ☐ Design

6 marks

12.5 ICT service management involves.

Select all the activities that apply by placing an X in the box.

- ☐ developing service strategy
- ☐ operating service support
- ☐ service improvement
- ☐ project management
- ☐ service delivery

4 marks

12.10 EXERCISES

- Search the Internet for companies in each of the ICT producer areas identified in this chapter.
- Look through job advertisements in various ICT magazines and try to develop precise job descriptions for the roles described in this chapter.
- Discuss the importance of regulation to the development of clear career paths for ICT professionals.
- Develop a brief policy statement indicating possible strategies for addressing the skills crisis in ICT.
- Take an organisation known to you and find out whether it has an ICT service function. In what way is the ICT service organised? Use the distinctions made in this chapter to

help describe it. Is the department seen purely as a service function or in a more strategic sense? Is the service centralised, devolved or distributed? How is the service funded?
- Try to identify the costs of maintaining a small network of personal computers.
- Does an organisation known to you have a help desk? Who staffs the help desk? How would you rate satisfaction with it?
- How do you back up your own data? How regularly? Do you store them off-site?

12.11 PROJECTS

- A number of different forms have been considered for the ICT service. Investigate two or more organisations. Consider differences in structure and function between their ICT services and why these differences have occurred.
- ICT, information systems and information are increasingly important to successful organisational performance. Does this mean that the ICT service has more power in organisations? Investigate the power that the ICT service has in modern organisations. For instance, how prevalent is the practice of placing CIOs on the board?
- Determine the precise make-up of ICT in a nation. For instance, try to determine whether it is possible to state the percentage in each producer area and the major consumers of ICT.
- How commonplace are professional development schemes for ICT staff in organisations and how seriously are they treated? Investigate the use of the professional development schemes in the area of ICT in an organisation known to you.
- Is there a skills shortage in the ICT area in your nation? If so, are there any attempts to address this shortage? If the shortage is not addressed, what effect is likely on the economy?
- How important is the successful operation of a help desk to the general rating of user satisfaction with ICT? Investigate the activities of the help desk in two or more organisations. Are there effective ways of measuring satisfaction with the help desk itself and more generally with the ICT service?
- Attempt to calculate the total cost of ownership associated with desktop computing in an organisation known to you. How does the organisation attempt to control such costs? For instance, does the use of open source software have any part to play?

12.12 FURTHER READING

Bott (2014) contains an overview of informatics as a profession. The book by Wilcocks and Lacity (2012) brings together their published material on ICT outsourcing. The Information Technology Infrastructure Library is introduced in a text from the UK Stationery Office (Agutter 2012). The Journal of Strategic Information Systems ran a special issue on the greening of ICT in March 2011.

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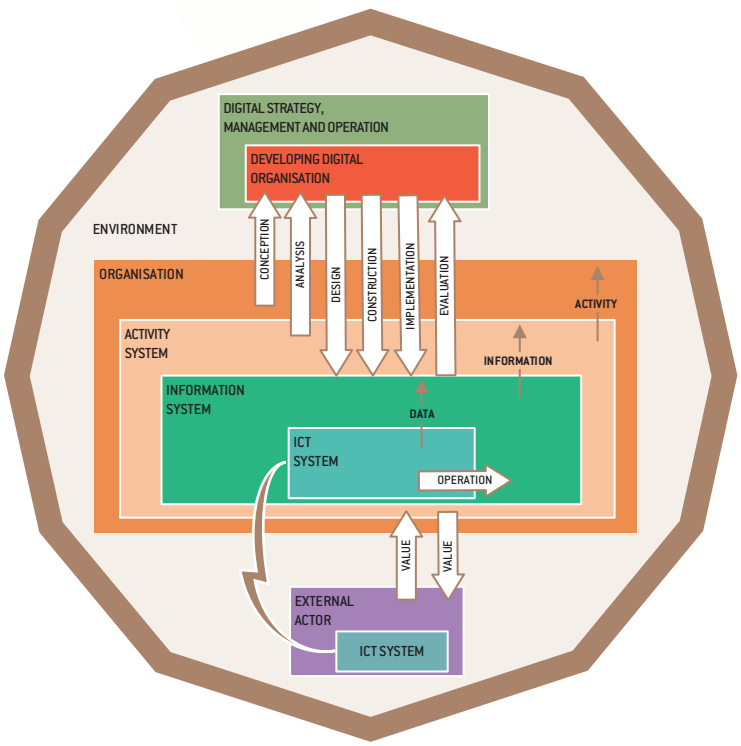
13 THE CHANGING NATURE OF DIGITAL INFRASTRUCTURE

'I must create a system, or be enslaved by another man's. I will not reason and compare: my business is to create.'
– William Blake (1757–1827) *Jerusalem*, chapter 1

LEARNING OUTCOMES	PRINCIPLES
Understand how ubiquitous computing is impacting upon digital infrastructure.	Computing and communication technology are becoming invisible but ubiquitous infrastructure through the increasing penetration of pervasive devices and the Internet of Things (IoT).
Explain how Artificial Intelligence (AI) is impacting upon decision-making within organisations.	The vast majority of successful AI applications operate within a narrow domain of expertise using heuristic algorithms to make decisions.
Understand how computers themselves are likely to change.	Because of certain limits to computation researchers are looking to build computers from different materials than silicon, such as DNA and quantum particles.
Relate key principles of a theory of information systems.	Systems of information are systems through which information is accomplished, which rely upon data systems and enable activity systems.
Use our theory of information systems to understand changes to digital infrastructure.	Trends such as ubiquitous computing, developing artificial actors and building computers out of atomic or biological stuff can be made sense of in terms of choices made as to the design of systems of organisation.

CHAPTER OUTLINE

13.1 Introduction
13.2 Ubiquitous computing
13.3 Artificial Intelligence
13.4 Future computers
13.5 A theory of information systems
13.6 Key principles of information systems
13.7 Understanding change to digital infrastructure
13.8 Conclusion
13.9 Further reading
13.10 Bibliography



13.1 INTRODUCTION

We started this book with the claim that our interest is in the interaction of ICT with organisation. The problem with this interest is that ICT as a range of technologies is of course continually changing, and organisations are continually having to adapt to and innovate with such technological change. In this final chapter we provide an overview of certain aspects of ICT change that are likely to affect the nature of infrastructure over the next decade or so. As a direct consequence, such technological change is likely to affect the way in which humans organise themselves in areas as diverse as the economy, society and polity.

Predicting the future is by its very nature prone to error, and never more so than in the area of technological change and its interaction with organisational change. Four historical predictions relating to the future of ICT and its application make this very clear:

- In 1946, the head of 20th Century Fox predicted that people would get bored with watching television after six months.
- In 1949, ENIAC, an early computer, was equipped with 18,000 vacuum tubes and weighed 30 tons. It was predicted at the time that computers in the future might have only 1,000 vacuum tubes and perhaps weigh 2 tons.
- In 1957, the late Arthur C. Clarke predicted that in 50 years, satellites would be positioned in space to provide television and microwave coverage for the whole planet.
- In 1977, the president of Digital Equipment Corporation predicted that no one would ever want to have a computer in their home.
- In 1995, Robert Metcalfe predicted that the Internet would collapse within the year.

Most of these predictions from well-respected experts of the time proved spectacularly wrong. One was treated with much scepticism at the time but proved spectacularly correct.

However, if we extrapolate from trends that are already apparent, there is more chance of success than with wild guesses. This enables us to provide a picture of some of the issues affecting digital infrastructure that are beginning to have an impact and are likely to continue to do so over the next 10 years or so. There is considerable overlap between some of the themes evident in these technologies, which we shall summarise at the end of the chapter. Some of these trends have been much hyped – so we have tried to provide as balanced an assessment of their likely effects as we can.

We can better make sense of the changes to digital infrastructure if we can apply coherent theory. Therefore, in the remaining part of the chapter, we bring together elements of the theory of information systems that we have discussed in previous chapters. This not only summarises our perspective on what information and information systems are, but also indicates what we think information and information systems are not. We suggest that this theory helps us not only better understand the potential digital future but also presents us with better ways of approaching the design of such future.

13.2 UBIQUITOUS COMPUTING

Ubiquitous computing
The trend in which computation is sinking into the background, becoming invisible infrastructure supporting our interaction with all sorts of things in different places and at different times.

The word ubiquitous means *any time and everywhere*. So here we examine certain trends which support the idea that computation is gradually being pushed into the background; that it is becoming invisible infrastructure supporting our interaction with all sorts of things in different places and at different times. Several ICT trends underlie the idea of **ubiquitous computing** – pervasive computing, tangible computing, robotics and the IoT.

13.2.1 Pervasive computing

Pervasive computing
Pervasive computing refers to the idea of embedding computational and communication capability into everyday objects.

Pervasive computing refers to the idea of embedding computational and communication capability into everyday objects. There are two types of everyday object important to pervasive computing – physical-first objects and digital-first objects. Physical-first objects have been designed and built without any computational and communication capabilities. A physical book has no inherent computational or communication capability, nor does a vinyl record. This means that such objects must be given such capability through augmentation in some manner. In contrast, digital-first objects have been designed and built from the outset with computational and communication capabilities in mind. An eBook is inherently a digital object, as is a music audio file.

13.2.2 Radio frequency identification

Radio frequency identification tag
An access device that can be incorporated into some object.

Physical-first objects can be given certain computational and communication capability through radio frequency identification (RFID). An **RFID tag** is an object that can be attached to or incorporated into a product, animal or person for the purposes of identification. Data from the RFID tag are transmitted using radio waves. Some varieties of tag can thus be read at a distance of several metres. Most RFID tags contain at least two parts. One is an integrated circuit for storing and processing data, producing a signal and other specialised functions. The second is an antenna for receiving and transmitting the signal. A technology called chipless RFID allows for identification of tags without an integrated circuit. This enables tags to be printed directly onto things such as clothing at a lower cost than traditional tags.

RFID tags can work in a passive or an active manner. Passive RFID tags do not communicate directly but have to be read by RFID readers. So a physical book might have a passive RFID tag which is read at specific locations such as at a library desk. In contrast, active RFID tags can continually signal their presence and can perform limited computation. Hence they can communicate with other digitally enabled objects. So goods containers may be tagged with active RFID tags to enable the tracking of items in transit. People might be tagged with an active RFID tag such that their movement and location can be monitored.

RFID tags are penetrating many parts of business operations. For instance, such tags are now typically used within the supply chain to improve the efficiency of inventory tracking and management. Hence a distributor might use RFID tags on large deliveries of shipment. These are automatically read at a number of points in transit and update an order-tracking system maintained by the company for its customers.

13.2.3 Pervasive objects

Pervasive computing objects acquire a unique identification number to enable them to authenticate and identify themselves to systems. When they participate in communication networks they also acquire an IP address, which enables them to communicate with other objects and devices (Figure 13.1).

Pervasive objects
Digitally enabled objects that are able to authenticate and identify themselves to systems.

Pervasive objects tend to look like that illustrated in Figure 13.2. This is similar to the idea of a control mechanism discussed in Chapter 2, but the control is distributed here in a network of objects, rather than in any one device.

Objects can typically sense certain features of their environment. Objects can compare what is sensed against certain control inputs set by humans or other devices. Objects can take limited action through effectors such as communicating back to humans or with other devices.

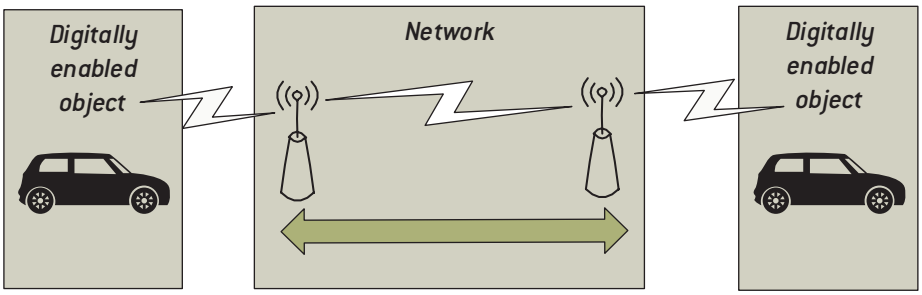


Figure 13.1 Digitally enabled objects

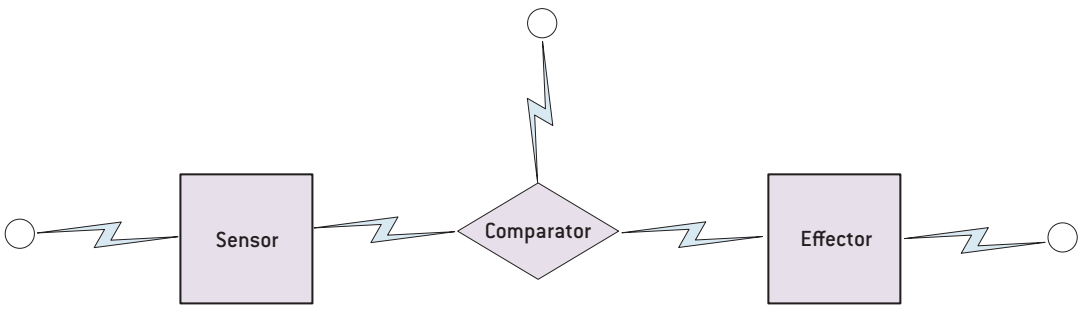


Figure 13.2 Pervasive objects

Here is a short list of some examples of objects that have or are being digitally enabled: automobiles, central heating boilers, lighting, fridges, wheelchairs, beds and other furniture. Of course, the things we wear or carry around can be provided with computational power. This makes it possible to track our movements as individuals through space and time. It also makes it possible for the things we carry or wear to interact with other digitally enabled objects.

REFLECT

Do you know of any other objects that either are or have potential to be digitally enabled?

13.2.4 Tangible computing

Tangible computing
Tangible computing refers to the idea that our interaction with tangible (physical) objects can replace traditional ways of interacting with computers via touchscreens or keyboards.

Tangible computing is a complementary idea to pervasive computing. It refers to the idea that our interaction with tangible (physical) objects can replace traditional ways of interacting with computers via touchscreens or keyboards.

Consider a simple example of a telephone answering machine designed according to the principles of tangible interaction (Figure 13.3). In a traditional answering machine the human user will interact with the device by pressing various buttons on the device or various icons on a touchscreen.

In the tangible answering machine illustrated, the manipulation of physical objects implements interaction with the device. Here, marbles stand for telephone messages. When a message is recorded a marble pops out of the device and rolls down to join the collection of existing messages. To play a message the appropriate marble is lifted and placed in the playing position. To delete a message the relevant marble is dropped down a recycling hole.

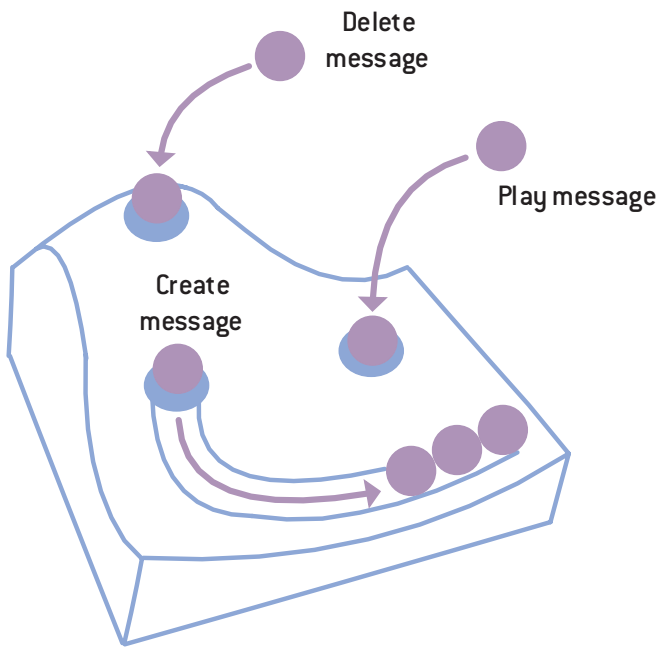


Figure 13.3 A tangible interface to an answering machine

We live in a tangible world where we engage with physical objects on a minute by minute basis. The transformation of many of these objects communicates certain things to actors within the environment. In a film of the 1970s, Sherlock Holmes holds the following dialogue with his landlady:

Sherlock:	'Madam, why have you tidied my room! I specifically gave you orders to the contrary …'
Landlady:	'I made sure I didn't disturb anything.'
Sherlock:	'Dust is an essential part of my filing system … By the thickness of it I can tell the date of any document immediately.'
Landlady:	'… but some of the dust was two inches thick!'
Sherlock:	'That would be March 1883.'

This humorous example makes the crucial point that pretty much any physical thing can communicate or inform someone of something. In this example Sherlock uses layers of dust to inform him of the age of documents. For his landlady, such dust informed her of Sherlock's untidy habits.

Tangible computing and tangible interfaces attempt to exploit our intuitive use of physical objects for the purposes of communicating with machines and ICT systems. In the near future, it is likely that we will communicate with many computational devices through physical manipulation of objects themselves, rather than through typing into a keyboard, moving and clicking a mouse or pressing an icon on a smartphone.

13.2.5 Robotics

Within this book we have particularly focused on the use of ICT in information systems applications. Within such applications ICT primarily plays the role of articulating data in support of communication and helping coordinate the work of humans and machines. ICT is of course also now used to directly control the work of semi and fully autonomous machines as critical organisational actors – as robots. The term 'robot' is taken from the

Robotics
The discipline devoted to the building of artificial actors able to perform activities such as manufacturing.

Polish word *robota* which means worker. It is therefore not surprising to find the first application of **robotics** replacing manual work, within the manufacturing workplace.

Such robots are traditionally programmed to undertake repetitive manual operations, and as such have replaced many human workers upon many manufacturing lines. However, many worry about developments that are attempting to marry AI to robotics. Such robots may be able to learn specialised tasks rather than be programmed directly. And as such, they would become relatively autonomous actors not only in the manufacturing workplace but also in other workplaces, such as in healthcare or retail. Such autonomous devices will probably also be able to communicate with other autonomous devices and coordinate their activity. It may be that many areas of work which rely on cognitive rather than physical capability may start to be infiltrated by robots.

13.2.6 The Internet of Things

Traditionally, the Internet has been used to connect together computing and communication devices, such as PCs and laptops. But, as we have seen, many other modern objects and devices are digital in the sense of having software controlling them and sensors that monitor critical things about them. If these devices are given the ability to communicate over the Internet then devices, can interact at a distance with human and non-human actors. This is the central purpose of the so-called Internet of Things (IoT). So your home central heating controller might monitor its output and give you a breakdown of your energy usage. Or your home fridge might monitor the food contained within it and create an electronic shopping list for you (Figure 13.4).

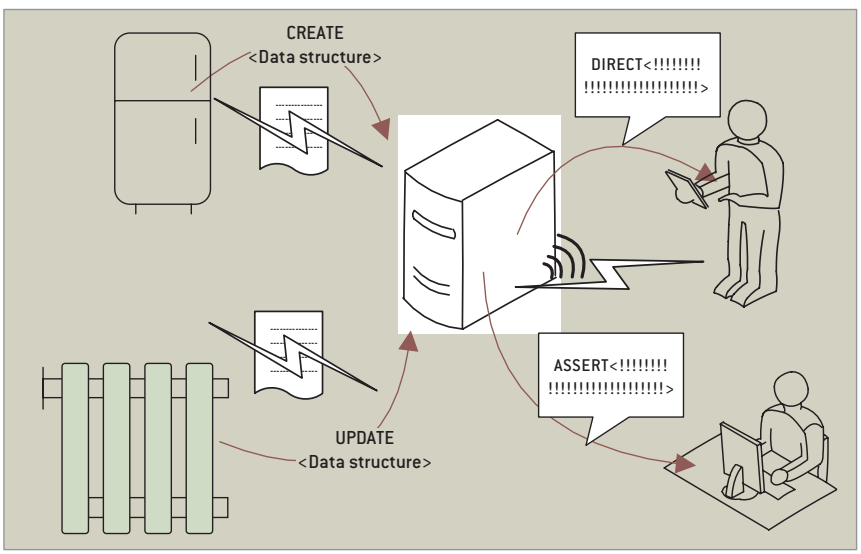


Figure 13.4 An Internet of Things

There are literally billions upon billions of potential devices or digitally enabled objects that could make up the IoT over the next decade (Figure 13.5). But to get this significant new level of technological infrastructure to work effectively there are significant challenges that remain, such as developing and enforcing open standards for intercommunication between devices. There is also significant concern that the increasing use of such devices in diverse settings is increasing the potential for data security risks. The communication channels used to control a large range of current digitally enabled devices are often unencrypted and easily open to interception. This opens up the potential for external actors to gain control of such devices for malicious purposes.

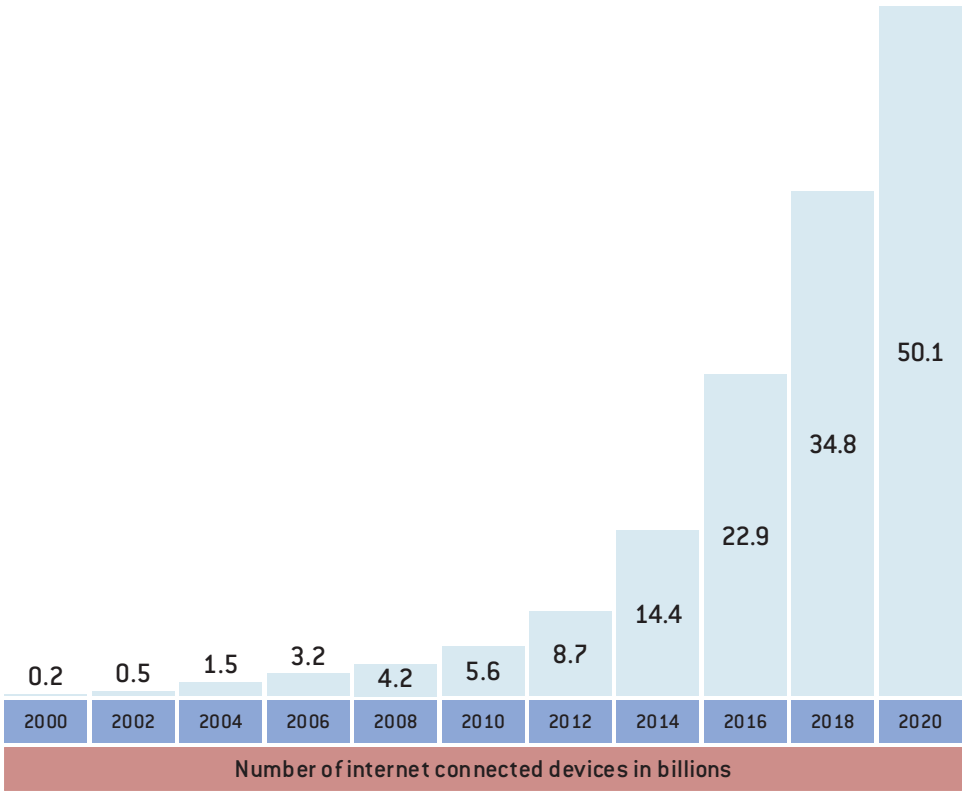


Figure 13.5 Growth in the number of Internet connected devices

The IoT of course is not just impacting upon domestic and consumer scenarios – it is likely to have its greatest impact in industry. The marriage of robotics with digitally enabled devices opens up the possibility of communication between computational devices that can perform instrumental activity. This means that such devices can alter their performance flexibly in terms of what is communicated to them by other devices. As a consequence, manufacturing organisations will be better able to adapt to changing market requirements.

RECAP

Computing and communication technology are becoming invisible infrastructure – ubiquitous infrastructure. Pervasive computing involves embedding computational and communication capabilities into everyday objects. Digital-first objects are designed with such capability. Physical-first objects have to be augmented with such capability. Our interaction with tangible objects offers a different way of interacting with ICT. The marriage of digitally enabled objects with the Internet creates the IoT.

13.3 ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI for short) refers to the attempt to build computing systems that can act intelligently.

The term **Artificial Intelligence** (AI for short) refers to the attempt to build computing systems that can act intelligently. But, as we shall see, this is not the same as saying that such devices can think.

The AI began with some speculative work published by Alan Turing (see Section 4.7.3). In 1950, Turing published a paper entitled Computing Machinery and Intelligence, in which he argued that artificially created entities might one day be able to generate sufficient intelligence to pass as human. He proposed in the same article a

test by which we might assess the intelligence of such a machine – a test which he referred to as the imitation game – but which has become more generally known as the Turing test.

The Turing test consists of two actors, A and B, which are interrogated by means of written questions by another human actor, C (Figure 13.6). One actor A is a human actor, while the other actor B is the machine actor. Actor C does not know which actor is the machine, and which is the human. A and B are required to provide written responses to the questions set by C. C must decide, purely on the basis of these responses, which is the machine actor and which the human actor. If C cannot make this decision, then the machine is regarded as demonstrating intelligence.

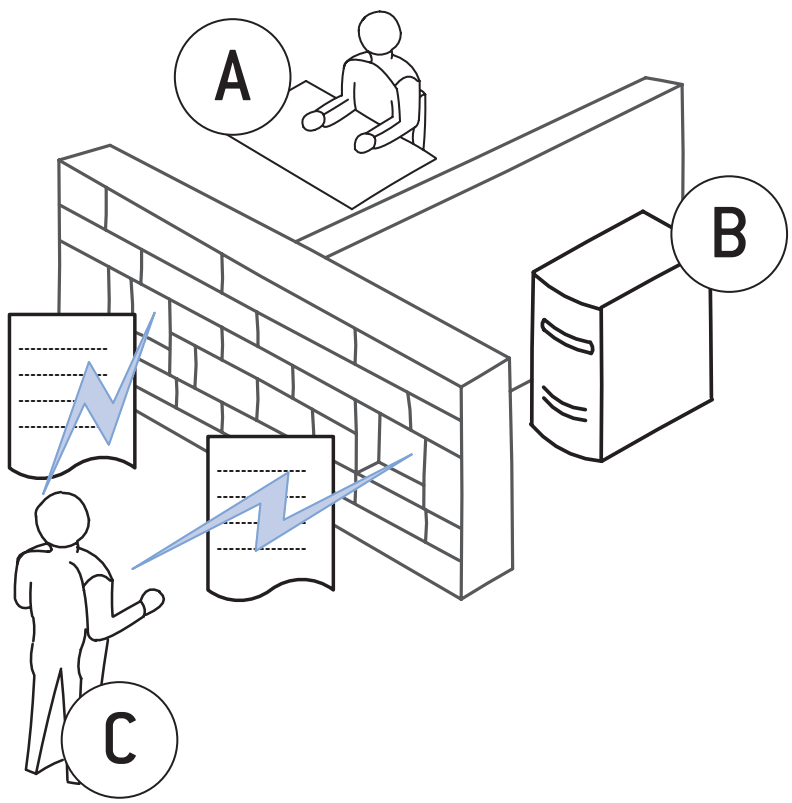


Figure 13.6 The Turing test

13.3.1 Physical symbol systems

The general point made by the imitation game is that we can only judge the intelligence of something through the actions that it is capable of. And the entity which is the motive force for action is of course the mind. From certain actions we can infer the presence of mind – that minds generate intelligent action.

In the 1960s, Herbert Simon and his colleague Alan Newell proposed the so-called **physical symbol system** hypothesis, which relates machines to mind. This states that a physical symbol system has the necessary and sufficient means for generating intelligent action. We know that brains can be considered physical symbol systems. Brains generate symbols through electrical activity conducted within an extremely complex network of neurones. And we know that symbols are the component elements of thought, which is the outward expression of mind, or at least conscious mind. The key consequence of the physical symbol hypothesis is that it should be possible to generate mind from different stuff than biological brains, such as the stuff of computing machinery.

Physical symbol system
A physical symbol system is a system that has the necessary and sufficient means for generating intelligent action.

13.3.2 Strong AI and levels of mind

Strong AI
The search to develop intelligence in a machine that displays complex, cognitive abilities, which generate the phenomenon we generally refer to as conscious mind.

The sort of intelligence that a machine would need to demonstrate in the imitation game demands that it has complex, cognitive abilities, which generate the phenomenon we generally refer to as conscious mind. The search for building such abilities into machines continues in an area generally referred to as **strong AI**, sometimes broad AI. But most researchers admit that they are nowhere close to generating the sort of higher-level cognitive abilities that most humans display with current strong AI technologies.

But more limited forms of intelligence are clearly displayed by organisms with less complex cognitive abilities than humans. The philosopher Daniel Dennett (1996) convincingly argues that the idea of there being only one type of mind is a mistake. He sees mind, and indeed the process of mind (consciousness), rather as an evolutionary process, and that complex organisms, such as humans, actually have a sedimentation or layering of minds, from the most simple found in lower organisms to the most complex found in higher organisms.

Mind, for Dennett, is effectively a control system. The purpose of mind is to produce future – the ability to produce decisions as to possible actions and to test such decision moves against some environment. The baseline for the presence of mind is where we have some entity with a body that is self-sustaining (hence the arrow in Figure 13.7) and which is distinguishable from some environment in which it exists. However, there is not interaction between entity and environment. An isolated chromosome is an example of such an entity.

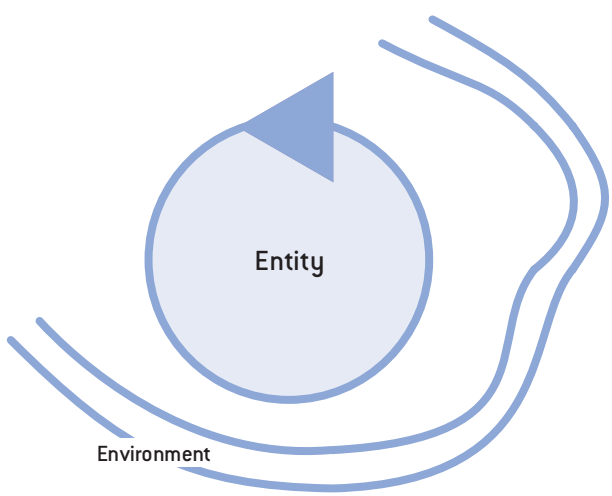


Figure 13.7 A self-sustaining entity

The next step is the evolution of an actor, an entity that can sense aspects of its environment through its sensory apparatus, and can manipulate aspects of its environment through its effector apparatus. Between its sensory and effector apparatus there is a set of invariant functions which enable the entity to produce a set of fixed responses to given stimuli. The entity has no memory and hence cannot learn. A single-cell bacteria (protozoa) is an example of such an entity. It is able to sense aspects of its environment (such as the presence of sugar) and effect rotation of its flagella (tail) to move towards the source of the sensation (Figure 13.8).

The next level of mind possesses some form of memory, and such memory allows different forms of decision strategy to be stored. Certain decision strategies can also be learned rather than inherited in the sense that the actor can evaluate the result of an action, reinforce one decision strategy over another (Figure 13.9) and store this within memory. An earthworm is an example of such an entity.

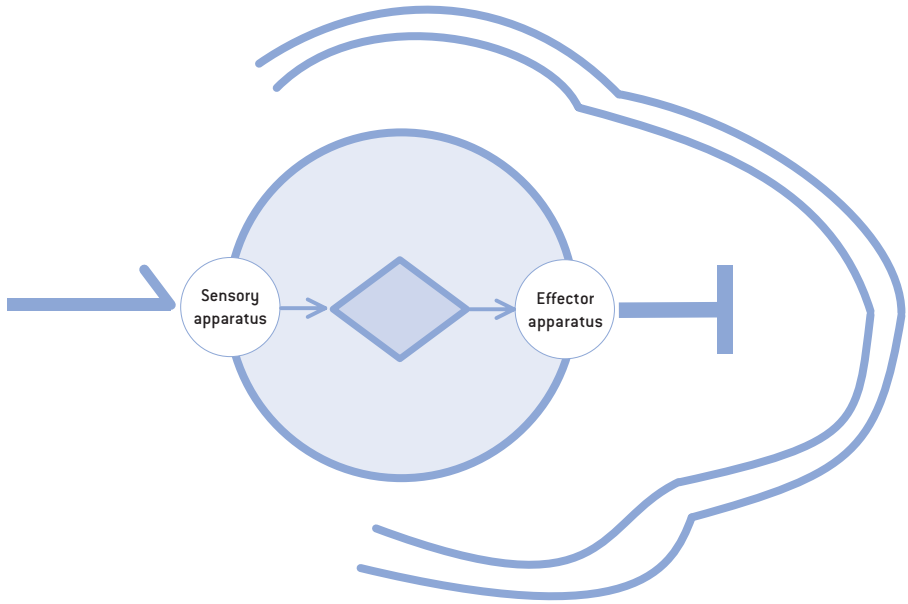


Figure 13.8 A simple mind

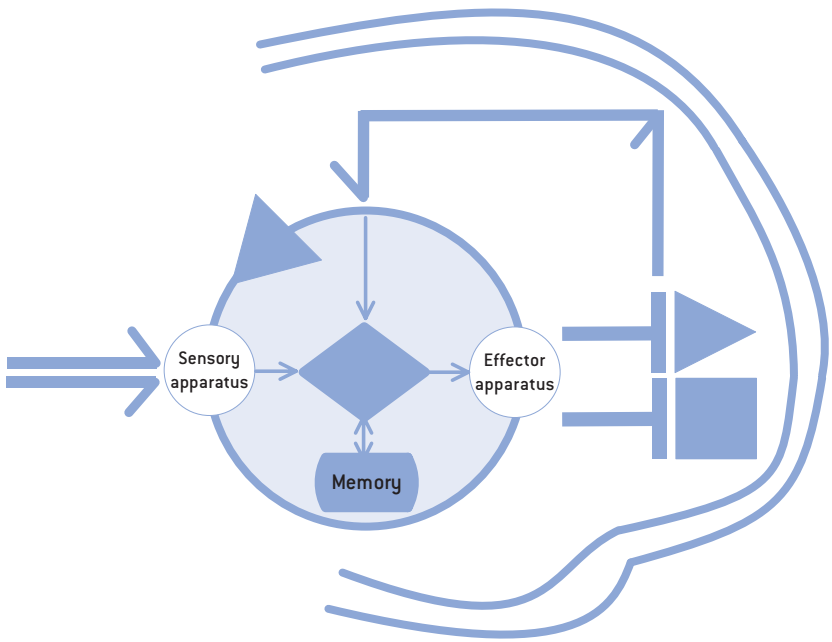


Figure 13.9 Mind with memory

What we think of as human mind builds upon these lower levels of mind to include higher-level cognitive functions, such as selective attention and the ability to work towards and shift between multiple goals. This means that the actor is able to exercise some selective control over both its sensory and effector apparatus. It is also able to shift its attention to working on different tasks in the achievement of multiple goals. All this eventually leads to the development of an inner environment in which actors can select among possible actions by testing such actions against the inner environment and observing results. This inner environment then becomes a precondition for self-consciousness – the ability that an actor can recognise itself as a distinct entity that is able to plan future behaviour.

DID YOU KNOW?

The claims made for the impact of AI have usually missed the mark – sometimes by substantial margins. In 1958, Herbert Simon made the claim that within 10 years a digital computer would beat the world's chess champion. In 1970, Marvin Minsky made the claim that in eight years we would have a machine with the general intelligence of an average human being.

13.3.3 Weak AI and its applications

Weak AI
Weak AI seeks to build working but much more limited minds capable of acting intelligently but in much more limited domains.

The notion of various levels of mind and consequent differences in intelligent action opens up the agenda of so-called **weak AI**. Weak AI seeks to build working but much more limited minds capable of acting intelligently but in much more limited domains than that proposed in the imitation game. Many of these software minds implement heuristic algorithms (see Section 3.4.10) of various forms to perform limited action. For instance, an online tool which awards you a loan, such as a mortgage on a house based on the answers you provide to its questions. Or a machine mind which recognises your voice and exercises a limited set of activities based upon the commands you give it. Or a surveillance system which automatically 'reads' your car's number plate and issues a fine to you (the driver) when you cross into a congestion zone. Or, finally, even a more sophisticated machine mind which can drive an automobile by itself.

Within the digital economy software actors now act relatively autonomously. Companies like Facebook use such algorithms to decide which posts from friends and family we should see. Software actors working for Google skew search results depending upon your location and browsing history. Companies like Walmart tailor prices using factors such as user's choice of browser, operating system and purchase history.

But the increasing use of such actors within the digital infrastructure for many activities originally performed by humans is of concern to many. Some believe that the decision strategies embedded within automated mortgage application systems contributed to the financial crash of 2008. More worryingly, these software actors when targeting high-risk borrowers disproportionally awarded high interest rates to minority groups in the United States, such as African-Americans and Latinos. More worryingly still, the National Security Agency in the United States used certain algorithms to determine, in the absence of specific data, whether someone was not a US citizen and hence open to surveillance.

13.3.4 Data-driven AI and machine learning

Machine learning
The attempt to develop limited minds through learning conducted upon large data sets.

The sort of intelligence that a machine would need to perform effectively in the imitation game demands it having complex cognitive abilities which generate what some refer to as an adaptive mind. Many researchers have become convinced that it is theoretically impossible to program any form of mind from scratch. Instead, they pin their hopes on building an entity that can evolve some kind of 'mind' through learning conducted upon large data sets. Such **machine learning** relies upon a construct known as a neural net.

Neural net
A neural net is built from interconnected layers of nodes and is trained through machine learning.

A **neural net** is built from three interconnected layers of nodes (Figure 13.10). The links between nodes in the net acquire weightings based on a comparison of inputs to outputs. The input layer is fed data appropriate to describing the range of differences found within a certain domain. The output layer defines appropriate and different responses in terms of a defined set of inputs. One to many hidden layers implement the heuristic algorithm of the net by forming linkages between certain inputs and outputs.

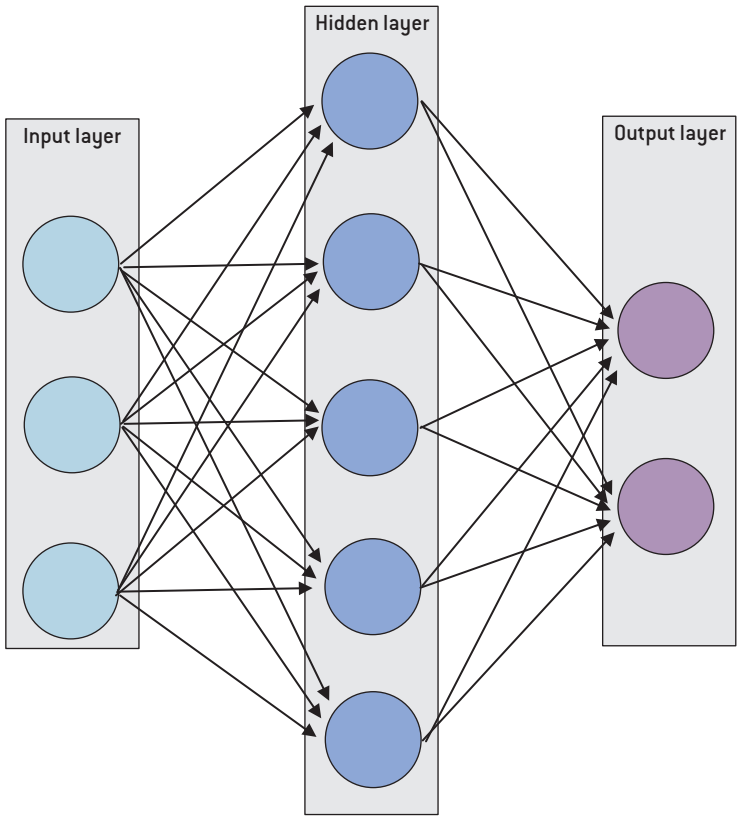


Figure 13.10 A neural net

The notion that a neural net can implement higher levels of mind has come under intense questioning. But even if we acknowledge their capacity to implement lower-level minds then neural nets have certain problems. One such problem is that the neural net is only as good as the data they are trained upon. Certain biases or 'prejudices' in the data feed through into the construction of the net and its responses to certain sensed phenomena. For instance, in 2015, the Google photo app categorised a certain photograph of some African-Americans as gorillas. The photo categorisation function of this app used a neural net trained on a large set of categorised images acquired by Google through its photo application. The net displayed prejudices inherent in the data set that it was trained upon.

Another problem is that the algorithms embedded within neural nets are by implication opaque to outside inspection. The net cannot explain its 'reasoning' and the algorithm itself is frequently too complex to analyse. It is hence very difficult to validate and verify the way in which the net acts in response to certain inputs. Humans are able to account for their actions, but a data-driven AI actor probably will always be unable to provide such an account. Some see this as disruptive to the very idea of accountability, which is of course a central principle underlying most legal systems.

13.3.5 Doomsayers

Some prominent thinkers, such as the late Stephen Hawking, have questioned whether we should develop better and better artificial 'minds'. Others worry about the effect the growing breed of software actors utilising various forms of AI are having on the world of work. Over the last five decades the increasing penetration of ICT has served to automate many aspects of low-level clerical and manual work. For instance, the whole

class of office workers known as typists has disappeared with the penetration of office software into the workplace. But some now worry that the increasing power of AI minds, even of narrow or weak AI minds, threatens many occupations which perform cognitive work – such as doctors, lawyers, teachers etc. Doomsayers see potential major disruption to employment within economic systems if this comes to pass.

REFLECT

What do your minds think about the potential of artificial minds?

Should data-driven AI actors be prevented from taking certain actions in certain domains, and why?

RECAP

Artificial intelligence began with the attempt to prove the physical symbol hypothesis. This is the suggestion that intelligence could be demonstrated in a construct built from stuff other than human brain tissue. Such intelligence could be tested and verified through some form of imitation game. Indeed, certain AI systems have performed well in certain imitation games conducted in very narrow domains of expertise, such as in playing chess, the game of Go or double jeopardy. But the vast majority of successful AI to date operate with narrow or weak AI – using heuristic algorithms to conduct intelligent action in very narrow circumstances. Some still hold out hope for the increasing power of minds developed through machine learning on big data.

CAREERS VIDEOS

Steve Lockwood

Steve Lockwood studied physics at university before working for eight years in the public sector as a physicist and operational research analyst. During that time he studied for an MBA, realising that acquiring a combination of business and technical skills would serve him well. Later, he worked for small and large consultancy firms and in retail before joining IBM, where he still works today. At IBM, Steve has worked in a variety of roles, including in strategic outsourcing, software consultancy, global business services, their European and global chief technology offices, and, most recently, in AI.

Visit this book's companion website at www.macmillanihe.com/beynon-davies-BIS3 to watch Steve talking about his long and varied career and about some of the exciting trends and technologies that he thinks will shape the industry (and the world) in the years to come. After watching the interview, reflect on the following questions:

- How does Steve say IS can help reshape the way businesses are run? Can you list some of the benefits that might be accrued by companies who have embraced such trends as analytics, big data or AI?
- What is 'big data'? Why is it so important? Can you think of some more examples of how it is, or could be, used to develop insights and help solve real-world problems? Read more about big data in relation to marketing analytics in Chapter 8 of this book.
- What are the 'five Vs'? What do they mean? How is each of them changing?
- What is the Internet of Things (IoT)? How does it relate to big data? Can you think of examples of how IoT could be used to solve problems in the real world? Read more about IoT in this chapter.
- Can you explain what is meant by 'design thinking'? See Chapter 10 of this book.
- What are the 'soft skills' that Steve mentions employers in the industry are looking for in potential employees? How can you develop these skills? For more on IS and employability, see the section towards the front of this book on 'Employability and Information Systems'.

13.4 FUTURE COMPUTERS

Since their invention in the 1940s digital computers have seen a steady increase in their performance, linked to improvements in the way we build them. In 1965, Gordon Moore, who worked at the time for the computer chip manufacturer Intel, noticed that the number of transistors per square inch printed on a circuit doubled every two years. This exponential growth, which has been referred to as Moore's law, has continued ever since then.

However, computing is meeting some physical limits in the way in which we construct our computing devices. In 1961, Rolf Landauer, then working for IBM, proposed a theoretical limit to the amount of energy that must be consumed by a unit of computation, such as the erasure of a bit from some storage device. This limit, which has been proven in physical experimentation, implies that there is an impending bottleneck to the amount of miniaturisation that can occur in an electronic system such as a computer chip. Some have estimated that with current rates this limit to miniaturisation will be reached by 2050.

Researchers are therefore looking at building computers from different materials than silicon, such as DNA and quantum particles.

13.4.1 Quantum computing

Quantum computing
The use of certain properties of quantum mechanics, such as superposition and entanglement to accomplish computation.

So the first idea is to build a Turing machine out of the strange stuff of quantum material. A Turing machine, if you remember, is a theorisation of the component elements of all computation devices (Section 4.7.3). The idea of **quantum computing** relies upon an area known as quantum mechanics, quantum theory or quantum physics. Quantum mechanics is the fundamental theory of physical nature at the small scale, at the level of atomic particles. Quantum computing makes use of certain properties of quantum mechanics, such as superposition and entanglement.

13.4.2 Superposition and entanglement

Superposition
The strange property of a quantum bit in which it can take many different values between 0 and 1 at the same time.

In conventional computing data are encoded in binary digits – bits (see Section 3.2). A bit is always in one of two possible states – a 0 or a 1, at any one time. These states, acting as on/off functions, ultimately drive computational functions. In contrast, quantum computation uses quantum bits (qubits), which can be in a **superposition** of states. The illustration gives us an idea of the strange notion of a quantum bit and superposition. It is possible to see at least two animals in this figure, a duck and a rabbit (Figure 13.11). Likewise, a qubit can be a zero (0) and a one (1), both at the same time.

Figure 13.11 An analogy of entanglement

Entanglement
The fact that qubits in a superposition can be correlated with each other.

In fact, a qubit is better thought of as a sphere in which the states of a qubit are represented by an arrow pointing to a certain location on the sphere. The north pole on this sphere is equivalent to 1 while the south pole is equivalent to 0. The other locations on the sphere are quantum superpositions of 0 and 1 (Figure 13.12).

Entanglement refers to the fact that qubits in a superposition can be correlated with each other. This means that the state of one qubit can depend on the state of another qubit.

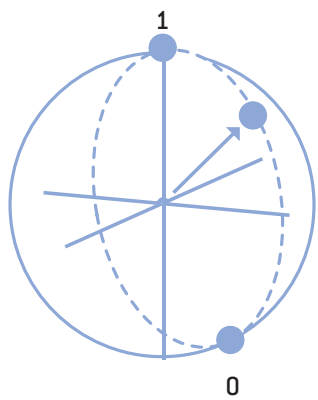


Figure 13.12 The superposition of a qubit

13.4.3 Quantum computers

Such properties of qubits make them interesting devices for computation. You can understand something of the power of a quantum computer if you consider a fundamental unit of a computer known as a register. Registers are used as working memory in computers. In a classical computer each unit of the register can take one of two values, a 0 or 1. Which means that a three-unit register can take only eight possible states (2^3) (Figure 13.13).

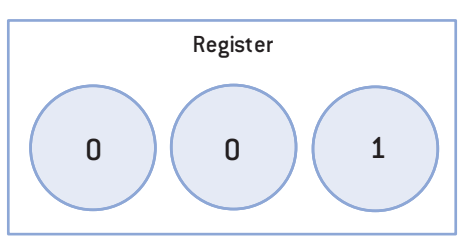


Figure 13.13 A computer register

Since a classical computer operates in a serial manner, to set each state of the register it needs eight individual operations. In a quantum register we can load all possible eight states of the register simultaneously in one operation (Figure 13.14).

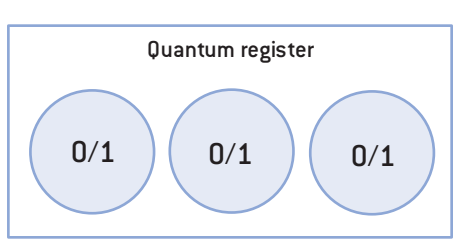


Figure 13.14 A quantum register

The larger the register the more computationally powerful a quantum computer becomes. One with 64 units could outperform a network of supercomputers, doing something like encryption. Some early prototypes of quantum computers have been built. The challenge is to find a reliable way of performing computation on a correlation of many qubits.

If and when such large-scale quantum computing becomes possible then there are numerous advantages to be gained. Quantum computers clearly have the potential to process large data sets very quickly. But they also could potentially be built out of cheaper materials than current devices and are likely to use lower energy consumption than a conventional computer.

13.4.4 Bio-computing

Bio-computing
The attempt to build or grow a computer from organic stuff such as DNA.

But what if it were possible to grow a computer rather than build one out of quantum material – this is the potential of bio-computing. Deoxyribonucleic acid (DNA) is a nucleic acid that is normally seen as the motor of biological organisation among all known living organisms. In this sense, DNA has always been referred to as a code. The molecular structure of this acid is seen as containing the instructions needed to construct other components of cells, such as proteins.

DNA can be considered a complex data structure consisting of chemical building blocks known as nucleotides, which consist of three parts: a phosphate group, a sugar group and one of four types of nitrogen base. The four types of nitrogen base are adenine (A), guanine (G), cytosine (C) and thymine (T). The order or sequence of these bases code biological instructions. For example, the sequence ATCGTT might code for blue eyes, whereas the sequence ATCGCT might code for brown eyes.

Each DNA sequence that codes for a protein is known as a gene. Proteins are complex molecules that do most of the work in constructing and reconstructing organisms. The size of a gene may vary greatly, ranging from 1,000 to 1 million bases. The complete DNA code or genome for a human contains about 3 billion bases, chunked into some 20,000 genes.

13.4.5 Bio-computer

A bio-computer uses systems of biologically derived molecules such as DNA to not only store data, but to compute with such data. It is easy to see how one might encode pretty much any data as the differences in nitrogen bases within DNA. But certain metabolic pathways can be engineered to behave in certain ways with a set of input molecules to produce a series of consequent reactions that produce a certain output.

One of the potential major benefits of bio-computing is that the components of a computer could be grown in cultures through natural processes of self-replication and self-assembly. This would make them cheap to produce, easy to repair and potentially infinitely expandable.

13.4.6 A universe of information

The biologist Tom Stonier (1994) argued that information is the fundamental essence of the universe, in being the catalyst for order. Just as energy is defined in terms of its capacity to perform work, so information is defined in terms of its capacity to organise a physical system. We observe something as being ordered if we see evidence of patterning. We observe a common pattern of differences which displays continuity

through time. But the persistence of any pattern demands regulation through control, and control demands information founded in some form of data. So it makes sense to think of all negentropic (ordered) objects in the universe as being founded in the accomplishment of information. Perhaps, in the long-term future, this will lead to a unification of computation, information, energy and matter, especially biological matter.

RECAP

Because of some inherent limits to computation, researchers are looking at building computers from different materials than silicon, such as DNA and quantum particles. This may lead to a unification of computation, information, energy and matter, especially biological matter.

13.5 A THEORY OF INFORMATION SYSTEMS

There is a tendency to think that the technology themes discussed in this and previous chapters are merely matters of changes to technological or ICT infrastructure. Writers then presume some degree of technological determinism, implying that innovations in computing and communications technologies act as critical drivers or forces that shape changes to social, economic and political infrastructure, particularly to the ways in which organisations work. For instance, AI is seen as a disruptive technology that necessarily will change the ways in which we organise many areas of contemporary work, currently performed by humans. Another viewpoint might be referred to as social determinism, the idea that both the development of and adoption of digital technologies is shaped by social forces. In this guise, the drive to develop AI actors can be seen to be driven by the demands of capitalist systems to gain ever greater control over the ways in which work is undertaken.

Within this book we have tried to provide a more sophisticated, and we believe more accurate, view of the relationship between social systems and technology systems as they apply within domains of organisation. It should be apparent from our method of exposition that we believe that a more sophisticated and accurate view is to portray the relationship between information technology (data systems) and activity systems as being much more cyclical in nature. Data systems and activity systems exist in a reinforcing cycle of interaction and creation through the mediating position of information systems.

Within much literature there is also a rather artificial separation between theory and practice. Theoreticians are meant to sit in their ivory towers remote from practical action while practitioners disdain the use of theory. We take the position that having stronger theory does not mean less relevance to practice. In fact, we would argue the opposite; as the American sociologist Kurt Lewin once said: '*nothing is as practical as a good theory*'. Good theory can help guide good practice in business information systems.

Within this section we want to highlight some of the key principles underlying the notion of an information system and how it helps us understand not only the worth of ICT (as data technology systems) but how both data systems and information systems are critical to any notion of organisation. We shall then see how this theory of information systems can accommodate ways of explaining and understanding some of the technology trends we have discussed in this and previous chapters. It also suggests a more encompassing notion of what applying ICT to issues of organisation means in practice and consequently what design and innovation should mean in relation to such technology.

13.5.1 Thought experiments

Thought experiment
A device of the imagination used to investigate things.

Let us make a thought experiment. The Stanford Encyclopaedia of Philosophy considers thought experiments to be '*devices of the imagination used to investigate the nature of things*'. A **thought experiment** (gedankenexperiment, in German) begins usually by portraying the features of some theoretical situation. It then 'experiments' with this situation, typically by thinking through its consequences.

Thought experiments are much used in theoretical physics. For instance, the thought experiment typically referred to as Schrödinger's cat was famously used to explore the consequences of quantum indeterminacy which actually underlies the qubit. Similarly, Maxwell's demon was used to explore certain consequences of the second law of thermodynamics, which defines the notion of entropy. Finally, Einstein's elevator was successfully used to expand upon the notion of relativity. However, thought experiments have a long and established history within philosophy, dating back to Socrates and Plato. Daniel Dennett has argued that philosophy would not be philosophy without the thought experiment. Thought experiments are also conducted frequently in professional disciplines such as law, where they are typically referred to as hypothetical cases.

Intuition pump
Thought experiments which rely upon the thinker's intuition to develop an answer to a specified problem.

The type of thought experiment we shall employ Daniel Dennett refers to as an **intuition pump**. Intuition pumps are thought experiments which rely upon the thinker's intuition to develop an answer to a specified problem. If a thought experiment is sufficiently rich, then various 'knobs' can be 'turned' within the experiment to see if our intuition holds.

13.5.2 The thought experiment of information situations

In this and the following sections we conduct a thought experiment which illustrates the necessary features of all information situations. We use this intuition pump to then show that any information system is built from these events or situations in which information is accomplished. Indeed, we would go so far as to say that we must think of any information system as a system of action through which information emerges. In other words, information is not a property evident in any part of such systems, it arises purely from the interaction between the elements of such systems.

Figure 13.15 illustrates the essential elements of any situation in which information is accomplished. Such situations consist of actors, structures, messages and actions, all taking place within some environment – which in our case is some domain of organisation. Actors (A1 and A2) are represented as cyclical and habitual entities. By this we are attempting to indicate that an actor is continually reproducing and reconstructing its internal environment (mind) in continuous interaction with some external environment (see Section 2.3).

The actor is continuously evaluating the results of its completed actions upon the external environment and feeding back such evaluations to help continuously 'form' its internal environment. Through such continual reconstruction, as well as improvisation, the actor learns or acquires certain habits or conventions which implement decision strategies. Such decision strategies, stored in memory, enable the actor to make effective choices between alternative courses of future action within certain environments or domains of organisation.

We assume here that actors have bodies, meaning that an actor's capacity to act involves interaction with its external environment, and that such interaction relies upon two critical forms of apparatus making up the body of the actor: a sensory

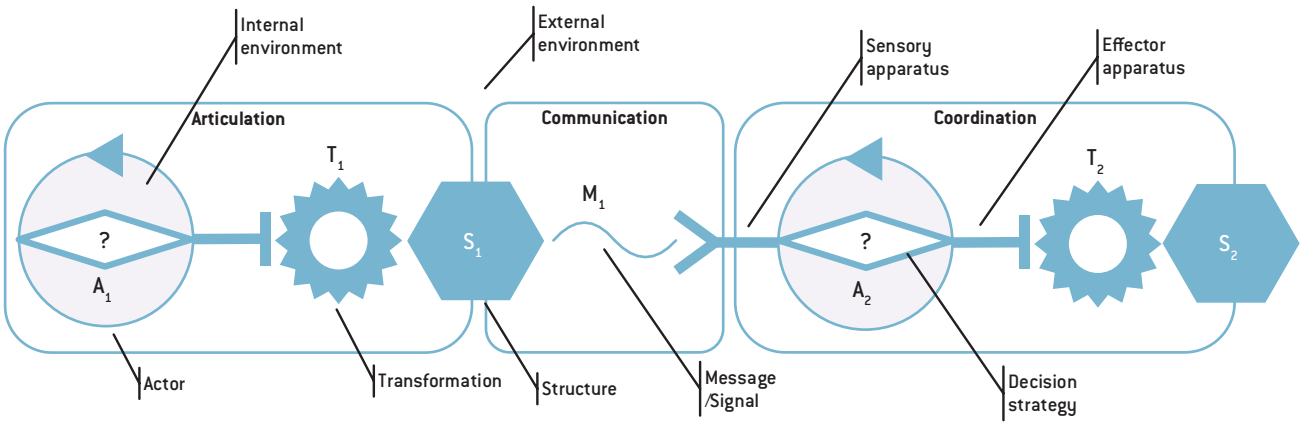


Figure 13.15 Component elements of information situations

apparatus and an effector apparatus. A sensory apparatus is made up of a series of sensors which continually monitor differences in the state of the external environment. An effector apparatus consists of a series of effectors that allow the actor to perform instrumental action in relation to this external environment – to manipulate structures within the external environment and through so doing to make differences to the state of the external environment.

Consider the minimal situation in which actor A1 transforms or articulates some physical structure S1 using his or her effector apparatus. This corresponds to a domain of action we have referred to previously as the *articulation* domain. The articulation T1 of structure S1 is sensed by the sensory apparatus of some other actor, A2. The sensed physical state of structure S1 serves to communicate, through acquired conventions, some message M1 to actor A2. These actions take place in what we have referred to as the *communication* domain. Finally, the message M1 acts as stimulus to the transformation T2 of some structure S2 within some work or *coordination* domain. This coordination may lead to further articulation of S1 in the articulation domain, and so on.

13.5.3 An information situation at Goronwy Galvanising

We can use this theorisation of an information situation to help understand information situations in practice. Consider one instance of such an information situation, visualised in Figure 13.16, from the case we considered in the opening chapter of the book. Within the domain of Goronwy Galvanising, an actor A1 (an outbound logistics manager) articulates some physical structure S1 (an electronic dispatch advice) in interaction with some IT system. The articulation of structure S1 is sensed by the sensory apparatus of some other actor A2 (an outbound logistics operative) in interaction with the IT system. The sensed physical state of structure S1 serves to communicate through certain acquired habits some message M1 to actor A2. The message M1 directs him to manipulate some structure S2 within the work or coordination domain, namely to load some shipping item upon a trailer. But this transformation only occurs if the actor evaluates both the content and the intent of the communication and decides to take the action communicated in the message. This coordinated action may lead to further articulation of structures such as S1 in the articulation domain, and so on.

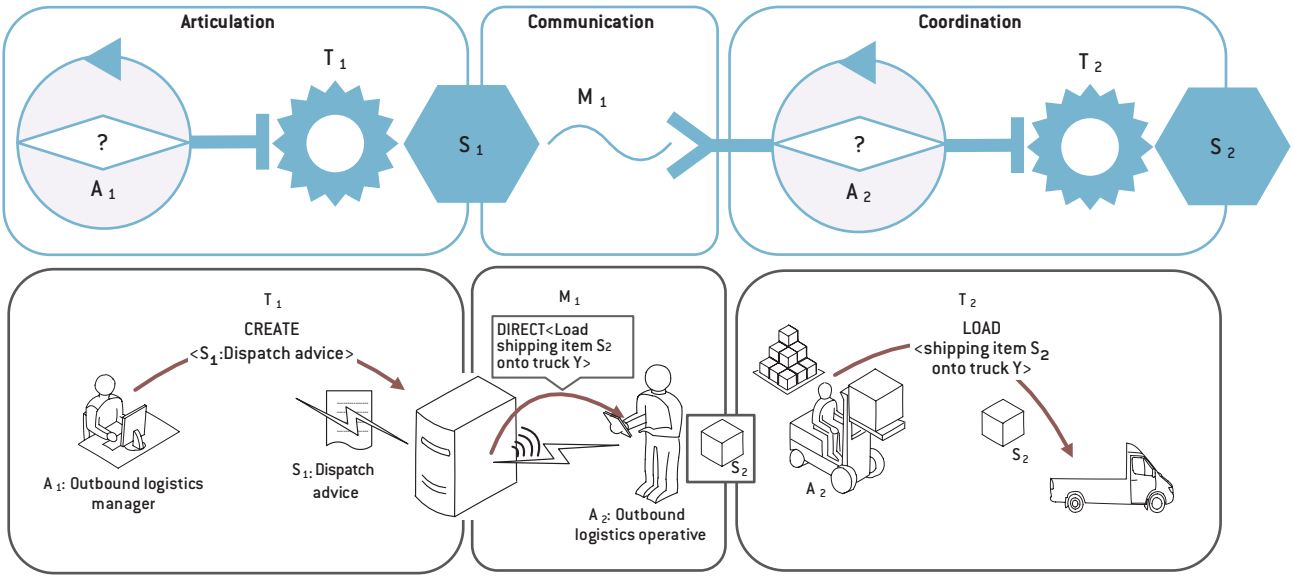


Figure 13.16 An information situation at Goronwy Galvanising

13.5.4 An information situation within eCommerce

We can also think through the consequences of our thought experiment within other domains of organisation, even in areas of digital business. Figure 13.17 illustrates another information situation, situated in a different domain of organisation – supermarket retail. Here a customer creates an online grocery order on some B2C eCommerce website. This order communicates to some grocery operator to pack and deliver the indicated groceries to a specified location on a specified date. This triggers a grocery delivery to the particular customer by another actor, namely a deliver driver.

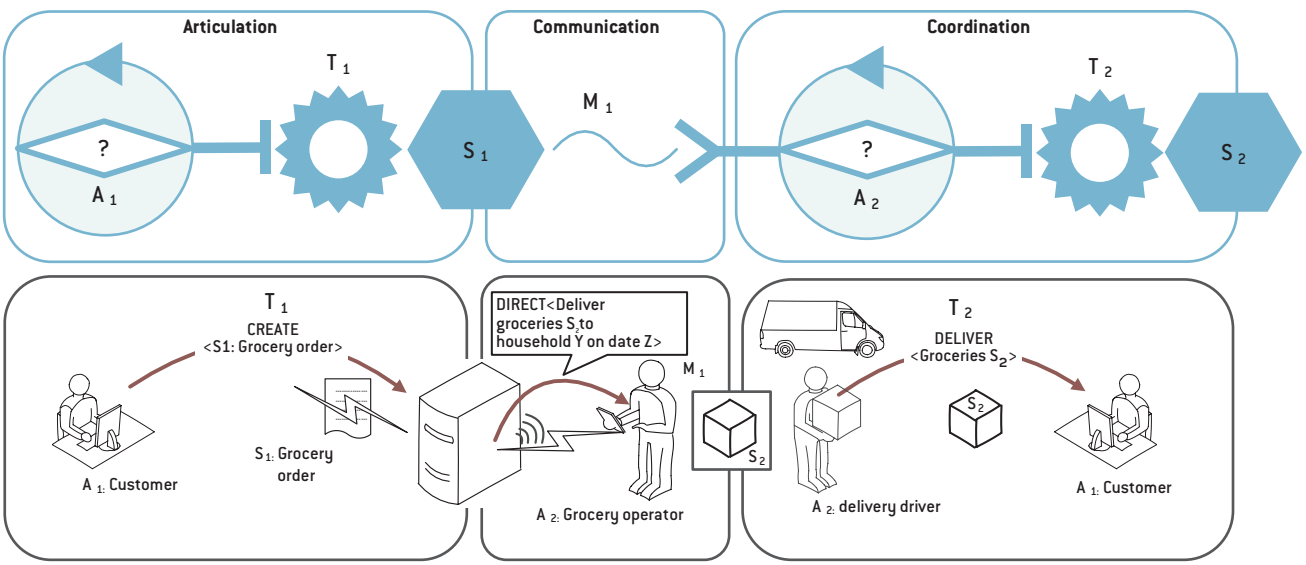


Figure 13.17 An information situation within B2C eCommerce

13.5.5 An information situation within a tangible information system

So information situations look similar in terms of their fundamental elements in both clicks and mortar (conventional) and clicks only (digital) business. The final example concerns an information situation in the public sector – within healthcare (Figure 13.18). It is also an example of a situation evident within a tangible information system rather than a digital information system. Here, a ward nurse articulates a coloured, magnetic token in relation to a magnetic whiteboard. The state of the whiteboard records the current state of action in relation to bed management on an intensive care unit (ICU). The positioning of this token upon the whiteboard is read by another actor, namely another ward nurse, and it informs her to move (admit) a particular patient to a designated bed for treatment.

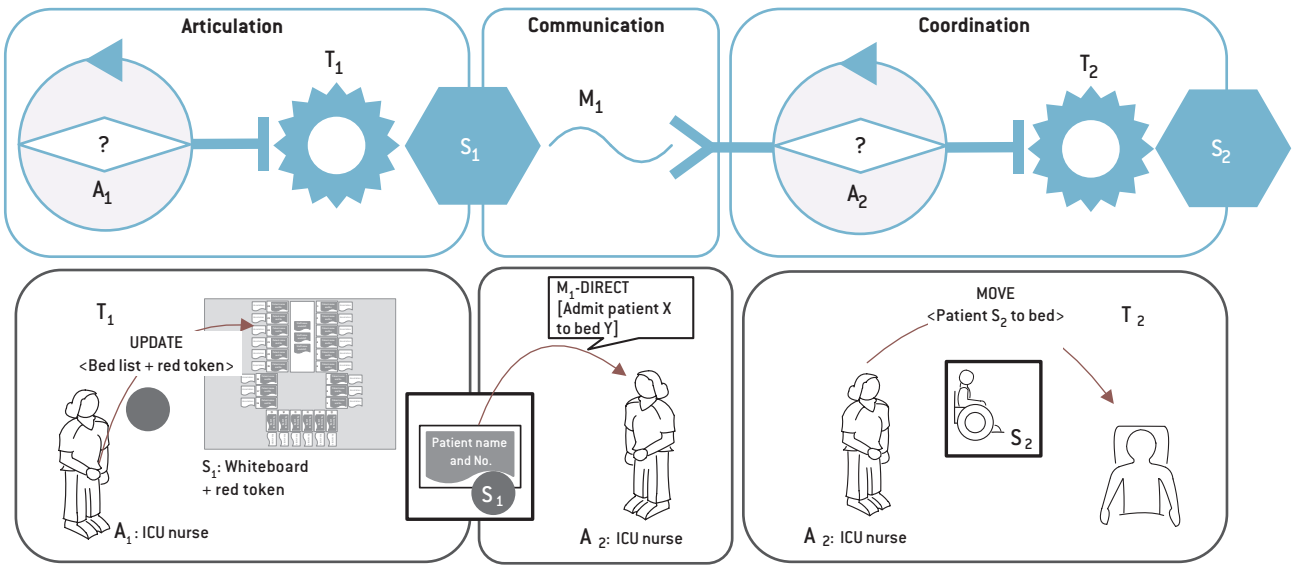


Figure 13.18 An information situation within healthcare

13.6 KEY PRINCIPLES OF INFORMATION SYSTEMS

Within the previous section we developed an intuition pump – a thought experiment of information situations. Clearly, any information system in practice must consist of a multitude of such information situations enacted by multiple actors at different times and in different locations and often within different domains of organisation. Therefore our intuition pump reveals important principles about the nature of information, and information systems within all domains of organisation.

13.6.1 What information is and is not

Clearly, situations of information are about information. But there is much confusion as to what information is. There is a tendency to think of information in much literature as stuff that can be created and transmitted relatively unproblematically, as well as used effectively with little issue. We have tried to demonstrate in this book that this view is incorrect.

But to do this the use of clear terminology has been important. We have devoted great effort in this book to clearly distinguishing between differences making further differences – between data and information (Chapter 3). Data are symbols formed

out of stuff and given structure within data structures – they are artefacts articulated in some substance such as air, light, paper or silicon. Information is an accomplishment made with such data structures by actors. Differences are made in some actor by the encounter with some data through data structures.

This means that it is important to separate out the act of manipulating or articulating some structure of data from the act of being informed by it. As a direct consequence, the actor being informed by a data structure may not be the same actor who articulates that data structure. Hence, in the bed management information situation one ward nurse places a magnetic token at a certain point on the whiteboard – this is an act of articulation. One shift later another nurse comes onto the ward and looks at this point on the board. The presence of a token of a certain colour informs her of the current health state of this patient placed in the indicated bed.

A certain data structure may be informative for one actor and not for another. In other words, two different actors may accomplish different information with the same structure as a direct result of a communicative habit or convention established within some domain of organisation. Hence, in the case of Goronwy Galvanising, a production IT system might assert that a given product container is placed currently at a given production location. In another information situation within this same domain of organisation a production supervisor might direct a production operator to move a production container to a designated production location.

13.6.2 What an information system is and is not

Information situations, such as the ones described, clearly do not stand in isolation. They are clearly component elements of wider patterns or systems of information. Therefore our intuition pump should tell us what an information system is, and consequently also what it is not.

So where is the information system evident in the information situations we have considered? It is not in the technology, which is devoted primarily to the articulation of data structures, such as the creation of electronic records or the positioning of magnetic tokens. It is also not in the work, which is devoted to the realisation of coordinated, instrumental action, such as moving production containers or managing beds in an ICU. It is also not solely in the acts of communication, such as assertions and directions, which result from the articulation of data structures and their use for making sense of what to do next.

This leads us to suggest that assigning the concept of an information system to the category of one or more of the substantive elements of our intuition pump, which each contributes to some way of organising, is to commit what the philosopher Gilbert Ryle refers to as a *category mistake*. A category mistake is an error in understanding and classifying a thing within reality. It involves stating that something belongs to a category or class when this thing belongs to a different category or class altogether.

Within disciplines where the use of the term *information system* is commonplace, there appears to be a marked tendency to commit a similar category mistake. Much of the literature tends to equate an information system necessarily with the application of digital computing and communications technology. It is evident from a close analysis of actual information situations (such as the ones described throughout this book) that an information system belongs to a different category altogether.

We have deliberately considered several historical examples in this book (such as the Inka khipu, the electronic tabulator, station X and the RAF's warning network) to

emphasise that we have had information systems for many thousands of years – perhaps for as long as humans started to organise themselves for the collective achievement of activities such as agriculture and manufacture (Chapter 4). We have only had digital computing and communications technology for 80 years or so, and these technologies have only really been employed within information systems for at most 60 of those years (Chapter 5).

We have also hinted that information situations are clearly not the sole preserve of human organisation. Many animals, such as honeybees, clearly engage in systems of action in which information is accomplished, albeit of a much simpler kind than experienced within domains of human organisation. Scout bees clearly communicate with other honeybees as to the location of sources of nectar.

What makes things different in the modern digital infrastructure is that information situations increasingly occur within machine-to-machine interaction. Such situations are increasingly important to many contemporary domains of organisation. For example, the automatic trading systems by which much securities trading occurs around the world must clearly fall within the remit of an information situation.

All this suggests that it is best to conceive of information systems and the information situations from which they are made up as not reliant upon certain technologies, such as ICT and actors such as humans. Instead, the notion of an information system is a meta-concept detached from any nominated technologies and actors, but which emerges within some system of action having elements characteristic of our model of an information situation.

13.6.3 Systems and patterns of action

The concept of pattern and the related concept of a system are central elements of the account provided in this book (Chapter 2). They help, of course, to provide the context for all information situations and their corresponding information systems.

A pattern is anything which repeats across situations. The things that repeat within domains of organisation are actors, actions, locations and times; actors taking repetitive action in designated locations at certain times.

Within most contemporary domains of organisation action is not only taken or enacted by humans, but also by 'machines' (such as ICT systems) and somewhat by other artefacts (such as data structures). Hence, within many of the cases discussed in this book, such as Goronwy Galvanising, the emergency ambulance service and university short courses, patterns of organisation are evident in the way in which humans interact with machines such as forklift trucks, but also with ICT systems such as production ICT systems.

It is evident that what organising consists of in all the domains we have considered is an interleaving of three interrelated types of action, which for lack of better terms we have referred to as articulation, communication and coordination. Articulation is concerned with data. It stands for the various ways in which substance is given form, with the intended purpose of informing actors. Communication is concerned with information. It stands for the various ways in which actors inform themselves and others, with the intention of coordinating activity. Coordination is concerned with instrumental activity. It stands for the various ways in which informed actors achieve coordinated performance in the achievement of collective goals.

Take the example of patient admissions to general hospitals. To enact or undertake patient admissions a human actor must interact with a machine actor, namely a patient admissions ICT system. Clearly, this ICT artefact affords human actors certain actions,

such as being able to make and view electronic patient records. However, the affordances of the ICT artefact apply purely within the domain of the ICT artefact itself and involve solely the articulation of data structures as signs. But these data structures are used as cues or triggers to further action by actors in another context or domain – the domain of coordinated, instrumental work. Informing on such data structures triggers a consequent change to the action of another actor who detects that electronic record on the patient administration system, and then performs an action in a completely different place (such as at a hospital bed) and at a different time (such as one working shift later).

Action takes place as sequences or cycles of events, and these events occur at specific times and are located somewhere. This means that patterns of organisation always have a temporal and a spatial component. There is a necessary time lag between one actor articulating a magnetic token, or entering a patient record, another actor interpreting the meaning of such articulation, and yet another actor performing some activity. The lag may be seconds, minutes, hours, days, weeks or potentially even months, depending on the work setting. Actions also always take place somewhere. One of the key advantages of ICT is that communication can spring across locations remote from one another and therefore serve to coordinate activity in different places and at different times.

A system of organisation consists of a coherent set of interrelated patterns of action that serve to achieve certain goals. One of the key advantages of thinking of ways of organising as systems is that we can apply the principle of hierarchy to help us deal with complexity. We can think of the environment as a system, or a subsystem as a system, and apply analysis to better understanding how such systems work. We can also think of whether the system is doing what we would like it to do and consider change to such systems.

13.6.4 Designing organisation

All systems are purposeful, meaning that there is a clear relationship between systems thinking and design (Chapter 10). Systems of organisation exist for some purpose or purposes which are normally to produce value of some form – to produce something or to provide some service.

Systems of organisation can be designed because systems of action are open systems and all open systems are subject to the property of *equifinality* – that the goal or outcome of some system of action can be achieved in a number of different ways. This implies that we can design different systems of action to achieve the same goal; that we can implement different conventions of action to achieve the same outcome, of creating value.

There is a tendency in much literature and practice to think of information systems design as purely ICT systems design. This is probably one of the biggest mistakes that technologists make. Analysis of why information systems fail frequently points to inappropriate design taken because of the limitations of this worldview.

The design of information systems must necessarily involve much more than the design of merely the technology. It must involve the design of organisation because of the necessary coupling of data, information and activity in all domains of organisation (Chapter 11). Hence, to design information systems for certain ways of organising, we must inherently make sense of not only how three patterns of articulation, communication and coordination pan out but how they interrelate.

For instance, to make sense of some data structure and explain the design of such an artefact to others, we need to describe not only the structure of such an artefact, we need to describe how the elements of such structure are articulated by significant actors

for the domain in question – how the data structure is created, updated, read and eventually deleted. People wishing to explain the design of the information system then frequently attempt to relate the articulations performed upon the artefact with certain coordinated work actions. But to do this successfully the designers must deal with the ways in which certain articulations communicate to other actors and how such communication in turn relates to instances of coordinated action.

Take an example relevant to digital computing and communication systems. Suppose a health service wishes to design an electronic patient record which is shared across different domains of healthcare. Decisions as to what should go on such a record or what should be omitted from such a record can only be taken in terms of the action, or more likely actions, taken with this record. In other words, you cannot design an effective electronic patient record and its associated system without knowing not only who is likely to use such a record and how, but for what communicative purposes and to initiate what coordinated action.

This helps explain why numerous problems have been experienced with the introduction of electronic patient record systems, particularly those that attempt to integrate the work of multiple teams of healthcare workers. This is because a level of agreement about appropriate action to take in relation to aspects of this data structure is difficult to achieve across different healthcare roles such as clinicians, nurses, physiotherapists etc.

13.7 UNDERSTANDING CHANGE TO DIGITAL INFRASTRUCTURE

Our theory of information systems not only provides for us a theory of design, but also a theory which allows us to understand change to domains of organisation, particularly those which involve some form of digital innovation (Chapter 11). So, in this final section, we speculate upon some of the likely effects of innovations in ubiquitous computing, AI and new architectures for computation to digital infrastructure.

13.7.1 Tangible information systems

The philosopher of information Luciano Floridi (2014) has argued that the threshold between online and offline has been gradually breaking down as the digital infrastructure becomes so critical to activity of all forms. As a result, we have all become *information organisms* acting within *the infosphere*. By this he means that the digital infrastructure that penetrates everywhere causes a fading between face-to-face and remote or mediated communication. The transition between the offline and the online worlds becomes almost invisible to the average citizen and consumer.

This prediction appears to gel with developments in ubiquitous computing. We take it as a general trend that computation is gradually moving from the foreground into the background of human activity. To interact with ICT currently you must interface or interact with it – which normally means that you use certain input devices such as keyboards and mice to articulate data and receive data back through certain output devices such as screens and printers.

But developments in ubiquitous computing suggest that computation will inevitably become a pervasive and embedded part of our everyday interaction with many, if not most, tangible or physical artefacts. As more and more non-digital objects become digital objects, the worlds of bits and atoms will necessarily merge. More specifically, the notion of interface will eventually disappear as we push the notion of computing devices into the background, making them all but invisible.

Information systems which involve the articulation of tangible or physical artefacts have existed for many thousands of years. For example, in as early as 10,000 BC small clay tokens were being used as signs which signified the quantity of certain commodities held in various storehouses. But tangible artefacts such as whiteboards and magnetic tokens are still very much used in many domains of organisation, such as manufacturing, healthcare and education, for the coordination of work. Such systems are often referred to, and somewhat confusingly, as manual information systems or sometimes visual management systems. The term 'tangible information system' is a better way to refer to such systems.

Tangible information systems continue to be effective as ways of coordinating activity among small groups of co-located workers performing routine work – such as in the case of our ICU example. But they suffer as a means of providing an organisational memory – of informing a large multitude of different actors what has happened, what is happening and what is likely to happen within interacting domains of organisation. In other words, tangible information systems do not provide digital traces of activity very effectively. And for such reasons it becomes very difficult to account for this activity and to audit this activity. Digital information systems are of course very good at providing such digital traces.

There is much potential for a melding of the tangible with the digital in future information systems. An example of such melding is provided in Figure 13.19. This tangible interface emulates many of the features of the original tangible whiteboard within an ICU in that rather than data being entered via a keyboard, physical tokens are

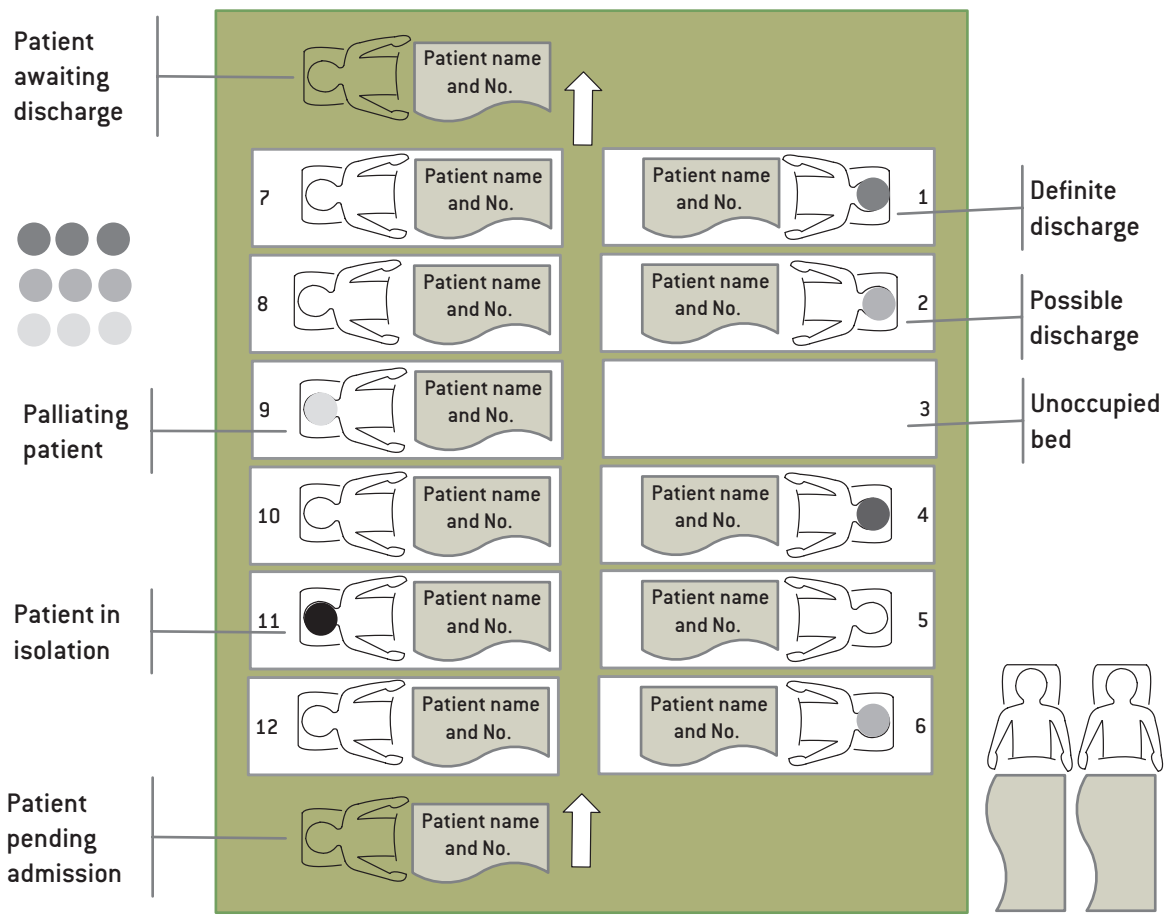


Figure 13.19 A melding of the tangible with the digital

moved onto or off the interface 'surface'. A patient token first becomes inscribed with a patient name and number to indicate that a given patient is awaiting admission to the ICU. Medical staff then tap on this token or perhaps place it in a read position on the 'surface' to access further details and decide on this basis the priority of admission by placing the chosen patient token(s) at a pending position upon the 'surface'. To admit a pending patient, the patient token needs to be placed in an unoccupied bed on the 'surface'. Moving a 'patient' token onto an area of the surface in this manner would not only signal to all other actors within the ICU, it would create a digital trace of the current bed allocation of the patient. Also, placing a token of a certain colour on the 'face' of a designated patient not only signals a change of patient state to the actors of the ICU, it enters a digital trace which records this change to their current classification.

13.7.2 Artificial actors

ICT systems are particularly used as sophisticated data articulation systems within modern organisation. And, as such, ICT systems are critical communicative actors in modern economic, political and social systems. But, as such, most contemporary domains of organisation still involve a mix of human and machine action – even in highly automated domains such as manufacturing.

With innovations in AI, IoT and robotics the potentiality of technological actors clearly increases. Technology systems become performative as well as communicative actors. In other words, the range of ICT systems moves to accommodate all types of action within certain domains of organisation.

Weak AI has demonstrated the potential to produce actors that can emulate and sometimes exceed human decision-making in limited domains of action. The increasing penetration of the IoT is likely to increase the range of machines that can not only communicate with humans but also with other machines. Advances in robotics increase the number of activities that can be physically performed by machines, independently of human intervention.

All such developments raise the possibility that major domains of organisation will be enacted not by humans and machines, but machines acting in association with other machines. But the key point made in this book is that change to systems of organisation is not inexorable and inevitable – it involves choice. The critical question for all of us in modern societies is whether we should design future systems in this manner or whether we should engage in much more human-centred design.

13.7.3 Convergence, control and the centrality of data

The typical view of data, just like information, is that it is a passive concept. But it is clear from the way in which data form a critical pillar of growing digital infrastructure that data are very much active – they get things done. This is not just a result of technological innovations like big data and data-driven AI, it is a direct result of the central place of data within any infrastructure of organisation.

Consider a piece of data – a personal identifier such as a passport number. A passport number such as *109999555* refers to a person. But a passport number as well as other data which serve to describe the person identified and which are placed within the data structure of a *passport* serves another purpose. Possession of a passport serves as one way of classifying a designated person as a citizen of a nominated nation-state.

Passports and passport identifiers were originally designed to enable the declaration of citizenship within the activity system of international travel. But such data structures

and identifiers are now used in many other situations relating not only to government and its agencies but to interaction with private sector institutions.

For instance, a member of the UK Border Agency can use a passport number to authenticate a person. In other words, the occurrence of a given passport number on a passenger list *asserts* that the individual is who they say they are and that they are entitled to travel on a given airline to a given destination. But passports and passport numbers are used as a form of personal identification in many other settings. For instance, many financial institutions demand the strong authentication provided by a passport when opening a bank or building society account within the UK. Passports are frequently used by young people to prove their age. The usefulness of this data structure and associated identifier is particularly evident in that over 70% of the UK resident population hold a passport.

Personal identifiers are used in many types of lists within many domains of organisation to sort people into categories which in turn determine the actions taken with such people. For instance, if you apply for a personal loan the personal data you supply will be checked against lists of persons supplied by credit-rating agencies. If you appear on one of these lists, then your loan will be refused; if you do not appear then your loan is likely to be granted.

The main difficulty here is that the pattern of activity we have just described may be enacted entirely by machines. ICT systems will be communicating about you, making decisions about you and controlling action taken in relation to you. The sociologist David Lyon argues that this has some unintended consequences. He refers to these patterns of action as *social sorting* – the way in which contemporary institutions make frequently life-critical decisions about individuals on the basis of inclusion or exclusion of personal identifiers upon particular lists. He argues that such lists are explicitly devices which serve to sort those persons regarded as 'eligible members' of a particular institutional area and to exclude others, regarded as in some way 'undesirable'. This serves to reinforce existing structures of social and economic exclusion within society and the economy (Chapter 6).

More worryingly still is the notion of *social credit* which is developing as a data construct in certain countries around the world. This amounts to monitoring people's online behaviour and scoring people's social as well as economic credit. Hence, for example, being friends with low rated people might lower your social credit score to such an extent that algorithms prohibit you from doing things like obtaining certain state benefits.

This would not be so problematic if there was not a developing convergence and control of the modern digital infrastructure. We know that much of the action taken through the Internet and the Web is undertaken through a small number of conduits. Much of the data collected about you are under the control of large, primarily US-based technology corporations. These organisations are extending their reach into areas such as digital cash and credit, which will, if unregulated, give them enormous power to control the activity of individuals across the globe (Chapter 7).

13.7.4 The melding of computation, information and organisation

With Turing machines made of atomic or biological stuff the distinctions between computation, information and organisation raised within this book perhaps start to break down. The physicist John Archibald Wheeler coined the phrase '*IT from BIT*' to sum up his contention that every material thing is at bottom derived from immaterial stuff – from yes-no responses (bits) to questions posed of such stuff by humans working with and through various forms of technology. In other words, for Wheeler, just like

Stonier, the organisation of material objects is derived from information. The semiotician Thomas Sebeok (1976) raised a similar conception of the relationship between information and biology when he came up with the aphorism that '*life is a sign's way of making another sign*'. At first sight this saying appears bonkers. But on closer examination, this apparently paradoxical saying encapsulates the performative nature of DNA as code, as a data structure. DNA of course code genes and genes are the fundamental building blocks of life. But in the very act of making life from such substance we recreate the sign, the DNA.

Take one practical example of this relationship between the material and the informational. Luciano Floridi raises the important problem that we are generating so much data in the modern digital infrastructure that we do not have sufficient capacity to store such data. The memory devices of ICT have grown astronomically in the amount of data we can store. But we still do not have enough capacity to store all the new data we generate on a second by second basis in the modern digital world. This means that what we tend to do is to overwrite old data with new data within the digital infrastructure, causing loss of history – the erasure of the record. Most modern websites, for instance, have a life of only a few weeks. When new websites are published the content of the old websites is normally lost.

But what if we could effectively store such data using biology rather than silicon? The three zeta-bytes of digital data that we generate in a matter of days might be recoded and written within DNA strands through DNA synthesis. Such DNA strands occupy comparatively little space and have been proven to last many thousands of years if kept dry and cool. To read back data DNA, sequencing machines can be used.

DNA is currently data which is computed through biological operations to build the infrastructure of life. In this example, DNA is data which is computed through operations of synthesis and sequencing to rebuild digital infrastructure.

13.8 CONCLUSION

In a book of classic science fiction, the author Ursula Le Guin provides a quote which is very relevant to the issues considered in this book. A character says, '*The idea is like grass. It craves light, likes crowds, thrives on cross-breeding; grows better for being stepped upon*.'

The field of information systems is necessarily a practical discipline. Its growth relies on continuous engagement with the application of information, information systems and ICT in and between organisations. But the field which used to focus solely upon the application of digital computing and communication within domains of organisation must necessarily broaden its range of intellectual discovery because of the increasing interplay of signs and systems within our growing range of technologies. The way in which the digital is becoming ubiquitous and embedded within the fabric of everyday existence requires that we become more engaged and critical of the ways in which ICT is being used to disrupt established patterns of action.

Readers are encouraged to engage with the field-testing of the ideas and approaches described in this text. Try, if you can, to give the ideas and approaches some light. Become part of the crowd which continually enacts practice, but also reflects upon and changes such practice. Do not be afraid of transporting new ideas and approaches into the mix and cross-breeding them with those expressed here. Most importantly, do not be afraid of 'stepping on' the ideas and approaches. Please contact the author (beynon-daviesp@cardiff.ac.uk) and tell him when you have found the ideas and approaches useful, but more importantly, when you have not and why not.

13.9 FURTHER READING

Intuition pumps are discussed in Dennett (2014). Works by Dourish (2004) are good ways into the area of ubiquitous computing. There are lots of accessible books on developments in IoT (Greengard 2015) and data-driven AI (Heaven 2017). Quantum computing is discussed in an accessible *New Scientist* collection. Stonier sets out his thesis that information drives the universe in his (1994) article. Lyon has discussed the idea of social sorting in numerous publications, such as his (2009) book. Floridi's books (2010, 2011, 2014) provide a fascinating account of the relevance of philosophy to understanding not only information but how our 'information' technologies are transforming notions of reality. Brynjolfson and McAfee provide a much more optimistic account of technological change than that account provided by doomsayers (2014). The performativity of data is discussed in my paper (2015).

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CASE STUDIES

	Specially written case studies (in the book)	Systems of organisation	Data and information	The infrastrcuture of organisation	ICT infrastructure	The digital environment	Digital business	Electronic marketing, procurement and government	Mobile commerce, social media and disruptive innovation	Designing digital organisation	Digital innovation and digital strategy	Developing, managing and operating digital infrastructure
1	Alibaba	●		●	●	●	●	●	●		●	
2	Amazon	●	●	●	●	●	●	●	●	●	●	●
3	Apple	●		●	●	●	●	●	●		●	
4	Cyberwarfare and data security	●	●		●	●	●	●	●		●	●
5	Digital innovation and disruption in the music industry	●		●	●	●	●	●	●		●	
6	Facebook		●			●	●	●	●			
7	Failure in public sector ICT infrastructure	●	●		●		●	●		●	●	●
8	Google		●		●	●	●	●	●		●	
9	Internet governance	●	●	●	●	●	●	●	●	●		●
10	Microsoft		●		●	●	●	●			●	
11	Online grocery	●	●	●			●	●	●	●	●	
12	Open source software	●			●	●	●	●		●	●	●
13	Twitter		●		●	●	●	●	●			
14	Wikipedia		●		●	●	●		●			●

	Specifically written case studies (On the web-site)	Systems of organisation	Data and information	The infrastrcuture of organisation	ICT infrastructure	The digital environment	Digital business	Electronic marketing, procurement and government	Mobile commerce, social media and disruptive innovation	Designing digital organisation	Digital innovation and digital strategy	Developing, managing and operating digital infrastructure
1	Cisco	●			●							●
2	Dell	●			●				●			●
3	Dotcym		●		●	●		●	●			
4	YouTube	●	●		●	●	●	●	●		●	
5	HM Revenue and Customs				●	●			●	●	●	
6	Offshoring in Bangalore			●	●		●			●	●	●
7	Open source software: MySQL and Linux				●					●		●
8	Tesco	●	●	●	●	●	●	●		●	●	
9	Victorian railway clearing house	●	●									

1. ALIBABA

Alibaba Group is a Chinese multinational digital business that was founded in 1999 by Jack Ma and his associates. Ma is supposed to have gained inspiration to establish eCommerce in China after a visit to the United States in 1995. Because China at this time had only 2 million Internet users (1% of its population), the platform was originally created as a means for Chinese manufacturers, such as makers of clothing, to sell to foreign buyers.

In the decades since its creation China has made tremendous leaps forward in its digital infrastructure. This has enabled Alibaba to take up a dominant position within the digital economy of this country. This eCommerce platform not only offers B2C eCommerce and digital entertainment but also social media and electronic payments as well. It is estimated that the various websites provided by the company now account for 80% of China's eCommerce transactions. Over 80% of adults situated in China's largest cities now shop online.

The rise of Alibaba was powered by hundreds of millions of well-off Chinese who were beginning to come online. It was also facilitated by a lack of native eCommerce sites and deficiencies in certain aspects of the Chinese digital infrastructure at the time. Reputedly to combat eBay's entry into the Chinese market, Alibaba created Taobao in 2004 as a C2C eCommerce platform, where independent sellers can

list their products. Taobao achieved a competitive edge over eBay by not charging listers transaction fees on sales.

In the late 1990s to the early 2000s, credit cards were almost non-existent in China. So, Alibaba created Alipay, a digital payments system that held a buyer's money until he received his order and was happy with it. Alipay is now used by over 500 million people not only to engage in eCommerce transactions but to pay household bills, buy lunch and to send money to family members. This means that Alipay has more than 2.5 times as many users as PayPal. Alipay now processes an estimated half of all online transactions in China. China has more than 100 cities with over 1 million people. This density of demand encouraged logistics firms to build effective distribution networks, which helped support the rise of eCommerce. In 2016, online sales in China hit 366 billion US dollars, almost as much as such sales in the United States and the UK combined.

The company has continued to expand its offerings, such as AliMusic – a music-sharing site, Youku – a video-streaming site, Weibo – a social media company, and Difi – a ride-sharing service. The strategy is clear: to offer the Chinese population digital businesses based within and operating out of China. Alibaba is thus a conglomerate of digital business operations not seen in the West. Some feel it useful to think of Alibaba as like a combination of Amazon, Twitter, eBay and PayPal all combined. The company, like many of the US-based technology giants, makes most of its revenue through advertising. But Alibaba is not the sole eCommerce company in China. It has competition from companies like Tencent and JD.

Points for reflection

- Alibaba has obtained dominance in online retail by being the first to offer eCommerce in the Chinese market. But what other factors explain its dominance?
- Why have US companies like Amazon been slow to enter the Chinese economy? What barriers to entry exist in the Chinese market?
- The Chinese financial sector is highly regulated. How has Alibaba managed to innovate in financial services within this market?
- Alibaba has a curious structure of ownership, in that Western investors work through an intermediary based in the Cayman Islands. Investigate this and come to some conclusion as to whether this model of ownership is sustainable within the global marketplace.

2. AMAZON

Amazon.com is an American eCommerce company based in Seattle, Washington State. The company was one of the first major companies to sell goods over the Internet. It was also one of the most prominent traded securities of the late 1990s dot-com 'bubble'. When this bubble burst, many claimed that Amazon's business model was unsustainable. The company made its first annual profit in 2003. Consequently, Amazon.com is probably the most cited example of a company that has succeeded at B2C eCommerce. Amazon is expected to make approximately 158 billion US dollars in sales in 2018. Amazon earns more than two thirds of its income in North America.

Amazon.com was launched on the Web in June 1995 by Jeff Bezos. Bezos obtained backing of venture capitalists in Silicon Valley to start the operation. He chose to name his site after the world's longest river because Amazon, according to Bezos, was set to become the world's largest bookstore. At the time of Amazon's entry into the market it had no significant rivals. Within one year the company was recognised as the Web's largest bookstore.

At the start, Bezos warned investors that they were unlikely to make a profit in the first five years of operation. However, Amazon has engaged in an aggressive expansion strategy since its inception. It has acquired a number of additional retail outlets such as toys and CDs, and has provided a facility for online auctions of small goods. It introduced zShops in 1999 which is a facility that allows any individual or business to sell through Amazon.com – a form of C2C trading. It also has invested in a number of digital businesses and has opened a number of distribution centres and operations around the world.

Although we tend to think of Amazon as one website, it has separate websites placed strategically around the globe in places. The company provides a number of levels of functionality through its website, such as search features, additional content and personalisation. Many of these features were first innovated by the company. The site also provides searchable catalogues of books, CDs, DVDs, computer games etc. Customers can search for titles using keyword, title, subject, author, artist, musical instrument, label, actor, director,

publication date or ISBN. In terms of added value, the company offers a vast range of additional content over and above its products. For example, cover art, synopses, annotations, reviews by editorial staff and other customers, and interviews by authors and artists. The website attempts to personalise the customer experience by greeting customers by name, instant and personalised recommendations, bestseller listings, personal notification services and purchase pattern filtering.

The primary value stream for Amazon is non-digital goods such as books and CDs. As primarily a non-digital goods retailer the major transformation of its value-creating system is distribution and sales. It offers a vast range of non-digital goods for sale to customers and delivers them to customers. From the start, Amazon has also offered a range of value-added services to its customers. A popular feature of the website is the ability for users to submit reviews for each product. As part of their review, users must rate the product on a scale from one to five stars. Such rating scales provide a basic measure of the popularity of a product. The reviewing facility has been seen by some as critical to the explosive growth of the company. Other added-value services include a personal notification service for customers requesting particular products, a recommendations section where customers can recommend products in various categories to other customers, an awards section which lists goods such as books that have won prizes and an associate programme where other sites can link to Amazon to sell their own selections – a form of P2P eCommerce.

In 2007, Amazon launched its Kindle eReader. This has enabled the company to offer content as a digital good in the form of an electronic book or eBook. Customers owning a Kindle can both download content from the Amazon website and pay for such content. This has become a major revenue stream for Amazon over the last decade. Amazon has increased the range of digital content available, creating Amazon Prime for movie streaming in 2005. In 2009, Amazon introduced its full table device, Kindle Fire. Through these devices, which the company sells largely at cost, Amazon has developed an effective digital ecosystem.

Although Amazon is a retailer, its key business strategy is based on differentiation in terms of technical infrastructure. For Amazon to keep this competitive differentiation it must continually be at the forefront of Internet technology. Bezos has indicated that he considers Amazon to be a technology company first and a retailer second. Hence the key differentiating factor for Amazon over the conventional retailer is the Internet and Web.

Not surprisingly, the company must ceaselessly innovate in terms of technology. Amazon must ensure that back-end systems managing its supply, sales and distribution processes work effectively. To be continuously able to upgrade its digital infrastructure the company employs a vast range of software developers situated in a number of centres around the world. Amazon's main software development outfit is based in Seattle, United States.

Amazon's service to customers relies on a close integration of its website to back-end information and activity systems. For instance, the company uses a streamlined ordering process reliant on previous billing and shipment details captured from the customer. Amazon also utilises secure server software that encrypts payment information throughout its integrated fulfilment process. Most of the company's products are available for shipping within 24 hours. Amazon also requires a range of integrated back-end systems in place. Inbound logistics involves the management of the purchasing of goods and the distribution of goods to large warehouses. The process of operations involves unpacking and storing such shipments as well as picking of goods to fulfil customer orders. Outbound logistics involves the distribution of goods to the customer. Marketing and sales involves the advertisement of goods on its web catalogue and handling the purchasing of goods through its website. Aftersales service involves the handling of customer enquiries and complaints.

Since the mid-2000s, Amazon has engaged in a strategy of attempting to build upon its core business model of online retail as a basis for engaging in two major forms of B2B eCommerce: providing order fulfilment and web services for external business actors.

Fulfilment allows small and large companies to pay to use Amazon's order fulfilment infrastructure for their own purposes. Amazon stores the company's inventory in their own warehouses and provides product picking, packing and shipping to the customer once an order is received by the company.

Amazon played a significant part in the development of cloud computing. An analysis of the performance of its data centres in the early 2000s found that they were utilising only 10% of their capacity at one

time. Introducing aspects of cloud architecture, such as data virtualisation, allowed it to operate its data centres far more efficiently. This led to the development of an effort to provide cloud computing to external customers. Amazon Web Services was launched in 2006. This developed from a major revision of its ICT infrastructure which separated its back-end from front-end functions. This initially enabled the company to manage its websites more effectively. Eventually it was realised that a new business offering could be built upon this technological change. Now Amazon offers not only base utility functions, such as cheap online storage to external businesses, but also the ability to run complete applications for companies on Amazon servers.

This infrastructure has also enabled the company to engage in forms of P2P eCommerce. For instance, the websites of many global companies are now hosted by Amazon. The company also runs multichannel access for a number of companies. Such sites allow the customer to interchangeably interact with the retail website, standalone in-store terminals and phone-based customer service agents. Amazon's cloud computing arm is in fact far more profitable than its B2C eCommerce arm, earning more than 70% of its revenue.

It is possible to describe briefly some of the gains that Amazon experiences from its engagement with B2C eCommerce and, in particular, the close integration of its ICT infrastructure with its activity infrastructure. First, in terms of efficacy, Amazon has been able to diversify into a vast range of products for retail. Since Amazon is primarily a B2C company it is able to run without any physical retail outlets and can pass on efficiency gains in lower costs to its customers. Finally, in terms of effectiveness, Amazon is able to sell its products across the world and is able to relate to a large range of suppliers.

Points for reflection

- Amazon obtained dominance in online book retail by being the first into a niche market. This raises the question of the importance of niche strategies in the online world.
- It took a considerable amount of time for Amazon to make a profit. Many dot-com companies created in the same period as Amazon no longer exist. What caused Amazon to survive and other companies to go under?
- Dot-com companies such as Amazon rely on a critical mass of people having access to the Internet and prepared to order and pay for goods and services online. What affect does the digital divide have on the customer base of companies like Amazon?
- Online retail of low-cost, packaged goods such as books, CDs and DVDs now outstrips physical retail of these items in many countries. How has online retail affected consumer behaviour generally?
- How important is the access device – the Kindle – to Amazon's digital ecosystem?
- Amazon relies on effective management of a supply and distribution (customer) chain to make a profit. How effectively does Amazon engage in B2B eCommerce?
- Amazon.com does not publish a customer service number on its own website. Customers are instead asked to submit written service requests (which are answered by email) or to use a click-to-call service to be connected by phone to an available service representative. Despite the perceived difficulty in reaching customer service by phone, Amazon.com remains high in customer satisfaction surveys. Why do you think this might be?
- Amazon has been an early adopter of cloud computing. How important is the provision of web services to Amazon's future strategy?

3. APPLE

Based in Cupertino, California, Apple is a multinational company that designs and markets a variety of products, including personal computers, smartphones, tablets and software. Apple, which was created in 1977, has established a unique reputation in the consumer electronics industry for the aesthetic principles exercised in its design work and its distinctive advertising campaigns.

The range of Apple hardware products has evolved over time: from the Macintosh line of personal computers to the iPod, the iPhone and – most recently – the iPad. The Mac OS X operating system, the iLife suite of multimedia and creativity software, the iTunes media browser and the iWork suite of productivity software are well-known examples of Apple software.

The company operates several retail stores in a number of countries worldwide, as well as an online store. The company reached its peak in mid-2010 when it was reported as one of the largest companies in the world. It was also reported as the most valuable

technology company in the world, having surpassed Microsoft in this regard.

Part of the secret of the company's continued success is ceaseless innovation. In 2001, Apple introduced the iPod digital music player. This was not the first of the so-called MP3 players, but in 2003 the company introduced the iTunes music store, which was closely integrated with the iPod. This online store essentially connected various music providers directly with a large market of music consumers and soon made Apple the world's largest online music retailer. It also made the iPod, at the time, the market leader in portable music players.

In 2007, the company announced the iPhone: a convergence of an Internet-enabled smartphone and iPod. In 2008 the company launched its App store for the iPhone, which enabled iPhone users to directly download applications and install them on their iPhones. Apps are created in large part by external software producers, but Apple takes a 30% royalty on all apps sold through its app store.

In 2010, Apple announced their tablet computer – the iPad. As well as offering much of the functionality of the iPhone it allows access to a wider range of media content through a device controlled by a touch-sensitive screen interface.

Apple develops software to support its increasing range of devices. It has always used its own operating system, Mac OS X, for its personal computers and laptops. The company also independently develops its own productivity software, which is normally installed on Apple computers. Software applications such as iDVD, iMovie, iPhoto, iTunes, GarageBand and iWeb, for example, are bundled together in the iLife software package. The Apple package for presentation, page layout and word processing is iWork. Sometimes Apple software can be downloaded for free – this is the case of the QuickTime media player or the Safari web browser, that can be used on both Mac OS X and Microsoft Windows.

Apple has sourced the production of much of its technology, such as the iPod, from Chinese manufacturers. In 2006, a number of media outlets reported that sweatshop conditions existed in some of these factories in China, with employees regularly working in overcrowded conditions for more than 60 hours per week and for little pay. Apple reacted to these allegations by launching an investigation and introducing yearly audits of all its suppliers regarding workers' rights. However, there is much debate over the success or otherwise of such initiatives. In 2010, it was revealed that the workers making iPads and iPhones in a Foxconn facility in China had to sign a legally binding document in which they pledged that they would not commit suicide; apparently, this was due to the high number of suicides among the company's employees. In 2011, Apple recognised that some of the factories of its major suppliers in China had employed a growing number of child workers.

On 5 October 2011, Apple's founder Steve Jobs died. Apple still competes across an increasing range of offerings, making it unusual in being both a hardware and software provider in the digital economy.

Points for reflection

- Apple has a large and loyal customer base for its products. Reflect on how this loyalty is maintained.
- How does Apple compete in terms of software with other established suppliers such as Microsoft?
- Apple has demonstrated the power of what some refer to as a digital ecosystem business model. It did this with the iPod and iTunes store and the App Store and the iPhone. Reflect on the similarities and differences between the business models of Apple and Amazon in these terms.
- Many hardware suppliers, such as Apple, rely on production facilities based in the Far East. Reflect upon the pros and cons of this strategy.
- iPads are used extensively by people in leisure situations. How effective are they as access devices within work situations?

4. CYBER-WARFARE AND DATA SECURITY

Cyber-warfare involves activities undertaken by some actor (such as the agencies of some nation-state) to attack and attempt to damage another nation's digital infrastructure, through technological devices such as computer viruses or denial-of-service attacks. In a sense, the existence of cyber-warfare is a direct result of the embeddedness of ICT within systems of economic, social and political action within modern nation-states. Because so much of modern-day activity is reliant upon digital infrastructure, attacks upon such infrastructure can cripple nation-states and wider systems of action. For such reasons, governments

around the world are investing heavily in both offensive and defensive cyber-warfare facilities. Such facilities can be utilised both as an adjunct to conventional physical warfare and as a separate, independent and continuous series of operations in attempts to undermine nation-states. Some also distinguish between hard cyber-warfare, which involves direct attacks designed to cripple digital infrastructure, and soft cyber-warfare which attempts to utilise digital infrastructure for purposes such as espionage, surveillance and the dissemination of propaganda. Examples of soft cyber-warfare include the massive spying operations undertaken by US intelligence agencies on many countries and revealed by Edward Snowden and the data breach at the US Office of Personnel Management, widely attributed to Chinese intelligence agencies. Examples of hard cyber-warfare include the use of the Stuxnet virus to disable Iran's nuclear programme and the discovery of various software programs infiltrated into the control systems of the US electric grid and reputed to be sourced from China and Russia. In 2015, a major cyber-attack occurred against the power grid of the Ukraine which lead to temporary blackouts.

Points for reflection

- Some worry about the potential use of Artificial Intelligence within cyber-warfare. For what reasons, do you think?
- Some commentators make linkages between the potential for cyber-warfare and a country's reliance on digital infrastructure. Choose two countries and make an assessment on this basis of how likely they are to be attached in this manner.
- The increasing use of social media platforms for soft cyber-warfare is of increasing concern. Why do you think this is the case?

5. DIGITAL INNOVATION AND DISRUPTION IN THE MUSIC INDUSTRY

The key change to the music industry is generally attributed to the creation of an application known as Napster. The software application Napster is an important example of the way in which ICT impacts upon economic structures in an established industry – a process some refer to as creative destruction. In Porter's terms, such applications have begun to affect the competitive structure of the music industry.

Napster was created by Sean Parker when he was a freshman student at the North Eastern University in Boston, Massachusetts in the summer of 1999. It was initially produced as a fun application and Fanning originally released it to 15 fellow students swearing them not to release it to others. Napster was one of the first software applications that enabled users to locate and share digital music in MP3 format. It combined features of existing programs, such as search engines, file-sharing systems and instant messaging, and is generally regarded as a pioneer in what has become known as P2P (peer-to-peer) Internet software.

By August 2000 Napster had been used in a total of 6.7 million homes. By February 2001 Napster had 45 employees and by September 2002 it had 60 million devotees worldwide. Napster threatened the traditional value chain and business model of the music industry. The music industry encompasses many music-related businesses and organisations and is dominated by the major record groups or labels. Each of these record groups consists of many smaller companies and labels serving different regions and markets.

The traditional business model operated by the music industry involved musical artists recording for a recording company, which then mass-produced and marketed the musical material on media such as compact discs (CDs). Such material was then sold by a number of retail outlets. The consumer had to purchase material from the retailer, plus an appropriate means of playing the material such as a CD player. In this value network artists got paid royalties on the sale and use of their musical material and therefore got a return on their creative investment.

One of the most significant forms of good to benefit from digitisation is therefore music. The digitisation of music is most readily associated with a file format known as MP3. Developed by the Fraunhofer Institute in Germany in 1992, MP3 stands for Motion Picture Experts Group-1 Level 3. This format employs an algorithm to compress a music file, achieving a significant reduction of data while retaining near CD-quality sound. This means that a three-minute song, which would normally require 32Mb of disk space, can be compressed to 3Mb without significant reduction in sound quality. Hence, using a standard connection, the song can be transmitted over the Internet in a matter of a few seconds rather than the hours required if the file had not been compressed.

The success of digital formats such as MP3 is frequently attributed to the fact that it is open source and non-proprietary. As an efficient method of data compression such technology enables individuals to download and upload music to and from servers over the Internet efficiently and effectively. Individuals can 'rip' (duplicate) MP3 files from CDs easily and can exchange such files using technology such as email or more sophisticated peer-to-peer applications. Hence it is relatively easy for users to build virtual libraries of music and listen to them on various access devices.

The recording of music in digital form means that it can be produced and distributed at much lower cost. The convergence of access devices and communication channels around IP-based standards means that it can also be delivered over a wide variety of access channels. Hence, using MP3 and Napster, individuals could bypass recording companies and retailers. This is essentially a form of disintermediation in the customer chain of the music industry. Essentially Napster in its original form and similar offerings could be considered as a form of C2C eCommerce. Initially, networks of enthusiasts used the application to share music at no cost.

Music can be quickly copied from CDs and stored as MP3 files. Such files can then be freely distributed around the Internet using the Napster application. The music industry responded to digital music in general and Napster in particular on two fronts. First, the Recording Industry Association of America (RIAA) created the Secure Digital Music Initiative (SDMI). This was an industry group which attempted to create a secure form of digital music format. The intention was to attempt to prevent copying of digital music from CDs. Second, litigation was undertaken by various actors within the music industry which attempted to prove that the existence of Napster infringed US copyright law. In 2002, Napster had to close down because of a judicial ruling in favour of the music industry. However, many P2P applications are still impacting upon sales of CD music. Napster was relaunched as a legally licensed download site in the United States in 2003.

But the music industry was to experience another form of digital innovation that undermined its traditional business model. Apple Computer launched its iTunes online music store in 2003. Both Napster and iTunes, with the support of the major record labels, promote digital music subscription as an attempt to reduce digital piracy. Spotify, a Swedish company, was created in 2008, to offer streaming of Digitally Rights Managed music content from a set of major and independent recording companies. This stimulated the major record companies to begin to embrace digital downloading as the future of the music industry. As of 2018, the number of digital music album sales consumed through music-streaming sites continues to rise while the number of CDs purchased continues to fall.

Points for reflection

- Bands such as Metallica fought back against peer-to-peer programs such as Napster. The issue of digital rights management (DRM) was introduced in response to this. Investigate DRM and how it has shaped the contemporary music industry.
- The introduction of digital downloading is causing a fundamental change in the way music is consumed. In many ways it has become a utility that flows to a consumer rather than as a commodity that is bought one by one. Hence music is purchased like other utilities such as water. People effectively meter for their music, or may pay for their monthly consumption of music. Are all these trends positive for the music industry? What effect will this have long term upon music production?
- Change to other so-called content industries such as the movie industry has taken place. What are the similarities and differences between the movie and music industry in this respect? For instance, what effect has freely available software for music production had upon the industry?

6. FACEBOOK

Facebook was launched in February 2004 as a social networking website by Mark Zuckerberg along with his fellow computer science students Eduardo Saverin, Dustin Moskovitz and Chris Hughes. The name of the company is taken from the name applied to a book commonly given to university students within the United States at the start of the academic year. Zuckerberg and others had the original idea of building a website that offered an online version of such a document at US universities.

Initially, Facebook was intended as a means for Harvard students only to 'network'. The website was later expanded to other colleges in the Boston area, the Ivy League and Stanford University. Over time, students at other universities as well as high school students were gradually admitted to Facebook, not only in the United States but in other countries such as the UK. Nowadays, membership is open to anyone

aged 13 and over. In 2017, a sensible estimate placed the number of Facebook users as at 20 billion worldwide. It did not take long for Facebook to be highlighted as the vanguard of what would become referred to as social networking and social media.

Facebook eventually became a company in the summer of 2004. The first president of the company was Sean Parker, the creator of Napster. At the same time, Facebook moved its base of operations to Palo Alto California. The domain name facebook.com was purchased in 2005 for $200,000. In October 2008, Facebook set up its international headquarters in Dublin, Ireland. The major stream of the company's revenue comes from advertising. In September 2009, the company first began to make a profit. Millions of websites now integrate with Facebook through social plug-ins that allow people to share things, such as songs listened to or articles read, with other Facebook users.

Just to establish a baseline, here's what the basic functionality of Facebook comprises – but this functionality has of course been growing over the years. All Facebook users have their own personal profile, usually consisting of a profile picture, contact information, lists of personal interests, photos, notes and other personal data. There has been concern over the amount of personal data people 'release' to the world through their Facebook profile.

To this profile other users may be added as 'friends'. Facebook friends can interact in different ways: writing on profile walls, exchanging public or private messages, or using a chat feature. They may also receive automatic notifications when one of the friends in their network updates their profile. An additional facility for Facebook users is the creation of public or private groups formed around common interests. Private, public and voluntary organisations can maintain their own pages (the so-called 'Like' pages) as a form of advertising. A member using the 'like' function for one of these pages opens up their network for viral marketing.

The entry requirement for all Facebook users is to have a username and a profile picture that can be viewed by all the other users. The extent to which a profile can be accessed by other Facebook members, however, can be controlled through privacy settings. For example, all Facebook profiles have their own Wall – that is, a space on which Facebook users can write short messages and post hyperlinks; however, Facebook users can decide who can see (and write on) their Wall, and who cannot. One of the most popular applications in Facebook is the Photos application that allows Facebook users to upload and share albums and photos. This function has been cited a number of times in discussion of cyber-bullying, trolling and other worrying aspects of social media.

In 2010, Facebook reshaped the way in which its users can interact, introducing a new Facebook Messages service. This is a combination of text messaging, instant messaging (chat), emails and regular messages. The key point here is that although such a function uses some common communication protocols, all messages travel through the proprietary channel provided by Facebook. So, although the content of your Facebook messages is secured, the meta-data associated with your messages is a valuable resource for Facebook.

The key strength of Facebook as a company is reliant on the network effect – the value that members gain from having access to a large social network. In return for the free service which Facebook provides, users implicitly provide the company with masses of data about themselves. These data are very valuable as a platform for commercial services such as advertising. But users may feel that certain uses of such personal data invade their personal privacy. At such a point, users may decide to switch away from the service, removing the key value that the company provides to the market.

As probably the most prominent example of social media, Facebook has come under fire for acting as a platform for patent untruths broadcast as 'fake news'. A lie posted on Facebook can travel around the social network provided by this company in a matter of minutes. And such untrue messages can have nasty consequences in terms of the actions taken in terms of them. Some have claimed that the increasing use of social media serves to demote rather than promote open, rational debate in contemporary society. In March 2018, Facebook came under intense criticism for apparently collecting data from its members which it passed on to the company Cambridge Analytica. This company is claimed to have used these data to help develop strategy for the Donald Trump campaign for the US presidency.

Points for reflection

- Several governments have tried to block or even ban Facebook – this has happened in the People's Republic of China, Vietnam, Iran, Uzbekistan, Pakistan, Syria and Bangladesh. Within certain Islamic states, claims have been raised that Facebook would include anti-Islamic content. Are sites such as Facebook a form of cultural imperialism?

- Sites such as Facebook are claimed to have played a major role in the organisation of political protest around the world, such as in the case of the Arab uprising in Egypt and elsewhere. Investigate the role of such sites in political activity worldwide.
- Many young people now prefer to use Facebook messaging over other forms of communication such as email. What are the long-term consequences for email and what do users of Facebook lose when they use such messaging?
- Use of Facebook has been banned within many workplaces, in an attempt to prevent time-wasting. But how does this gel with professional social networking sites such as LinkedIn?
- Difficulties of maintaining the privacy of content produced by Facebook users has been a continuing issue. The safety of user accounts has been compromised several times over the history of the site. Reflect upon this in terms of current thinking on data protection and data privacy.
- Some people have questioned the advertisement policy of Facebook. Should friends of a member who likes a company be advertised to by that company?
- Facebook use has successfully moved onto mobile devices such as the smartphone. What part does a growing range of such mobile devices play in the growth of the company?

7. FAILURE IN PUBLIC SECTOR ICT INFRASTRUCTURE

Failure of ICT infrastructure can have a critical impact upon an organisation. There are many examples of such failure, particularly from the public sector. Some have claimed that this demonstrates poor management and operation of ICT infrastructure within the public sector. It may be, however, that detailed documentation of such failures is much more openly available from the public rather than the private sector. Here, we consider three important examples of such failure within the public section in the UK. One such failure contributed to the closure of the government agency concerned.

7.1 London ambulance computer-aided dispatch system

On 27 October 1992, an information system made the lead story on the BBC's Nine O'Clock News. It was reported that a new computerised system at the headquarters of the London Ambulance Service (LAS) (the LAS Computer Aided Dispatch system or the LASCAD system) had failed, and that as a direct result of this failure the lives of 20 to 30 people might have been lost (Beynon-Davies, 1995).

The key value produced by the LAS was, and still is, the care it provides to patients. As is the case with any activity system, its performance can be judged in a number of ways. For many years the key performance indicator used by ambulance services in the UK has been the time taken between receiving an emergency call and the arrival of an ambulance at an incident.

In 1992, LAS was under pressure from government and the wider National Health Service to make changes to address a number of perceived failings in performance. The argument was that LAS was clinging on to archaic practices and needed to update its activity systems if it was to perform effectively.

There had already been two attempts to introduce computerisation, but bad relations between stakeholder groups, a prior history of poor labour relations and a general distrust of management by the workforce made it difficult, and both projects were abandoned as a result. So there was considerable pressure on the 1992 developers to introduce a system that would make major changes, to bring the service up to date.

LAS at the time operated a largely unautomated activity system of ambulance dispatch, which consisted of three core processes: call-taking, resource identification and resource mobilisation.

Call-taking was the process of emergency calls being received by ambulance control. Control assistants wrote down details of incidents on pre-printed forms. They noted the location of each incident and recorded reference coordinates on the form. The forms were then placed on a conveyor belt which transported them to a central collection point.

The activity of resource identification involved other members of ambulance control collecting the forms, reviewing their details, and on the basis of the information provided, deciding which resource allocator should deal with each incident. Each resource allocator examined the forms passed to their sector, compared the details with information on each ambulance they controlled and its crew, and decided which ambulances should be sent where. The status information on the forms was updated regularly from

information received via a radio operator. The resource allocated was recorded on the original form, which was passed on to a dispatcher.

In resource mobilisation, the dispatcher either telephoned the nearest ambulance station, or passed the mobilisation instructions to the radio operator if an ambulance was already out in the field. This triggered the dispatch of an ambulance to an incident. These activities are represented as an activity system in Figure C.1.

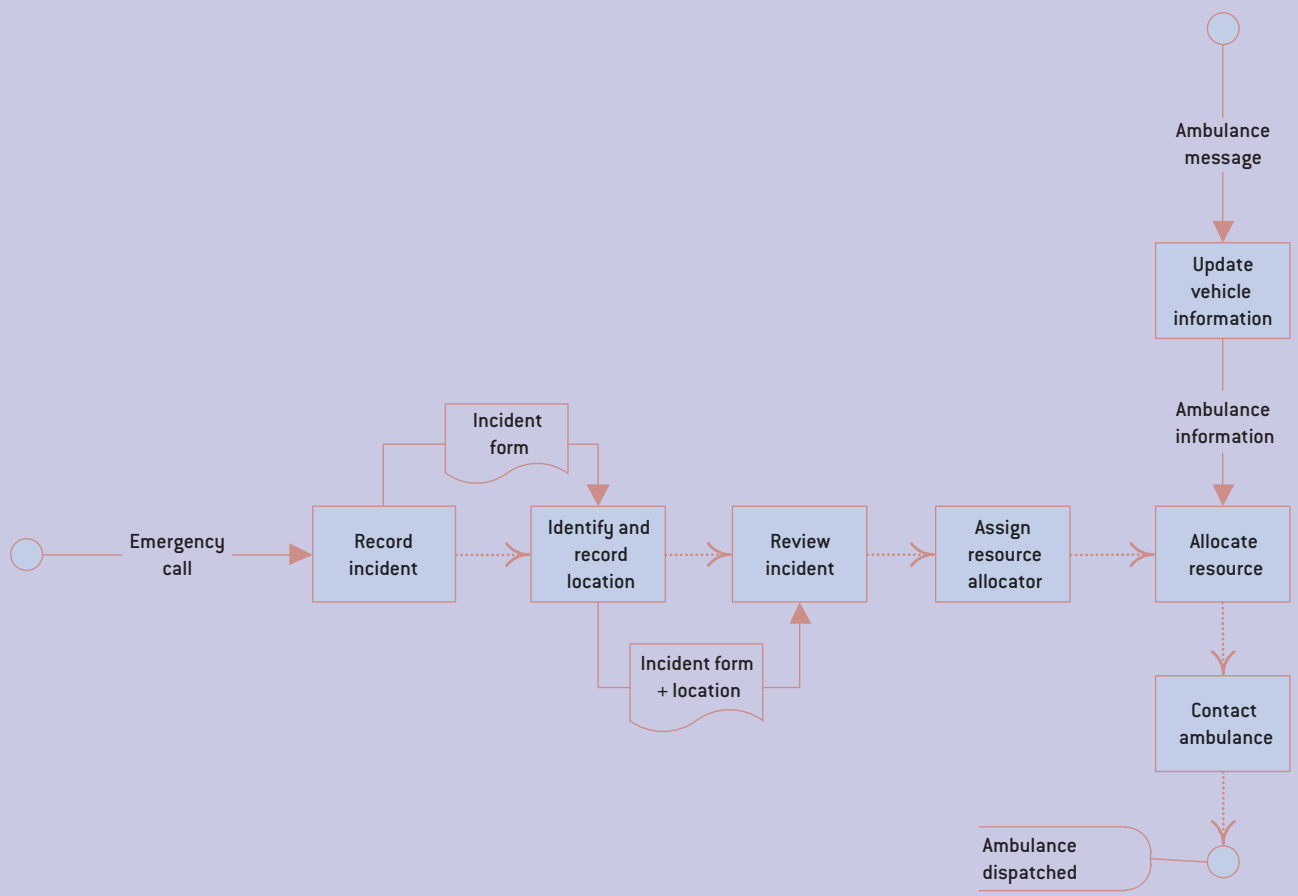

Figure C.1 The original activity system for ambulance dispatch

The essential functionality of the information system that was designed to replace this manual system is similar to that now commonplace among ambulance trusts in the UK. In the automated system, telephone operators routed all 999 calls concerning medical emergencies as a matter of routine to LAS headquarters (HQ) in Waterloo, central London. Eighteen HQ 'receivers' were then expected to record on the system the name, telephone number and address of the caller, and the name, destination address and brief details of the patient. This information was then transmitted over a local area network to an 'allocator'. The system pinpointed the patient's location on a map display of areas of London. The system was expected to continuously monitor the location of every ambulance via radio messages transmitted by each vehicle every 13 seconds. This would enable it to determine the nearest ambulances to the patient.

Experienced ambulance dispatchers were organised into teams based on three zones (south, north-east and north-west). The system was designed to provide the dispatchers with details of the three nearest ambulances and the estimated time each would need to reach the scene. The dispatcher then chose an ambulance and sent incident and patient details to a small terminal screen located on the dashboard of the ambulance. The ambulance crew were then expected to confirm to the system that they were on their way to the incident.

If the selected ambulance was in an ambulance station, the dispatch message was received on the station printer. The ambulance crew were always expected to acknowledge a message, and the system automatically alerted LAS HQ if no acknowledgement was made. A follow-up message was then sent from HQ. The system could also detect from each vehicle's location messages if any ambulance was heading in the wrong direction, and alert controllers. Further messages told HQ when the ambulance crew had arrived with the patient, when it was on its way to a hospital and when it was free again.

All this might appear perfectly reasonable, but unfortunately the system was a disaster when it went live. Instead of ambulances being dispatched more promptly to incidents, they were dispatched more slowly, or multiple ambulances turned up for the same patient. The chaos was headline news, as noted above, and the LAS chief executive resigned a couple of days after the launch. He was quoted as saying he had done so because of the evident lack of confidence in the LAS.

A new chief executive was appointed the next day. Under pressure from a number of sources, the health secretary announced a public inquiry into the system, which was headed by the South Yorkshire ambulance chief. The findings of the inquiry were eventually published in an 80-page report in February 1993, which immediately became news in the UK computing and national press.

According to the report, the reason for the system's 'failure' was not that the ICT system crashed. The hardware and software worked reasonably well, but the communications and the sociotechnical system did not. Crews pressed the wrong buttons on their dashboard access device; no messages were received by HQ when ambulances were in radio black spots. This led to a build-up in the amount of incorrect vehicle information. This had a knock-on effect because the ICT system then made incorrect allocations on the basis of the data it had. For example, multiple vehicles were sent to the same incident, or the closest vehicle was not chosen for dispatch. As a consequence, the ICT system was left with fewer ambulance resources to allocate.

The system also placed calls that had not gone through the appropriate protocol on a waiting list, and generated exception messages for incidents for which it had received incorrect status information. The number of exception messages appears to have increased to such an extent that staff were not able to clear the queue. It became increasingly difficult for staff to attend to messages that had scrolled off the screen. The increasing size of the queue slowed the system. All this meant that, with fewer resources to allocate, and the problems of dealing with the waiting and exception queues, it took longer to allocate resources to incidents. Eventually, a decision was made to switch off the system and return to a manual mode of operation.

Although the inquiry found evident problems with both the organisation and its ICT system, the report recommended that the LAS continue to seek to build an ICT system to support ambulance dispatch (Fitzgerald and Russo, 2005). However, it also recommended an extended timescale for development and implementation, and suggested that there should be effective stakeholder consultation, quality assurance, testing and training. As a result of this, the LASCAD project organisation was restructured and a new head of ICT appointed. This new head was reported at the time as having been given until August 1997, and a provisional budget of 13.5 million pounds sterling, to deliver an effective dispatch system for the LAS.

While the new system was being built, the original manual system continued in operation but with greater staff resource. A series of 'warm-up' projects, such as the construction of a new control room, the introduction of a digital phone system and the upgrading of the ambulance fleet, were used to build a new level of trust between LAS management and the workforce.

In contrast to the earlier development project, it was decided to build the new system in-house using prototyping to help involve users in the development process. A slow and deliberate approach was adopted to provide time for the necessary user involvement and the iterative development required of prototyping. A new development platform was adopted built around the Informix database management system running under the UNIX operating system. This allowed access from around 60 workstations. A mirror system was implemented: a backup to which operations could immediately switch over in the event of a failure in the main operational system.

The first stage of the work involved building a system with much reduced functionality from that originally intended. This included features for call logging, call transfer and address finding against a computerised gazetteer. This system went live on

17 January 1996, and after a week of successful operation was moved into the new control room. Enhancements to this basic system were introduced gradually. For instance, additional functionality allowing early viewing of emergency calls was introduced in September 1996, followed by the implementation of an automatic vehicle location system.

The introduction of the new system into the LAS control room was seen by the new LAS management to be a core factor in operational performance improvements. For example, in the period 1996/97, the service faced an increase of 16% in emergency calls. Nevertheless, the LAS managed to increase its proportion of ambulances dispatched within a three-minute activation period from 44% in 1995/96 to 80% in 1996/97. The number of complaints from users also fell from 100 per month to around 25 per month after the introduction of the new information system.

However, just like any organisation, the LAS continues to experience problems in managing its ICT infrastructure. For example, in 2012, it was reported that in an attempt to replace its call-logging software with some more up-to-date software, LAS lost a small number of emergency calls from its system. Fortunately, none of these incidents proved to be life-threatening and most only suffered from a slower response than normal from the service.

7.2 Child Support Agency

In the early 1990s, Electronic Data Systems (EDS) won the contract to develop an information system known as CS2 to support the work of the newly created Child Support Agency (CSA) in the UK. It is claimed that the failure of this information system contributed to the closure of the CSA and cost the UK taxpayer over a billion pounds sterling.

The CSA was a UK Government Executive Agency and was part of the Department for Work and Pensions in Great Britain and the Department for Social Development in Northern Ireland. The agency was launched on 5 April 1993 and was responsible for implementing the 1991 Child Support Act and subsequent legislation.

Child support, or child maintenance, is the contribution from a non-resident parent towards the financial cost of raising offspring. Maintenance is paid to the person with whom the child lives. The level and conditions of payment can either be mutually agreed between the two parties, or, in case of disagreement, decided by legal means.

The CSA as originally conceived was a government organisation whose primary purpose was information handling. For instance, the CSA was expected to:

- Receive and assess applications for child maintenance. This involved identifying and locating non-resident parents and confirming paternity.
- Calculate the payments to be made by non-resident parents. This involved establishing the non-resident parent's income or benefits status, determining the existence of children in the non-resident parent's current household and confirming levels of shared care.
- Maintain the accuracy of maintenance assessments. Any changes informed in the circumstances of the caring parent or the non-resident parent demanded recalculation of the maintenance payable.
- Collect money from non-resident parents and pay such money to the parent with care. This normally involved establishing a payment schedule with both parties.
- Enforce assessments. The agency was expected to chase missing payments and collect debt which may have built up.

After its creation in the early 1990s the CSA experienced difficulties in administering child support. This was apparently due to the complex rules embedded in the originating legislation that the agency was required to administer. In 2000, a new system of child support was introduced with the aim of simplifying the rules for child support and including a simplified calculation of maintenance. It was decided that the substantial business restructuring caused by these changes were to be supported by the introduction of a new ICT system.

In 2004, EDS was criticised by the UK's National Audit Office for its work on the ICT system for the CSA. This work ran seriously over budget and was over two years late in delivery, despite following the gateway review process mandated for the management of large projects of this nature and having spent over 91 million pounds sterling on external advice. These problems eventually led to the resignation of the CSA's head, since the blame for this failure was laid partly at the door of the CSA. It was claimed that they did not have sufficient internal technical staff to be an 'intelligent customer' of EDS. Consequently, it took some time to establish an effective partnership between the CSA and EDS.

Following its introduction in March 2003 the CSA experienced problems with the operation of the new ICT system. The system somehow managed to overpay 1.9 million people and underpay around 700,000. This meant that the CSA was obliged to write off one billion pounds sterling in claims, while 750 million pounds sterling in child support payments from absent parents remained uncollected. An internal EDS memo was leaked that admitted that the system was 'badly designed, badly tested and badly implemented'. Claims were made that this failure was partly due to the way in which a large and complex ICT system, at the upper end of what was achievable at the time, was introduced at the same time as attempts were being made to restructure the CSA.

In December 2006, the Department of Work and Pensions released its Child Support white paper outlining its plans for the future of child support. It was announced by John Hutton MP that the CSA would be shut down, and replaced by the Child Maintenance and Enforcement Commission (C-MEC). This is a non-departmental public body, therefore removed from the direct control of the Department of Work and Pensions.

The CSA case was part of a large programme of ICT adoption among government agencies in the UK at the time. Much of this eGovernment change was focused on enabling the customer chain with ICT. The CSA example demonstrates the importance of the effective implementation of back-end ICT infrastructure to eGovernment change. The CSA was both an information-handling organisation and an enforcement organisation. Many of the operational difficulties the agency experienced appear due to the difficulties of capturing sufficient data in a timely manner about claimants and non-resident parents to make effective decisions quickly about enforcement actions. The case is also an example of the difficulties of managing large-scale organisational change alongside considerable ICT change. The risk of failure in such situations is multiplied particularly when development is outsourced to an external supplier. Such sociotechnical change demands not only effective project management but also effective change management.

7.3 Passport Agency

The UK Passport Agency was established as an Executive Agency of the Home Office in April 1991. Its main aim was to provide passport services for British nationals in the UK promptly and economically. In 1998–99, the Agency employed an average of almost 1,800 staff in its passport offices in Belfast, Glasgow, Liverpool, London, Newport and Peterborough. The Agency's financial objective was to recover, via the passport fee, the full cost of passport services; the full cost includes the cost of non-fee-bearing consular services provided by the Foreign and Commonwealth Office to UK citizens abroad.

In July 1996, the UK Passport Agency decided to introduce the idea of digital passports, in an attempt to minimise the risk of fraudulent use of passports. To do this the agency needed to replace its existing ICT system. It was envisaged that this would be done through a private finance initiative or outsourcing contract. The contractor bids were received in April 1997 and in June of that year a 10-year PFI contract was awarded to The Stationery Office (now Security Printing and Systems Limited) for the printing and dispatching of digital passports, valued at 120 million pounds sterling. In July of 1997 the Agency awarded a 10-year PFI contract for a similar value of 120 million pounds sterling to Siemens Business Services for the collection, storage and transmission of passport application data. This included the development of a new ICT system for this purpose.

In April 1998, an announcement was made that from October of that year children not already on their parents' passport would require their own passports to travel abroad.

In October 1998, the new information system (ICT system and procedures, including those outsourced) were introduced in the Agency's Liverpool office. One hundred Agency staff transferred over to Siemens. In November of the same year, the new information system was rolled out at the Newport office. Ninety-six staff transferred over to Siemens at this office.

During the following summer of 1999, a number of problems were experienced by the Passport Agency. Over half a million British citizens were less than happy to discover that their new passports could not be issued in time for them to take their holiday. In June 1999, processing times for passport applications were taking up to 50 working days. Emergency measures were introduced by the Home Office in July 1999 – including free two-year extensions to passports. Coupled with a downturn in applications, these measures helped bring maximum processing times back within the Agency's 10-working-day target by the end of August. However, the Home Office had to pay millions in compensation to citizens and in staff

overtime required for managing the backlog of applications.

This information systems failure appears to have been due to a number of factors.

The change in the law on child passports was introduced at roughly the same time as the introduction of the new information system. The change in legislation caused a significant increase in the volume of applications for the summer of 1999. In May of that year, monthly output was 619,000 compared to a peak of 564,000 in the previous year. By June, the Passport Agency had around 565,000 applications still awaiting processing.

The introduction of a new passport-processing system in two of the Agency's six offices was exacerbated by a failure to assess and test adequately the time needed by staff to learn and work the new passport-processing system. The new system involved changes in clerical and administrative processes as well as computerisation. A four-month delay before the start of testing the new system, and testing its impact on productivity, was not completed before it went live in late 1998.

There was insufficient contingency planning in the event that implementation of the new system might not go according to plan. Despite the Passport Agency's experience of the flawed rollout of its previous computer system in 1989, the Agency launched the new system in its largest offices, Liverpool and Newport, which accounted for half its normal processing capacity.

The strategy adopted by the Agency in early 1999 to get through the busy season rested on its past experience that it would be able to increase output by increasing overtime and hiring casual staff. A recovery plan was agreed between the Agency and the Home Office in March, including the recruitment of extra staff. However, the Agency did not foresee the loss in public confidence, which led to a sharp increase in applications and enquiries about them, once the delays attracted publicity.

The agency was also criticised in its failure to communicate effectively with the public, both at a personal level in dealing with calls from the public to its telephone enquiry bureau, and more generally via the media.

A National Audit Office inquiry estimated that the cost of the additional measures taken by the Agency to deal with the failures during the year from October 1998 was around 12.6 million pounds sterling, including six million pounds sterling for additional staffing. The contract allowed Siemens to take responsibility for the risk associated with design and delivery of the system. However, the risk associated with business continuity remained with the Passport Agency. As a result the Agency incurred extra costs of 12.6 million pounds sterling, with Siemens paying just 2.45 million pounds sterling, spread over several years.

Not surprisingly, the inquiry highlighted a number of important lessons. First, the need for proper testing of new systems before committing to live operation. Second, for staff to be adequately trained in the use of new ICT systems and in new procedures required. Third, the need to have realistic contingency plans in place. Fourth, the need, when service delivery is threatened, to have the capability to keep the public well informed. For effective innovation, organisations need to treat information systems change as a total package in the sense of comprising both technical and social change. However, organisations frequently forget the need for effective management of project risks and effective change management practices, particularly user training.

Points for reflection

- These cases could be regarded as prominent examples of the continuing poor management of government ICT projects. There is a long history of public sector information systems failures in the UK, such as these cases. Why do you think this is?
- Evaluation of a number of public sector information systems failures (frequently through public inquiries) have expressed concerns over use of outsourcing providers for large-scale ICT projects. What sorts of concerns do you think might be raised in such evaluations, as, for instance, in the case of the CSA? Why do you think these problems occur?
- Much of the data required for effective working of the CSA demanded integrated government information systems. Consider the effect of such integration on this example of information systems and organisational failure.
- The case of the change in passport legislation and its impact upon both the information system and its encompassing activity system, demonstrates the need to consider activities, information and data in any design. Why do you think this lesson is frequently ignored?

8. GOOGLE

In a sense, although it developed merely as a search engine, Google as a company is now the most prominent example of an information brokerage on the Web. To *google* has become established as a verb in the English language and has become synonymous with searching for data on any topic. As such, the company is in an unprecedented position as a gatekeeper to data and information on the global scale. Some worry about its monopoly position as one of a limited number of global technology companies that dominate the digital infrastructure.

Google Inc. is the most well-known of the companies specialising in Internet search and online advertising. The company is based in Mountain View, California, employing many thousands of full-time workers. Google's mission statement is, '*to organize the world's information and make it universally accessible and useful*'.

Google was co-founded by Larry Page and Sergey Brin while they were students at Stanford University, United States on the back of research they were conducting on improvement to the algorithms underlying search engines. The company was first created in 1998 and went public in 2004. Its published company motto is 'Don't be evil'. In 2014, it is estimated that 2,000 billion searches were conducted through its website. Through a series of new product developments, acquisitions and partnerships, the company has expanded its initial search and advertising business into other areas, including web-based email, online mapping, office productivity and video sharing, among others.

A search engine is designed to search for data on the Web. Traditionally, search engines worked in terms of matching a series of search terms entered by the user against the terms found in web pages. The search results are generally presented in a list and are often called 'hits'. The ranking of hits on this list provided to the user was typically based on the number of times the searched for terms exist in the pages of the site.

Page and Brin produced an algorithm called *PageRank* which analyses the links emanating from and pointing to web documents and then assigns a numerical weighting to each element of a set of such documents with the purpose of measuring each document's relative importance within the set. In this sense, the PageRank algorithm treats links in a similar manner to academic citations. Generally, the larger the number of citations of an academic paper the more important the paper is considered to be, by the academic community.

Google uses web crawlers (also known as web spiders or web robots) to build and maintain its representation of links between web documents. A *web crawler* is a type of software agent; a program or automated script which browses the World Wide Web in a methodical, automated manner. Web crawlers are mainly used to create a copy of all the visited pages for later processing by a search engine that indexes the downloaded pages to provide fast searches for users.

Google is best known for its web search service, which now gives it a dominant market share of the search engine market. Google indexes billions of web pages through the process described above. Users search for web content through keywords and logical operators such as NOT and AND. The search engine ranks hits on the basis of the number of links a page receives as well as the importance of the web documents sourcing the links.

As a value proposition, Google relies on the network effect: namely, that many people use its search engine to look for products and services. Google's application AdWords allows web advertisers to display advertisements alongside Google's search results and the Google Content Network, through either a cost-per-click or cost-per-view scheme. This means that the company generates most of its revenue by displaying advertisements from the AdWords service that are tailored to the content of the email messages displayed on screen. The service is attractive to advertisers because it allows them to tailor eMarketing campaigns to specific searches and user profiles. The related service, Google AdSense, is also a key revenue stream. This allows website owners to also display Google adverts on their own site and earn money every time ads are clicked. Advertisers do not directly buy advertising space on Google. They bid on keywords associated with key terms and website content. The bidding occurs through an AdWords auction service. Hence, the more popular a keyword, the more money an advertiser has to pay for it.

Since its foundation Google has initiated a strategy of offering an array of 'freemium' software products. Freemium software is software which is apparently offered free of charge to users. But such software makes money for Google in a number of ways. One approach is to offer an entry-level version of its software for free but to charge for additional features. Google pursues this strategy in relation to its analytics software. Another strategy is to gather data about use of the software and use these data to proactively do

things. Google particularly uses these data to mine for patterns that it can sell on to other companies.

Google launched its own free web-based email service in 2004, known as Gmail, which provides the capability to use Google technology to search email. Google has also developed several innovative applications, the most well-known probably being Google Maps. This consists of an interactive mapping program which allows users to locate places and pinpoint them against maps of the surrounding area at various scales of resolution.

In an attempt to foster a culture of innovation Google encourages its employees to be creative. Personnel are allotted 20% of their time to pursue their own ideas. Several high visibility Google products, such as Gmail and Google Earth, emerged in this way. New ideas, at whatever stage of development are posted to the company's Intranet, where they are evaluated and ranked by other personnel. Those ideas that collect the highest community ranking are pursued in more depth.

However, Google's sometimes aggressive expansion strategy has sometimes met with controversy. For example, in January 2006, Google agreed to censor its search service within China. Google.cn was highly regulated by the Chinese authorities and restricted access to thousands of terms and sites. As an instance, the BBC news website was made unavailable and searches for the banned Falun Gong spiritual movement produced only articles denouncing it. In January 2010, Google threatened to stop its censoring of search results in China and even to shut down its site completely in the country. This was in response to apparent hacking attacks on the company's Gmail service, targeting Chinese human rights activists.

Google introduced an application known as Street View in May 2007. This feature of Google Maps and Google Earth provides panoramic views from a row of positions along a street. In March 2009, the service was launched in the UK among much controversy. Civil liberty groups cited it as a potential invasion of privacy. A number of images were taken off the site after requests from various people and organisations. These included an image of Number 10 Downing Street, an image showing some nude children playing in a garden, an image of a man drunk in the street and an image of a man leaving a sex shop.

In 2008, Google reached agreement with representatives of authors and publishers in the United States to make millions of books in America searchable online. Under the terms of the agreement, Google is free to digitise most books published in the United States, including those that are out of print. It then makes chunks of text available through its search engine, sells individual eBooks and offers libraries subscriptions to its entire database. Google keeps approximately one third of resulting revenue and gives the rest to a book-rights registry that pays copyright holders.

Google now acts as the virtual monopoly supplier of web search services. A monopoly is a situation in which one producer controls supply of a good or service, and where entry of new producers is prevented or highly restricted. In the early years of the Web there were many such search engines, now one dominates. Google is the most visited website in the world. This means that it acts as the primary gatekeeper onto major aspects of digital infrastructure.

Because of its gatekeeping position Google is in a unique position to collect lots and lots of data about you. As such, it has become embroiled in the debate about who owns such personal data. Recent legislation introduced within the European Union has enforced the individual's right to request that technology firms such as Google forget about them in the sense of erasing the data it holds about them.

Points for reflection

- Concern has been expressed over the dominance of Google in both the search engine market and the wider information brokerage market. As a reaction Microsoft proposed an alliance with the search engine Yahoo!, which came to nothing. What consequences might ensue if Google continues to act as the monopoly player in this market?
- For online businesses the issue of optimising chances of the company website being retrieved early in the list of hits by search engines such as Google is critical to online orders. This area of search engine optimisation is a specialist component of website design. How important is this optimisation to electronic marketing?
- Google has come under fire for implicitly allowing censorship of web content for users of the search engine in countries such as China. How healthy for individuals and organisations is the reliance on Google as a dominant gatekeeper to web content?
- Google has introduced a series of new privacy rules for users subscribing to its services. What impact will this have upon the continued growth of Google?

- Through its content applications, Google eventually intends to make all of the world's material published in English available in digital form. What are the pros and cons of this development?

9. INTERNET GOVERNANCE

Internet governance is the process of shaping the development and use of the Internet. No one actor runs the Internet. At a technical level it consists of a distributed collection of networks built upon common communication protocols. But at a social level the policies and standards making up the Internet must be shaped by agreement among a large range of stakeholders situated around the globe. The case of domain names is illustrative of this.

Domain names arose as an attempt to provide meaningful conventions enabling connections to be made between computer systems across the Internet. Any domain name is typically made up of three or more parts referred to as domain levels. Levels therefore provide structure to the domain name. In a particular URL, domain levels read from right to left: subdomain, 2nd level domain, top-level domain. Top-level domains (TLDs), consist of either so-called generic top-level domain names (such as .com) referred to as gTLDs, or country codes (such as .uk), referred to as ccTLDs. gTLDs are also referred to as 1st level domain names. 2nd level domains serve to further refine the top-level domain name by typically suggesting the type of provider. For instance, .ac indicates an academic institution based in the UK. Subdomains refer to those domains below the 2nd level and are typically used to refer to a specific content provider. In cardiff.ac.uk, cardiff signifies the website of Cardiff University.

Internet protocol addresses are mapped to domain names by domain name servers. These are computer systems in the internetwork that perform such transformation. For such domain servers to work effectively standardisation is needed in domain names. ICANN have responsibility for a number of naming conventions including gTLDs such as .com and .org, and ccTLDs such as .uk and .fr. They also have responsibility for sponsored top-level domain names (sTLDs) such as .coop and .museum and unsponsored TLDs such as .biz.

IANA, the precursor organisation to ICANN, originally created seven generic top-level domains (gTLDs), consisting of strings of three letters taken from the following list: .com (signifying some form of commercial organisation), .org (signifying any type of organisation but typically used to signify public sector or voluntary sector organisations), .gov (initially used to signify government establishments generally but now restricted to refer to US government establishments), .edu (used generally to signify an educational institution internationally), .mil (initially used to signify military establishments generally but now restricted to refer to US Armed Forces establishments), .int (initially conceived for international entities), .net (initially used to signify 'networks' and therefore a generic free usage domain).

However, in 'an uncharacteristic lapse of consistency on the part of early Internet designers' IANA established a parallel list of ccTLDs. Part of the reason ccTLDS were introduced and began to be used was because gTLDs gradually began to be perceived internationally as US TLDs. For instance, the original intention was that any educational institution in the world could register itself under the .edu gTLD. In practice, it turned out that, with a few exceptions, only US-based institutions registered under .edu.

Country code top-level domains (ccTLDs) consist of strings of two letters, for example .uk, .fr, .es. ICANN clearly states that it does not decide on the status of a country. The verification of countries is therefore delegated to the International Standards Organisation (ISO) and more specifically to inclusion in its ISO-3166 list of country codes. However, there are considerable anomalies in the ccTLD naming conventions arising both from inconsistencies in the ISO list and from the presence of early naming agreements established before the creation of ICANN. The ISO list is derived primarily from a list of country names published by the United Nations, which also assigns unique codes to a number of inhabited overseas territories. Thus in 2002, there were 189 countries which had seats in the UN General Assembly, but 239 countries on the ISO 3166–1 list. Some countries have also established country codes that conflict with the ISO 3166–1 list. The .uk country code is a notable example in that the specified country code for Britain in the ISO 3166–1 list is .gb. Some 'regions' within this country also have codes established in the ISO 3166–1 list. Examples here are .gg (Guernsey), .im (Isle of Man) and .je (Jersey). The current ICANN namespace contains 255 registered ccTLDs.

Therefore, over time, the domain system has been gradually extended, sometimes in an apparent piecemeal manner. For instance, the current ICANN namespace contains 21 registered gTLDs all of which are

open for use as supporting infrastructure for the Internet. Adding to its complexity, since 2000, a number of sponsored top-level domain names (sTLDs) have been created, typically backed by some defined community. The named sponsor of an sTLD is delegated the responsibility of administering the domain in the sense that it decides if a person or legal entity can register for use of the domain. Such sponsored domain names include, .aero (signifying the aeronautical industry), .coop (signifying cooperative organisations), .museum (signifying museums), and .cat (signifying the Catalan language and cultural community, discussed below).

Also since 2000 a number of unsponsored domain names have been created. These are generic top-level domain names, not backed by a community but which operate under the policies established by the global Internet community, directly through ICANN. Such unsponsored domain names include: .biz (signifying businesses), .info (signifying information resources – an extension of .net), .pro (signifying independent professionals – lawyers, doctors, etc.), .name (signifying individuals or legal entities that wish to register their names as domains).

Applications for the approval of a new TLD are made to ICANN using a defined process. Decision-making on applications within ICANN is conducted via a series of meetings held by ICANN's board of governors, and within a variety of committees such as the GNSO (Generic Names Supporting Organisation), the ALAC (At-Large Advisory Committee), the GAC (Governmental Advisory Committee) and other so-called constituencies. Representation from various interest groups is included at committee level. After approving a new TLD domain, ICANN delegates the administration of issuing it to IANA. Domain names frequently launch with a defined 'sunrise period' – this refers to the period of time at the launch of a new top-level domain during which owners of trademarks may register a domain name containing the owned mark.

In 2011, ICANN decided to end most restrictions on the names of generic top-level domains. This means that organisations are now able to bid for essentially any arbitrary top-level Internet domain name and pay an annual fee for its registration. However, it is likely that the process of changing over to these new TLDs by organisations will take some time as many organisations decide upon the most appropriate names for their business and attempt to persuade users of the Web to adopt them.

Points for reflection

- How important are domain names to the competitive performance of particular nations and regions?
- How important to an organisation's strategy is choosing and registering a domain name?
- What communities do the .cym or .cymru domain seek to signify, as compared to the .wales domain?
- How important is the registration of domain names to modern-day companies and other organisations?
- How important are domain names to nation-states?

10. MICROSOFT

Microsoft Corporation is a multinational business with its headquarters in Redmond, Washington State, United States. It has many thousands of employees based in over a hundred countries and global annual revenue of billions of US dollars. The main activities of Microsoft are the development, manufacture, licensing and support of a wide range of software products for computing devices. The best-selling of the Microsoft products are the Windows operating system series and the Microsoft Office suite of software.

The company was founded by Bill Gates in 1975, originally to develop and sell BASIC interpreters for the Altair 8800, an early micro-computer. Microsoft rose to dominate the personal computer market with another software product, its operating system MS-DOS, which rose to dominate the personal computer market by the mid-1980s. In 1985, Microsoft released its first retail version of Microsoft Windows, originally a graphical extension for its MS-DOS operating system. During the transition from MS-DOS to Windows, the success of the Microsoft Office suite allowed the company to gain ground on competitors of the time, such as WordPerfect and Lotus 1-2-3.

Throughout its history the company has been the target of criticism for various reasons, including monopolistic business practices. Both the US Justice Department and the European Commission have brought Microsoft to court for anti-trust violations associated with software bundling. Microsoft is known for its developer-centric business culture. Large investment is made each year recruiting young university-trained software developers and on retaining their services for the company. Key decision-makers at every level within the company are either developers or former developers. Within Microsoft the expression 'eating our own dog food' is used to

describe the policy of using the latest Microsoft products inside the company in an effort to test them in 'real-world' situations.

Microsoft has historically given customer support over the Web. The company awards Microsoft Volunteer Partner status to volunteers who are deemed helpful in assisting the company's customers. Technical reference for developers and articles for various Microsoft magazines, such as Microsoft Systems Journal (or MSJ), are available through the Microsoft Developer Network, often called MSDN. MSDN also offers subscriptions for companies and individuals, and the more expensive subscriptions usually offer access to pre-release beta versions of Microsoft software.

In June 2008, Bill Gates stepped down from the board of Microsoft to spend his time managing his charity, The Bill and Melinda Gates Foundation. Microsoft still dominates the software industry, particularly in the areas of system and office software. In particular, its business tactics of 'embrace, extend and extinguish' have led to much controversy. Microsoft initially embraces a competing standard or product, then extends it to produce their own incompatible version of the software or standard, which in time extinguishes competition that does not or cannot use Microsoft's new version.

Many have recently questioned whether Microsoft can maintain its dominance in the software market given a number of trends, such as open source software, software as services and cloud computing. Microsoft has developed strategy in light of such developments. For instance, it has invested heavily in a network of data centres, adapted its existing software to run in the Cloud and made acquisitions such as the takeover of the voice over internet protocol (VOIP) company Skype.

Points for reflection

- Business tactics employed by Microsoft have led to various companies and governments filing lawsuits against Microsoft. Consider whether this hinders the development of informatics.
- Concerns have been raised over the total cost of ownership associated with Microsoft products. In other words, organisations spend lots of money maintaining and upgrading software licences for Microsoft products. Consider how TCO is addressed in terms of Microsoft's cloud computing offerings.
- Microsoft and the open source software movement have taken issue over digital rights management. Consider this issue in light of the software industry as a value network.

11. ONLINE GROCERY

A tipping point has been reached in retail over the last couple of years in countries such as the UK. The UK has the highest level of engagement with B2C eCommerce in Europe. More goods are now sold through B2C eCommerce websites than in high street stores, particularly at key points in the retail calendar, such as the period before Christmas.

Online grocery is a particularly interesting aspect of online retail because of the way in which digital business strategy is currently being played out in experiments with various business patterns by major market players. Online grocery is clearly a specific form of business-to-consumer (B2C) eCommerce. Within the UK it began in 2000 when the *tesco.com* domain name and associated website was formally launched. However, this market sector has traditionally experienced problems with uptake. Analysts believe that this may have been due to customer resistance, with many people wanting to examine fresh produce before they buy. Also, grocery as a retail sector traditionally has a low markup. Delivery costs embedded within the operating patterns of online grocery can thus erode profit.

Nevertheless, over the last five years, steady growth has meant that online grocery constitutes something like 5% of grocery sales in the UK. There is also a predicted doubling in the size of the market within the UK over the next five years. This is due to a number of convergent factors such as the growth in digital natives and the consequent changes to consumer behaviour, the less time that people generally have to shop for foodstuffs as well as a growing elderly population mix. Many supermarket chains that held off from developing digital business strategy in this area have now embarked upon online grocery as a key part of their offerings.

Food retailers have interestingly taken different strategic decisions in relation to online grocery. The four big supermarket chains in the UK (Tesco, Sainsbury's, Morrisons and Waitrose) now all have an online grocery arm. Morrisons and Waitrose currently work in partnership with the online food retailer Ocado. But online grocery is clearly not a priority for

many food retailers. Marks & Spencer interestingly has stayed out of online grocery. Likewise, the low-cost retailers, Aldi and Lidl, have not invested in an online grocery arm.

A number of reasons appear to have persuaded supermarket chains like Morrisons to develop an online grocery strategy. First, consumer research suggests that online shoppers tend to be the best customers. They are typically more prosperous than the average customer, have children and consequently spend up to 30% more with a store. Also, distribution centres on cheap land consume less capital than spending on urban stores.

All the big four supermarket chains such as Tesco operate a traditional model of supermarket retail designed to manage the flow of physical goods from suppliers to customers. This involves maintaining a large floor space stocked with products. Customers travel to the supermarket, pick products from the shelves and transport them home themselves. This business model is expressed as a high-level coordination pattern in Figure C.2.

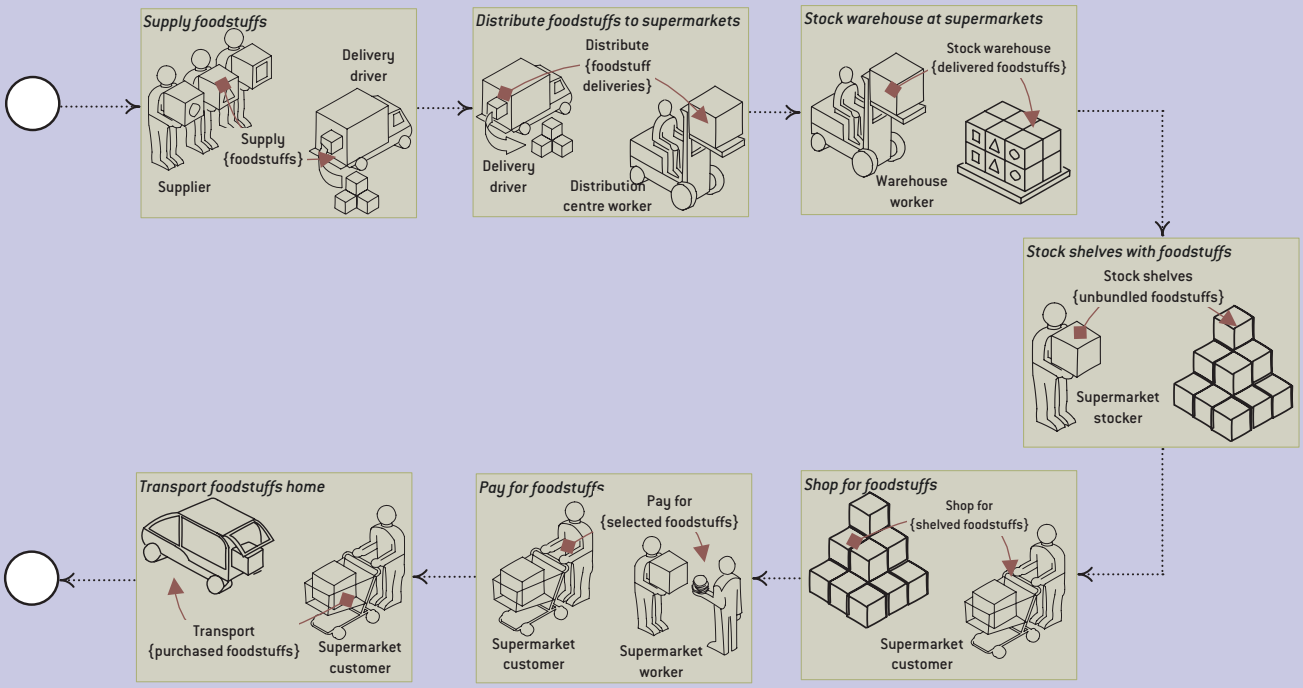

Figure C.2 Coordination pattern for traditional grocery retail

Online grocery has the potential to disrupt this common retail pattern. Not surprisingly, there are clear differences between digital business strategies among the online grocery retailers. Four business patterns dominate – stock from store, stock from warehouse, stock from dark stores, and click and collect.

Tesco, until recently, adopted solely a stock-from-store business pattern in support of its online grocery operations. Grocery sales made online through the website are available to customers for delivery within a defined range of selected supermarket stores. Goods for each customer are hand-picked from goods held within each store by supermarket operatives. The goods are crated and placed within delivery vans which deliver to the local area from the supermarket concerned.

The stock-from-store pattern was an easy eCommerce strategy to develop for Tesco as an initial bricks and mortar company making the transition to a clicks and mortar company. This was because it allowed rapid expansion with limited investment in terms of changes to established operating patterns such as logistics. However, this pattern does suffer from problems such as customers experiencing a high level of substitutions when stock becomes unavailable within nominated supermarket stores.

The online food retailer Ocado has always adopted a stock-from-warehouse business pattern. The advantage of this pattern is that no investment in offline

presence is needed. The retailer need only operate delivery from large and strategically placed warehouses. This reduces base operating costs. A high-level coordination pattern for the stock-from-warehouse business model is provided in Figure C.3.

In response to this competitive environment and the increasing business being done in online grocery, Tesco has recently invested in changing aspects of its online grocery strategy. In certain areas of the UK, the retailer now delivers foodstuffs to homes from so-called 'dark stores'. The term dark store refers fundamentally to a business pattern in which a retail outlet or distribution centre operates exclusively for online shopping.

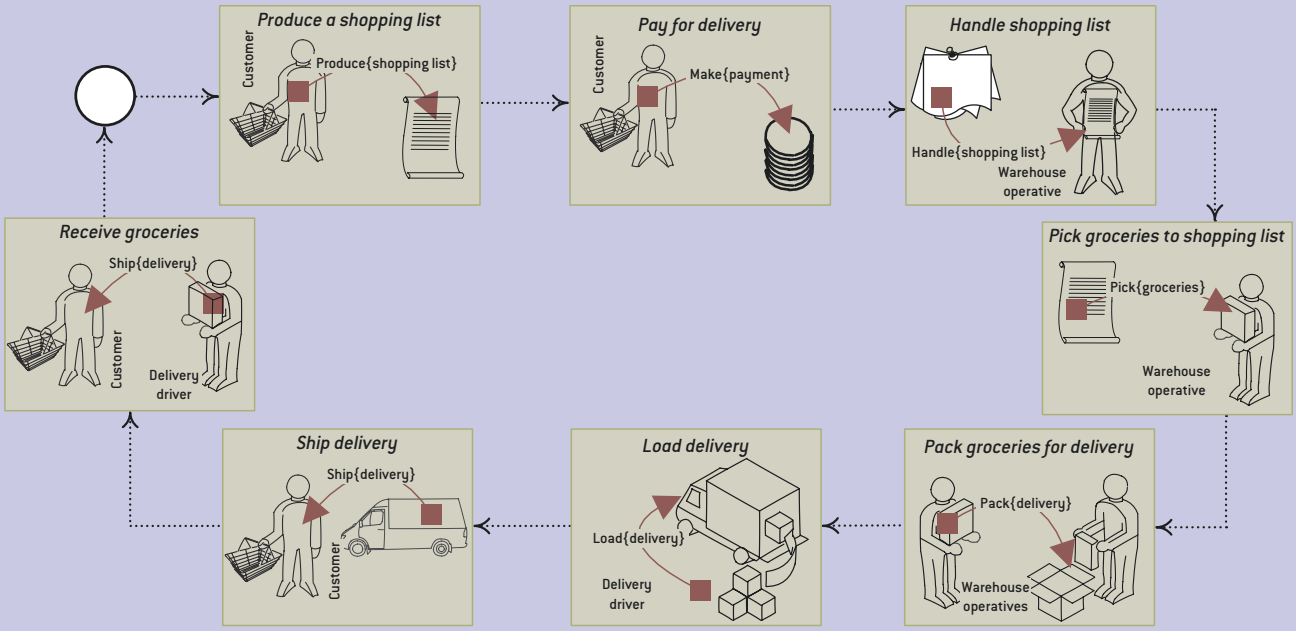

Figure C.3 Coordination pattern for stock from warehouse online grocery retail

Points for reflection

- How does the growth of online grocery affect traditional grocery retail?
- Online grocery has taken off in the UK because of population density and a substantial road network. How effective would such digital business be in a more sparsely connected and less well-connected country?
- Some companies deliver online grocery through a partnership model. In what way is this an example of P2P eCommerce?

12. OPEN SOURCE SOFTWARE

Open source software is computer software for which the source code is made available under a copyright licence (or arrangement such as the public domain) that meets the Open Source Definition – a formal specification of what it means to be open source. The aim of the open source movement is to make software easier to understand, modify and duplicate. Hence an open source licence permits users to use and change software, and to redistribute it in modified or unmodified form.

Open source software can be developed in traditional ways. However, such software has become associated with a particular model of software development which sees itself as substantially different from traditional approaches. Open source software is the most prominent example of open source development. Traditional software development is that promoted by people like Frederick P. Brooks in his book *The Mythical Man-Month* (1997). In contrast, the open source guru Eric Raymond distinguishes between two different models of software development: the cathedral model and the bazaar model. In the cathedral model, development takes place in a centralised way. Roles are clearly defined and include people dedicated to designing

(the architects), people responsible for managing the project and people responsible for implementation.

Raymond suggests that all software should be developed using the bazaar model. This he describes as 'a great babbling bazaar of differing agendas and approaches'. Such a bazaar model tends to have features such as:

- Users as co-developers. The users of open source software potentially become co-developers. Users are encouraged to contribute to the software with additions, code fixes for the software, bug reports, documentation etc. The general principle is that having more co-developers increases the rate at which the software evolves. One key claim is that the rate at which bugs are identified and fixed increases with open source production. Linus Torvalds, the originator of Linux, states this as a law that 'Given enough eyeballs all bugs are shallow'.
- Early releases. Versions of software are released as early as possible, so as to increase the chance of finding co-developers.
- Frequent integration. New code is integrated as often as possible so as to avoid the overhead of fixing a large number of bugs at the end of the project life cycle. Some open source projects have nightly builds where integration is done automatically, on a daily basis.
- Several versions. Open source software tends to have at least two versions. A development version is for users who want immediate use of the latest features, and are willing to agree to accept the risk of using code that is not yet thoroughly tested. The users can then act as co-developers, reporting bugs and providing bug fixes, in fact acting as co-developers. The stable version offers the users fewer bugs but usually fewer features.
- High modularisation. Open source software tends to be highly modular – this allows for parallel development by a larger network of programmers.
- Dynamic decision-making structure. A decision-making structure, whether formal or informal, is needed – this structure makes strategic decisions as to the ongoing design of the software.

The bazaar model of software development might be seen as an alternative to conventional approaches to information systems development. However, some maintain that the approaches promoted by the open source movement are not suitable for bespoke information systems development for a number of reasons. Perhaps the most important difficulty is that the requirements for such systems rely on a great deal of business domain knowledge, whereas open source production relies on a wide distribution of commonly accepted requirements for software. Hence successful open source software products tend to be packaged or commoditised software products that can be used across a range of different industries. Two key examples are MySQL and Linux.

The data management layer of the typical ICT system normally relies upon a database management system or DBMS. First released in 1995, MySQL is a multi-user relational DBMS which has millions of installations worldwide. MySQL is popular for web applications and acts as the DBMS component of the so-called LAMP stack for application development. LAMP is an acronym for Linux, Apache, MySQL, Perl/PHP/Python. The DBMS has been used as part of the ICT infrastructure of organisations such as Wikipedia. After purchase of the product by first Sun Microsystems and later Oracle, MySQL has been offered in two versions: the open source MySQL community server and the proprietary Enterprise server.

Linux is a computer operating system, which is based on a popular operating system created in the 1960s known as UNIX. An operating system is a piece of software that manages resources on some computing device and provides an interface used to access such resources. An operating system performs basic tasks such as controlling and allocating memory, prioritising system requests, controlling input and output devices, facilitating computer networking and managing files.

The name Linux is attributed to the creator of this operating system's kernel or core facilities. Work on the kernel started in 1991 by Linus Torvalds while he was a student at the University of Helsinki. Although Linux is generally available free of charge, several large corporations have established business models that involve selling, supporting and contributing to Linux and free software. The free software licences on which Linux is based explicitly accommodate and encourage such commercialisation. One common business model of commercial suppliers is charging for support, especially for business users. A number of companies also offer a specialised business version of their distribution, which adds proprietary support packages and tools to administer higher numbers of installations or to simplify administrative tasks. Another business model is to give away the software as a bundle in order to sell hardware.

Points for reflection

- Investigate the range of software produced using the open source model. For instance, is office software available as open source? Can you run an entire desktop computer or tablet using open source software?
- Investigate the similarities between open source software production and the collaborative production of web content through crowdsourcing.
- The open source software movement has now been in existence for decades. Hence one might argue that earlier critics of the movement who argued that it lacks a sufficiently robust revenue model have been silenced. But what of the software development industry? Does open source undermine the business model of companies like Microsoft?
- Why do companies need to have DBMS such as MySQL in their ICT infrastructure? Why is MySQL preferred for use by companies such as Wikipedia?
- What advantages do organisations that adopt Linux achieve as compared to those that utilise Microsoft Windows as their dominant operating system?

13. TWITTER

Twitter is an online networking service launched in July 2006 by Jack Dorsey. Dorsey came across the definition of the word 'twitter' as 'a short burst of inconsequential information' and felt that this was a perfect description of the type of product that his company wanted to create. The company is based in San Francisco, California, but Twitter also has offices and ICT infrastructure in other parts of the United States and the wider world.

Technically Twitter is a social networking and micro-blogging application. Twitter users can write and read short text-based messages, the so-called tweets; these messages are shown on the user's profile page. By default, tweets are visible to all. However, users can change their privacy settings and restrict delivery of tweets to their followers – that is, those users who subscribe to a particular user's tweets. Twitter users can mention or reply to other users by using the @ sign. In addition, the use of hashtags (#) as a prefix allows Twitter users to group tweets together.

Users send and receive tweets as posts via the website, through external applications such as those available on smartphones or through the short message service (SMS). The messages were initially set to the 140-character limit for compatibility with SMS messaging. This caused users to use shorthand notations in tweets in a similar manner to that used within SMS texts. For this reason, the company started to be described as the 'SMS of the Internet'. Estimates vary but Twitter appears to have many of hundreds of millions of active users, generating millions of tweets a day.

Twitter displays no advertising. Nonetheless, personal data about Twitter users is collected by the company, that can also be shared with third parties. This means that advertisers can target users analysing their tweets and may also quote tweets in ads directed specifically to the user. Most commercial organisations also use Twitter as forms of electronic and viral marketing.

Sites such as Twitter appear to have played a major role in the organisation of political protest around the world, such as in the case of the Arab uprising in Egypt and elsewhere. But Twitter has also played a large part in what some see as the age of untruth – namely the use of tweets to promote blatant and sometimes abusive lies about persons, organisations, issues and products.

Points for reflection

- Twitter has suffered in the past from a number of security vulnerabilities causing a number of security breaches. What are the implications of this for data protection?
- Supporters of the site feel it is a good way to keep in touch with busy friends. Critics maintain that you can be 'too' connected and that following the day-to-day activities of persons described on Twitter is part of the increasing cult of celebrity in modern societies. In this sense, is tweeting or following tweets a good or bad thing?
- Social media appears to be playing an increasing role within democratic process. Some believe that tweeting by political figures such as President Donald Trump is having a detrimental effect upon politics. What do you think?
- Companies have used tweeting as a form of intra-organisational communication. Examine the pros and cons of this technology for internal business communication.

14. WIKIPEDIA

Wikipedia is cited as the pre-eminent example of the use of Web 2.0 technologies in collaborative production. The content is user-generated by a network of authors around the world for no financial gain. It thus has similarities with the production of open source software. Wikipedia was created by Larry Sanger and Jimmy Wales and launched as an English language project on 15 January 2001. It is now operated by the not-for-profit Wikimedia Foundation. Wikipedia is a multi-lingual project which offers a free encyclopaedia on the World Wide Web: the name Wikipedia being a combination of the words wiki and encyclopaedia. Wikipedia uses a type of software called a wiki which handles the construction of shared content that can be updated using easy-to-use tools through a web browser.

Registered users of Wikipedia are able to create new articles. However, once an article is present on the site anyone with access to it can change its content and changes made to pages are instantly displayed. The consequence of this is that Wikipedia does not declare any of its articles to be complete or finished. This process of so-called collaborative content production is built upon the premise that collaboration among users will improve articles over time, in much the same way that open source software develops. Some of Wikipedia's editors have compared this process to Darwinian evolutionary processes where the 'fitness' of content improves over time.

However, this collaborative content production model means that so-called 'vandalism' and disagreements about content are common. Some take advantage of Wikipedia's openness to add nonsense to the encyclopaedia. Collaboration also sometimes leads to 'edit wars' which consist of prolonged disputes when editors do not agree.

Controversy has surrounded the project since its inception. Much criticism centres around the reliability and accuracy of the content on the site. Such content has been criticised for uneven quality and inconsistency, systemic bias and preference for consensus or popularity over credentials. The content of particular articles has been accused as being sometimes unconfirmed and questionable, lacking proper sources. The authors of articles need not have any expertise or qualifications in the subjects that they edit, and users are warned that their contributions may be edited mercilessly and redistributed at will by anyone who wishes to do so.

Interestingly, a 2005 comparison performed by the science journal Nature of sections of Wikipedia and the Encyclopædia Britannica found that the two were close in terms of the accuracy of their articles on the natural sciences. However, this study was challenged by Encyclopædia Britannica, who described it as fatally flawed.

It is argued that there is a battle for the future of Wikipedia. Inclusionists would like all to have access to making content on whatever people choose to add to the encyclopaedia. The ideal would be to have as many articles on as many subjects as its contributors are able to produce. Deletionists believe that Wikipedia is more likely to be successful if it maintains both a relevance and quality threshold for its content. This implies a certain level of editorial control over content. Currently, deletionists have the upper hand. Decisions as to whether to keep or delete articles are made after deliberation by some 1,000 or so of Wikipedia's most ardent contributors. If a member of this group believes that your article fails to meet notability criteria it may be nominated for immediate deletion or to be removed after five days if no one objects. Notability criteria consist of a host of ever-changing rules. For instance, in terms of citations, articles in journals have a higher notability than an article in a newspaper; 10 matches on Google is better than one match, and so on. Not surprisingly, debates about the merit of articles can drag on for weeks.

Some believe that the governance bureaucracy surrounding collaborative production deters people from contributing to Wikipedia. This is because to ensure that an article survives authors must make sure their article is deletion-proof. This raises the threshold for writing articles to a level which deters many.

It is difficult to determine the precise number of articles held on the Wikipedia website. The site itself claims that it has approximately 5.5 million articles in many languages. There are 293 language editions of Wikipedia.

Points for reflection

- The Wikimedia Foundation relies upon small donations from a vast array of people around the world for its continuous operation. Is this a sustainable business model?
- Academics generally discourage students from citing Wikipedia articles. Why do you think they do this? Is this justified?
- In what sense is the collaborative production model of Wikipedia applicable to other domains? For instance, could you write a textbook in this manner?
- Wikipedia clearly sees itself as an encyclopaedia, but many traditional encyclopaedias would beg to differ. Investigate the main differences between these two forms of publication.

JOURNAL OF INFORMATION TECHNOLOGY TEACHING CASES

	Journal of information technology Teaching cases (in the book)	Systems of organisation	Data and information	The infrastrcuture of organisation	ICT infrastructure	The digital environment	Digital business	Electronic marketing, procurement and government	Mobile commerce, social media and disruptive innovation	Designing digital organisation	Digital innovation and digital strategy	Developing, managing and operating digital infrastructure
1	Multiasistencia: transforming the digital ecosystem *Javier Busquets*	●	●	●	●	●	●	●	●	●	●	
2	Understanding the value and organisational implications of big analytics: the case of AUDI AG *Christian Dremel, Jochen Wulf, Annegret Maier, Walter Brenner*	●	●		●		●			●	●	
3	The Healthcare.gov project *Janis L. Gogan, Elizabeth J. Davidson, Jeffrey Proudfoot*			●						●	●	●
4	Tick a box, any box: a case study on the unintended consequences of system misuse in a hospital emergency dept. *Reeva Lederman, Sherah Kumia, Fei Peng, Suelette Dreyfus*	●	●		●		●		●		●	●
5	Reframing healthcare through social media *Øystein Sæbø, Andrea Recca, Paolo Spagnoletti*	●		●	●	●	●		●	●		
6	Managing the risks of big data at MyTelco: taking ethics seriously *Ulrike Schultze, Richard O. Mason*		●		●			●			●	
7	FC Bayern München goes social – the value of social media for professional sports clubs *Jochen Wulf, Matthias Söllner, Jan Marco Leimester, Walter Brenner*			●					●	●	●	

MULTIASISTENCIA: TRANSFORMING THE DIGITAL ECOSYSTEM

Javier Busquets

The firm Multiasistencia offered home repair services, claim adjustment and management through its 100 clients (financial institutions and insurance companies) to some 8 million customers. The firm also managed a network of some 6,000 trade professionals who performed various repairs for customers. Since the early 2000s the company had managed the coordination of the various actors within this digital ecosystem through various digital platforms accessed through mobile devices. The case explains the way in which the firm reacted to various environmental changes such as new digital entrants, the technological innovations surrounding the smart home and the increasing demands from its customers for personalisation of products. These changes stimulated the company to create a digital hub and to utilise big data technologies to better develop digital strategy.

Keywords

- Digital ecosystem
- Big data
- Business models
- Digital strategy
- Insurance
- Spain

Points for reflection

- Digital ecosystems have been seen as an example of disruptive innovation. Consider whether the Multiasistencia case fits the mould.
- In what way is big data an essential element of the digital strategy of Multiasistencia?

UNDERSTANDING THE VALUE AND ORGANISATIONAL IMPLICATIONS OF BIG DATA ANALYTICS: THE CASE OF AUDI AG

Christian Dremel, Jochen Wulf, Annegret Maier, Walter Brenner

This presents the case of AUDI AG and its attempts to implement big data analytics within the organisation. The case highlights the position of Audi within the automotive industry and the potentials and challenges that big data analytics offers to the organisation. The case considers both the technology of business analytics as well as the organisational implications of big data. The material is presented through the eyes of Hortensie, an aspiring manager at AUDI, who considers the value of big data and analytics to the organisation.

Keywords

- Big data
- Business analytics
- Business change
- Manufacturing
- Germany

Points for reflection

- Big data means different things to different people. Consider how AUDI AG formulates their conception of the business utility of big data.
- Consider how building an appropriate data infrastructure is important to change within an organisation such as AUDI AG.

THE HEALTHCARE.GOV PROJECT

Janis L. Gogan, Elizabeth J. Davidson, Jeffrey Proudfoot

This case describes the development of the HealthCare.gov website, as well as back-end systems and databases supporting the implementation of the Affordable Care Act within the United States. In late October 2013, Kathleen Sebelius (US Health and Human Services Secretary) and Marilyn Tavenner (US Centers for Medicare and Medicaid Services Administrator) appeared before a Congressional subcommittee to apologise for a number of problems experienced with the system. The case considers the project risks associated with the huge systems development effort involved and how to ensure that millions of uninsured or underinsured Americans would be able to sign up for affordable health insurance through such a system.

Keywords

- Project management
- Programme management
- ICT infrastructure

- Failure of ICT infrastructure
- Healthcare
- USA

Points for reflection

- This case demonstrates the importance of thinking of organisational change as sociotechnical change. Consider the implications of this for strategy.
- Failure of ICT infrastructure is frequently not down to the technology but the relationship of technology to communication and activity. Consider the proper design of business systems in terms of the case.

TICK A BOX, ANY BOX: A CASE STUDY ON THE UNINTENDED CONSEQUENCES OF SYSTEM MISUSE IN A HOSPITAL EMERGENCY DEPARTMENT

Reeva Lederman, Sherah Kurnia, Fei Peng, Suelette Dreyfus

Long patient waiting periods and a high administrative load had continuously plagued the emergency department of a major Australian hospital. As a response, the department installed a new information system, which technically seemed to perform well. However, within nine months of the introduction of this new information system the department suffered a catastrophic loss of patient revenue and forced senior doctors to abandon their medical duties in order to address complex administrative problems. This case traces how the error came about, how the hospital responded and what hospitals should do when deploying new systems to prevent such errors.

Keywords

- Information systems development
- Change management
- Information systems failure
- Healthcare
- Australia

Points for reflection

- Deploying new information systems is a critical form of change management. Consider such practices in light of the case from the emergency department.
- Data are critical to effective delivery of healthcare. Consider this in light of the case.

REFRAMING HEALTH CARE THROUGH SOCIAL MEDIA

Øystein Sæbø, Andrea Resca, Paolo Spagnoletti

This case presents the story of the Hospital Campus (HC) project and its effort to reframe healthcare services for the elderly through the adoption of social media. In a world of global aging, in which an increased number of elderly patients will be cared for by a shrinking number of workers, a challenge is how to use technology to provide better and more efficient services for the elderly. The HC campus project focuses on how to involve ICT-illiterate elderly patients and their social networks in the design and use of social media services to improve their quality of life.

Keywords

- Social media
- Digital innovation
- Healthcare
- Norway

Points for reflection

- Many of the elderly are digitally excluded. Consider some of the challenges from this case in terms of digital exclusion.
- Ethical issues always impact upon any application of ICT. Consider the ethics of introducing social media for reframing healthcare.

MANAGING THE RISKS OF BIG DATA AT MYTELCO: TAKING ETHICS SERIOUSLY

Ulrike Schultze, Richard O. Mason

In 2014, MyTelco established an independent organisation (MyBA) to provide data analytics services to both MyTelco and to third-party customers. It was expected that this organisation would be able to fund itself through revenue generated from the commercialisation of business insight derived from MyTelco's data. To address the ethical risks associated with mining and commercialising big data, MyBA relied on an Ethics and Compliance Committee (ECC) to review project proposals that involved customer

data. The case considers some of the ethical choices faced by this committee in relation to the management of personal data.

Keywords

- Big data
- Business analytics
- Personal data
- Data privacy
- Telecommunications
- USA

FC BAYERN MÜNCHEN GOES SOCIAL – THE VALUE OF SOCIAL MEDIA FOR PROFESSIONAL SPORTS CLUBS

Jochen Wulf, Matthias Söllner, Jan Marco Leimeister, Walter Brenner

In 2010, FC Bayern München (FCB), one of the world's most successful football clubs, had just finished a successful season from a commercial perspective as well as on the field. In this year, FCB had successfully established important aspects of its ICT infrastructure to better manage digital content distribution and eCommerce platform. However, the club seemed to have missed one major trend: the rise of social media. European competitors were already attracting large crowds on Facebook. The management of FCB were unsure about how social media would contribute to the digital strategy and how value can be generated through the use of social media.

Keywords

- Social media
- Virtual community
- Sports
- Germany

Points for reflection

- Consider the issue of how ICT can be used to facilitate coordination of activity in light of this case.
- In what way do football fans constitute a virtual community in the sense considered in this case?

You can download the full PDF versions of each of these case studies from the companion website at **www.macmillanihe.com/beynon-davies-BIS3**

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GLOSSARY

A

Access A precondition for the electronic delivery of services and goods. Stakeholders must have access to remote access devices.
Access channel A means of accessing the goods and services provided by some organisation. Consisting of an access device plus an associated communication channel.
Access device A device that enables access to organisation ICT systems.
Accounting information system That part of the information systems infrastructure involved in managing information concerning the financial state of some organisation.
Action perspective The perspective on organisation that considers it as a collection of people undertaking action.
Activity An activity is some transformation of the world performed by some actor or actors.
Activity system A coherent collection of interrelated and coordinated activities performed by some group of people.
Activity systems infrastructure The entire set of activity systems performed by some organisation.
Activity-based project planning A form of project management in which planning and control is conducted in terms of project activities.
Actor Any human, animal or machine that can act.
Adaptation The process of ensuring that a system continues to sustain itself in the face of environmental change.
Adjunct communities Forms of virtual community that focus around the development of relationships between customers and the business.
Aftersales service A primary process in the internal value chain. These are services that maintain or enhance product value by attempting to promote a continuing relationship with the customer of the company. It may involve such activities as the installation, testing, maintenance and repair of products.
Algorithm A specification for solving a class of problems.
Alignment The degree to which ICT systems are coupled to our information needs and how closely coupled our information systems are with our activity systems.
Analogue signal A signal modulated with a continuous range of values.
Analysis See Business analysis.
App Originally, an 'application' was any piece of software with sufficient functionality to do something useful. Now the term app tends to refer to a small, specialised program downloaded onto a mobile device and running within the mobile operating system.
Application A term generally used as a synonym for an ICT system or some other piece of software designed to perform a particular function.
Application service provider A company supplying a software service as an application.
Application software Software designed for a particular set of tasks in an organisation.
Appreciative system An interconnected set of largely tacit standards of judgement by which we both order and value our experience.
Articulation The action associated with the manipulation of data structures.
Articulation act An act of creating, updating, reading or deleting data structures.
Artificial Intelligence (AI for short) refers to the attempt to build computing systems that can act intelligently.
ASCII American Standard Code for Information Interchange – a standard coding scheme for characters on computing devices.
Assertive Communicative acts that explain how things are in a particular part of the business domain being communicated about.
Association Two information classes are associated if some instances of one class are related to certain instances of the other class.
As-if model A model of how things might be in some domain of organisation.
As-is model A model of how things are in some domain of organisation.
Attribute A symbol which describes some aspect of a thing.

Auction A form of commercial exchange involving bidding.
Authentication The process of identifying some actor to a system.
Authorisation The facilities available for enforcing database security.
Awareness A pre-condition of electronic delivery. Stakeholders must be aware of the potential benefits of electronic delivery.
Axiology The study of value.

B

B2B Business to business. See Supply chain.
B2B eCommerce The use of eCommerce in the supply chain.
B2C Business to customer. See Customer chain.
B2C eCommerce The use of eCommerce in the customer chain.
Back-end ICT infrastructure The ICT systems used to support the core information systems of the business.
Back-end ICT system A core ICT system involved in manipulating the key data for the organisation.
Back-end information system A core transaction-processing information system concerned with supporting the internal processes of some organisation.
Back-end information systems infrastructure The core set of interrelated information systems supporting business operations.
Balancing feedback See Negative feedback.
Banner advertisement Adverts typically displayed across the top of some web page.
Benchmarking Sometimes called competitive practices benchmarking. The process of comparing performance against other comparable organisations or processes.
Bespoke development The development style in which an organisation produces a new information system to directly match the organisation's requirements.
Big data Data applications characterised by volume, variety and velocity.
Bit An abbreviation of binary digit – one of the two digits (0 and 1) used in binary notation.
Bitcoin A digital currency that uses the blockchain.
Bio-computing The attempt to build or grow a computer from organic stuff such as DNA.
Blockchain A distributed digital ledger used to support application such as Bitcoin.
Blog A website where entries are written in chronological order and commonly displayed in reverse chronological order.
Brainstorming The technique of generating issues and/or their solution in a free-form manner.
Branding The process of using some form of sign to identify a product or service provided by some organisation.
Bricks and mortar business Businesses that have a physical presence usually in terms of some buildings where they are located.
Broadband A term generally used to describe a high bandwidth communication channel.
Browser A program that allows users to access and read web documents.
Business analysis The analysis of systems of business (organisation more generally).
Business end Part of a motivation model. A convenient way of expressing a desired future is in terms of end points or end states.
Business evaluation The activity of assessing the worth of some business action.
Business design The design of systems of business (organisation more generally).
Business layer That part of an ICT system involved with the management of update functions, transactions and business rules.
Business means Part of a motivation model. Courses of action designed to achieve particular means.
Business model An organisation's core logic for creating value. A model of the action appropriate to some particular business domain.
Business motivation A specification of the rationale for moving from a current business model to a new business model.
Business process A term which tends to be used in various ways, sometimes to refer to an activity system.
Business process re-engineering An organisational analysis approach to redesigning business processes.
Business rule A rule which specifies how a particular part of an ICT system should behave.
Business sign A sign of interest to some business domain.
Business strategy Optimising the selection among as-if models and specifying courses of action to implement a new (to-be) business model for the chosen domain.
Business transaction A unit of work performed by some ICT system which articulates data structures within the data system.
Byte A collection of eight bits.

C

C2C eCommerce Consumer-to-consumer eCommerce. ICT enablement of aspects of the community chain.

C2C eGovernment Citizen-to-citizen eGovernment. Enablement of the community chain with eGovernment.
C2C exchange An ICT-enabled facility that involves trade between complex networks of individual actors.
Cash commerce The exchange of low-price goods in irregular exchange between actors.
Cellular network A wireless network supporting mobile phones.
Change management That range of activities involved in the implementation of new systems, particularly ICT systems.
Channel strategy A set of choices for the organisation about how, and through what means, services and goods will be delivered.
Character set A scheme for representing symbols in binary notation.
Chat Technology enabling near synchronous many-to-many communication over the Internet.
Chief information officer (CIO) A term for an executive level manager in the organisation responsible for informatics.
CIO See Chief information officer.
Class See Information class.
Clicks and mortar business Businesses that still maintain a physical presence but also offer services and products accessible by clicking online.
Clicks-only business Businesses that have emerged entirely in the online environment.
Click per acquisition Only if a consumer purchases a product that he/she has clicked upon is a payment made to the marketer.
Client A key type of organisational stakeholder. Clients sponsor and provide resources for the construction and continuing use of some information system. Also, that computer that requests services from servers.
Client-server An applications architecture in which processing is distributed between machines acting as clients and machines acting as servers.
Closed system A system that does not interact with its environment.
Cloud The idea of computing power being delivered to the user in much the same way as electricity or water is delivered as a utility over the Internet.
Cloud computing A term used to refer to a number of technologies that support remote computing such as SOA, data centres and virtualisation.
COBIT Control Objectives for Information and Related Technology – a method for ICT governance.
Coding The translation of a signal from one medium into the same pattern expressed differently in some other communication medium.
Consumer of ICT A consumer of some aspect of ICT infrastructure such as hardware or software.
Commerce That process which deals with the exchange of goods and services between actors.
Commercial Web A corporate infrastructure built upon the Web but using closed, proprietary standards.
Commissive An act that commits an actor to some future course of action.
Commodity code A code used to identify and sometimes describe a product.
Communication The process of enacting communicative acts. The accomplishment of meaning between actors.
Communication channel The medium along which messages travel.
Communication network A set of devices connected with communication channels.
Communication subsystem That part of an ICT system enabling distribution of the processing around a network.
Communication technology Technology used for communication.
Communicative act An act in which a message is sent between sender and receiver with a particular intent and content.
Community chain The chain of social networks within which the organisation sits.
Comparator A process that compares signals from sensors with control inputs.
Competitive position An organisation takes up a particular position in a market defined by its activities and relationships with its competitors, suppliers, customers and regulators.
Competitor A key type of organisational stakeholder. Key organisations in the same industrial sector or market that compete with an organisation.
Complex adaptive system A system of organised complexity which continuously has to adapt to its environment.
Complex data Data structures using complex data types such as images, video and audio.
Concept The idea of significance. The collection of properties that in some way characterise a phenomena.
Conception Setting the problem to be considered and establishing a team to solve the defined problem.
Construction Creating new systems of sociotechnical action.

Content A term now used to refer to any media stored in digital form. Can also be used to refer to the symbols within some message that identify or describe things of interest.
Content management The process of ensuring that content is accurate, relevant and timely.
Control The process that implements regulation and adaptation within systems.
Control inputs Special types of input to a control process that define levels of performance for some system.
Control process See Control subsystem.
Control subsystem That subsystem which regulates the behaviour of a system it is monitoring. Also known as a control process or mechanism.
Convention A pattern of action which continues to be undertaken purely because of the weight of precedent.
Conversation for action A term used to refer to the way patterns of communication facilitate coordinated action.
Coordination The achievement of joint activity by a group of actors.
Coordination problem The problem of achieving joint action among a multitude of actors in fulfilment of a goal in common.
Coordination act An act of coordinated action.
Coordination cost A cost incurred in making an economic exchange. Also known as a transaction cost.
Cost advantage An organisation strategy. This essentially aims to establish the organisation as a low-cost leader in the market.
Cost per acquisition A form of revenue generation in which the advertiser pays for new acquisitions such as new customers, prospects or leads achieved through online adverts.
Cost-benefit analysis Cost-benefit analysis is critical to assessing whether or not the process of developing an IS (information system) is a worthwhile investment.
Coupling The way in which various types of action are bound together.
Create (articulation) An act of articulation that brings a new data structure, element or item into existence.
Credit commerce Credit commerce is where irregular transactions occur between trading partners and the processes of settlement and execution are separated.
Critical path The activities within a project whose float is zero, and so determine the total calendar time required for a project.
Critical success factor A factor which is deemed crucial to the success of a business.
Crowdsourcing Crowdsourcing refers to the outsourcing of work to people collaborating over the Internet.
CRM See Customer relationship management.
Customer A key type of organisational stakeholder. Consumers of an organisation's products or services.
Customer acquisition Customer acquisition consists of that set of activities and techniques used to gain new customers.
Customer chain The set of activities that are involved in the delivery of value to the customer of the organisation.
Customer extension Customer extension consists of the set of activities and techniques used to encourage existing customers to increase their level of involvement with a company's products and services.
Customer profiling and preferencing A mechanism of customising online products and services for the customer based on detailed information captured about the customer.
Customer relationship management The set of activities devoted to managing the customer chain.
Customer relationship management system That information system devoted to managing all interactions of a customer with an organisation.
Customer resource life cycle A strategic planning framework created by Ives and Learmonth. Also useful in defining elements of the customer chain.
Customer retention The set of activities and techniques used to maintain relationships with existing customers.
Customer-facing information system A type of information system supporting interaction with the customer of the organisation.

D

Darknet A term used to refer to any communication network that uses protocols different from the Internet.
Darkweb Websites accessible through the Darknet.
Data Symbols used to represent something. See Forma.
Data administration That function concerned with the management, planning and documentation of the data resource of some organisation.
Data analytics Data analytics broadly refers to a number of techniques for identifying and analysing patterns in business data. The aim is to use such intelligence for better business

decision-making, particularly strategic decision-making.
Data element A collection of data items.
Data exhaustivity Whole populations rather than samples of data are collected and stored within big data applications.
Data flexibility Both the structure and size of data can expand easily and rapidly within big data applications.
Data flow A Pipeline through which data of known composition flow.
Data format A format for the structure of data.
Data indexicality Data are uniquely identifiable to designated people or things.
Data infrastructure The set of interrelated data models that define the data needs of the organisation.
Data integrity Ensuring that the data stored in an ICT system remains an accurate reflection of the state of the activity system it describes.
Data item A physical structure which can store some value.
Data layer See Data management layer.
Data management The set of facilities needed to manage a data resource.
Data management layer That part of an ICT system involved with the storage and maintenance of data.
Data mining The process of extracting previously unknown data from large databases.
Data model A model representing the structure of data appropriate to some domain or a blueprint of data requirements for some application.
Data privacy Ensuring the privacy of personal data.
Data protection The activity of ensuring data privacy.
Data relatability Data in one data set is relatable to that in other data sets.
Data resolution An important attribute of big data applications. Data handled is fine-grained.
Data security The process of ensuring the security of stored and transmitted data.
Data store A place where data structures are kept for later access.
Data structure A collection of data elements.
Data velocity An important attribute of big data applications. The speed with which data are captured and processed and output is rapid.
Data variety An important attribute of big data applications. The sources of data are diverse.
Data volume An important attribute of big data applications. The size of the data sets used are very large.
Data subsystem That part of an ICT system concerned with managing the data needed by the application.
Data system A system in which data structures are articulated.
Data system infrastructure The collection of data systems appropriate to some domain of organisation.
Data type A definition which constrains the data appropriate to some data item.
Database An organised repository for data.
Database administration Involves technical implementation of database systems, managing the systems currently in use and setting and enforcing policies.
Database management system An organised set of facilities for accessing and maintaining one or more databases.
Database system A term used to encapsulate the constructs of a data model, DBMS and database.
Datum A unit of data.
DBMS See Database management system.
Decision A selection between alternative courses of action.
Decision point A point within some pattern of action which changes the course of action.
Decision strategy A set of rules that implement control inputs.
Decision support system DSS. See Executive information system.
Decision-making The activity of deciding on appropriate action in particular situations.
Declarative Communicative acts that aim to change aspects of or the state of some business domain through the communication itself.
Delete (act of articulation) An act of articulation that removes an existing data structure, element or item from existence.
Demand chain See Customer chain.
Design See Business design.
Design orientation The notion that design is an activity worthy to be taught.
Design artefact The output of applying some design theory in practice.
Design science The science of the possible.
Design theory A theory which proposes how to undertake design in relation to a class of design artefact.
Design workshop Sessions in which the business analyst and representatives of stakeholder groups get together in a structured situation to formulate thinking about either an existing domain of organisation or a new domain of organisation.
Development failure Failure of an information system project while in development.

Development information system That information system designed to support the development process.
Development method A specified approach for producing information systems.
Development organisation The group of people involved in a particular development effort.
Development process That activity system concerned with developing an information system.
Development technique Normally used to guide activity within one phase of the development process.
Development toolkit The methods, techniques and tools available to the development organisation.
Differentiation strategy The organisation undertaking this strategy aims to differentiate its product or service from its competitors.
Digital by default This means that the primary access channel to government services is deemed to be through remote access.
Digital certificate Sometimes referred to as digital signatures, they are used to authenticate parties in some eCommerce transaction.
Digital currency Currency stored and processed as digital data.
Digital democracy The use of ICT to support informed deliberation among citizens and help them to participate in decision-making.
Digital divide The phenomenon of differential rates of awareness, interest, access, skills and use of ICT among different groups in society. See also Digital exclusion.
Digital ecosystem An interdependent set of actors and activity systems that share digital platforms.
Digital exclusion The way in which certain sectors in society are excluded from access to digital infrastructure.
Digital good A good that can be delivered over a digital access channel.
Digital innovation Much modern innovation is clearly digital innovation – innovation with and through ICT.
Digital native Persons who have not known of a time when digital technology has not been around.
Digital polity The interaction of ICT with political systems.
Digital service A service that can be delivered over a digital access channel.
Digital signal A signal modulated with a limited range of values.
Digital strategy Traditionally, digital strategy is seen to involve aligning technological (ICT) infrastructure with activity infrastructure.
Directive Communicative acts that represent the sender's attempt to get the receiver of a message to perform or take an action.
Discourse A continuous stretch of language use, longer than a sentence, which is treated as a coherent unit.
Disintermediation The process by which intermediaries are removed from parts of the value network.
Division of labour This is the way in which tasks and responsibilities are assigned to members of the organisation.
Domain name A hierarchical naming convention for identifying host computers on the Internet.

E

eBusiness Electronic business. The conduct of business using information and communication technology. A superset of eCommerce.
eCommerce Electronic commerce. The conduct of business-to-business commerce using information technology such as that supporting the Internet.
eCommunity Term used to describe either a traditional community enabled with ICT or a virtual community.
Economic actor Some agency which engages in economic exchange.
Economic environment That part of the environment concerned with material provisioning.
Economic system See Economic environment.
eDemocracy Electronic democracy – the application of ICT to support democratic processes and systems.
EDI Electronic data interchange. A set of standards for the transfer of electronic documentation between organisations.
Effectiveness A measure of the extent to which the system contributes to the purposes of some higher-level system.
Effector A process that cause changes to a system's state.
Efficacy A measure of the extent to which a system achieves its intended transformation. See also Utility.
Efficiency A measure of the extent to which a system achieves its intended transformation with the minimum use of resources.
eGovernment Electronic government – the application of ICT within government organisations.

EIS See Executive information system.
Electronic commerce See eCommerce.
Electronic community A community supported through ICT.
Electronic delivery The use of ICT to deliver goods and services to customers.
Electronic government See eGovernment.
Electronic marketing See eMarketing.
Electronic procurement See eProcurement.
Electronic sourcing The sourcing, typically of bespoke goods and services, from suppliers by electronic means.
Email Electronic mail. The transmission and receipt of electronic text messages using communication networks.
Email protocol A communication protocol for the transfer of electronic mail.
eMall A collection of eShops.
eMarket A market in which economic exchanges are conducted using information technology and computer networks.
eMarketing The process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services using electronic channels.
Entropy The process of disorder, which is the natural state of the universe.
eProcurement ICT enablement of the activities of procurement.
Emergence Most systems display emergent properties – properties that emerge from the operation of the system and which are not present in any of the parts of the system.
Employee-facing information system A type of information system supporting interaction with employees of the organisation.
eNabled community A traditional community supported by ICT.
Encryption The process of securing data through application of some security algorithm.
Enrolment The process by which identified individuals gain access to the systems of a particular organisation or institution.
Enterprise resource planning system ERP system. A package that implements an enterprise architecture for some organisation.
Environment Anything outside the organisation with which the organisation interacts and which influences the behaviour of the organisation.
Entanglement The fact that qubits in a superposition can be correlated with each other.
eProcurement A term used to refer to ICT enablement of key supply chain activities.
Equifinality The idea that a system can be designed to fulfil its purpose in a number of different ways.
eShop An eShop is a single firm selling their products or services online.
Evaluation The activity of assessing the worth of something.
Executive information system EIS. That type of information system designed to support high-level, strategic decision-making in organisations.
Expectation failure The inability of an information system to meet a specific stakeholder group's expectations.
Expressive Communicative acts that represent the speaker's psychological state, feelings or emotions.
Extranet A network established such that external users can gain access to specified parts of the internal network of some organisation.

F

Feasibility study That part of systems conception concerned with assessing the feasibility of developing some information system.
Feedback The way in which a control process adjusts the state of some system being monitored to keep it within defined limits.
File An element of physical data organisation: a collection of records.
Firewall A collection of hardware and software placed between an organisation's internal network and an external network such as the Internet.
Five forces model A strategic planning framework due to Porter and Millar.
Focus group A type of one-to-many discourse in which a group of people are asked a series of questions about their perceptions, opinions, beliefs and attitudes towards something or some situation.
Foreign key An attribute or attributes within a table which cross-relate to data held in other tables within some database.
Formative evaluation Assessing the shape of an information system within the development process itself.
Front-end ICT infrastructure The organised collection of ICT systems interacting with key stakeholders.

Front-end ICT system An ICT system that supports a front-end information system.
Front-end information system An information system which interacts with internal or external stakeholders of the organisation.
Front-end information systems infrastructure The set of related information systems that interact with the major stakeholders of the organisation.
Functionality What an ICT system is designed to be able to do.

G

G2B eGovernment G2B, or government-to-business eGovernment, concerns electronic enablement of the relationships between government bodies and the private sector.
G2C eGovernment G2C, or government-to-citizen eGovernment, is a form of external eGovernment since it is particularly involved in supporting the customer chain of the government body.
G2P eGovernment G2P (government-to-partner) eGovernment involves ICT enablement of activities between government and its partners.
G2G eGovernment The use of eGovernment to support intragovernment cooperation and collaboration.
General systems theory See Systemics.
Giga-byte 1,000,000,000 bytes (billion).
Good Any product or commodity which is valued and exchanged.
Government The activities of enabling and supporting democracy, developing and implementing policy, and delivering services.
GPRS General Packet Radio System. A form of radio communication channel for data transmission with high bandwidth.
Green ICT Considering and managing the impact ICT has upon sustainability.

H

Hard system Systems in which the goals of the system are relatively unproblematic. Many technological systems are hard systems.
Hardware The physical aspects of ICT consisting of processors, input devices and output devices.
Heuristic algorithm An algorithm which specifies a series of rules for solving a class of problems.
Hierarchy An important systems concept in which a system can be de-composed to form various levels of detail.
Holistic thinking Thinking which studies the properties of whole systems rather than its parts.
Horizontal infrastructure A term used to refer to the ways in which distinct activity, information and data systems are coupled across the organisation.
Homeostasis The process of ensuring that a system remains regulated within defined limits.
HTML Hypertext Markup Language. A standard for marking up documents for publishing on the Web.
HTTP Hypertext Transfer Protocol. A communication protocol designed for the transfer of hypertext documents.
Human resource management A secondary process in the internal value chain. This involves the recruiting, hiring, training and development of the employees of a company.
Hypermedia The technology supporting the construction of documents of multiple media associated together with links.
Hypertext A subset of hypermedia concentrating on the construction of network text.
Hypertext Markup Language See HTML.

I

IaaS Infrastructure as a service – a form of SOA in which key elements of ICT infrastructure are supplied through the Cloud.
ICT Information and communication technology. Any technology used to support data gathering, processing, distribution and use. A term used to encapsulate hardware, software, data and communications technology.
ICT governance A subset of the discipline of corporate governance, focused on ICT systems and their performance.
ICT infrastructure The set of interrelated ICT systems used by some organisation.
ICT infrastructure service That organisational function devoted to the delivery of ICT services.
ICT management Concerned with the maintenance of the ICT infrastructure, developing new applications and maintaining existing ICT applications.
ICT service delivery Delivering services, monitoring operation and costing services.
ICT service improvement Managing the process of improving aspects of ICT infrastructure.
ICT service strategy Defining a strategy for the ICT service.
ICT service support Supporting users' use of the ICT service.
ICT services management The management of ICT as a service.
ICT strategy A specification of the hardware, software, data,

communication facilities, and ICT knowledge and skills needed by the organisation to support its information systems.

ICT system An ICT system is a technical system sometimes referred to as a 'hard' system. An ICT system is a system of data representation and processing. In the modern organisation it generally consists of an organised collection of hardware, software and communications technology designed to support aspects of some information system.

Identification The process of using an identifier to connect to a stream of data constituting a person's identity.

Identifier Some symbol which identifies some thing (often uniquely).

Impact The effect of information systems on individuals, groups and organisations.

Implementation Introducing new systems into the domain in question.

Inbound logistics A primary process in the internal value chain involving the receipt and storage of raw materials and the distribution of such materials to manufacturing units.

Information The accomplishment of meaning by some actor with data.

Information and communication technology (ICT) Any technology used to support information gathering, processing, distribution and use. Information technology consists of hardware, software and communications technology.

Information and communication technology system See ICT system.

Information and communication technology infrastructure See ICT infrastructure.

Information centre A structure for the informatics service in which the service acts as a centre of expertise for other business units.

Information class A category which defines something of interest. A key element of an information model.

Information infrastructure The set of interrelated information models describing the information needs of the organisation.

Information management That part of informatics management concerned with the management of information.

Information model A model of the things of interest relevant to some area of business.

Information security The process of protecting information systems from criminal or unwanted activity.

Information situation An intuition pump which demonstrates necessary elements of all situations of information accomplishment.

Information society A term very loosely used to refer to the effect of ICT, information systems and information generally on modern society.

Information strategy That part of an informatics strategy concerned with specifying the information need for the future within some organisation.

Information system A system of communication between people that supports coordinated and purposive activity.

Information system model A representation of an information system.

Information systems development That activity system devoted to the creation of a new information system or the maintenance of an existing information system.

Information systems development method A specified approach for producing information systems.

Information systems development technique Development techniques are normally used to guide activity within one phase of the development process.

Information systems development tool The hardware, software, data management and communication technology used to construct information systems.

Information systems evaluation Assessing the worth of some information system.

Information systems failure The development or use failure of some information system.

Information systems infrastructure The entire set of information systems supporting activity in some organisation.

Information systems management Concerned with the management of information-handling applications, both computerised and non-computerised.

Information systems planning The process of defining some information systems architecture.

Information systems portfolio A list of current systems in the information systems architecture or future systems in the information systems strategy.

Information systems strategy A specification of the information systems needed to support organisational activity.

Informative action Action involving communication, directed towards coordination.

Infrastructure Systems of activity, communication and technology that create organisation.

Innovation Thinking differently with the aim of doing things differently, to hopefully make a difference.

Input The things that a system takes from its environment.
Input device A device concerned with the input of data.
Input subsystem That part of a computer system concerned with the input of data.
Institutional perspective That perspective on organisation which considers organisations as entities independent of the humans participating within them.
Intent The intent of a communicative act refers to its purpose. There are five major types of intent.
Interaction failure The argument is that if a system is heavily used it constitutes a success; if it is hardly ever used, or there are major problems involved in using a system then it constitutes a failure.
Interest A pre-condition of electronic delivery. Stakeholders must be interested in using remote access channels for electronic delivery.
Interface layer That part of an ICT system devoted to the management of the user interface.
Intermediary Sometimes known as a channel organisation. An organisation which mediates between other organisations in the value chain.
Intermediation The process by which intermediate actors establish themselves within the value network.
Internal eGovernment Internal eGovernment refers to the enablement of internal processes within the government body itself with ICT.
Internet A set of interconnected computer networks distributed around the globe that adopt the TCP/IP standard.
Internet auction An auction conducted over the Internet.
Internet governance The development and application of shared viewpoints by governments, private sector corporations and civil society as to the further evolution and use of the Internet.
Internet of Things The use of the Internet to connect digitally enabled devices.
Internet protocol A communication protocol standard that drives the Internet.
Internet service provider (ISP) a company supplying connections to the Internet.
Interoperability A measure of the degree to which information systems are able to coordinate and collaborate.
Interorganisational information system That form of information system that is developed and maintained by a consortium of companies in some cognate area of business for mutual benefit.
Intrabusiness eBusiness The use of ICT to enable the internal business processes of the firm.
Intranet The use of Internet and Web technology within the confines of a single organisation.
Intuition pump Thought experiments which rely upon the thinker's intuition to develop an answer to a specified problem.
IP address Internet protocol address. A unique identifier for computers on a communication network using TCP/IP.
ISP Internet service provider – a company supplying connections to the Internet for customers.
Iterative development In this model systems conception triggers an iterative cycle in which various versions of a system (prototypes) are analysed, designed, constructed and possibly implemented.
ITIL Information Technology Infrastructure Library – a method for ICT services management.

J

Job analysis Involves the analysis of the content and relationships of current jobs in terms of both organisational and individual objectives.
Job satisfaction The satisfaction that workers have with the role they are required to perform.
Just-in-time (JIT) A set of practices where the flow of value is pulled through the value stream (value chain) when it is required by consuming activity.

K

Kanban A pull-production system designed around the articulation of data structures.
Kilo-byte 1,000 bytes.

L

LAN See Local area network.
Legacy ICT system An aging ICT system that is important for the organisation but which constrains infrastructure change.
Linear development The phases of development are strung out in a linear sequence with outputs from each phase triggering the start of the next phase.
Local area network LAN – a type of communication network in which the nodes of the network are situated relatively close together.
Location-based services A service that uses data about location within the provision of some digital service.
Location strategy A location strategy involves the organisation attempting to find a niche market to service.

M

Machine learning The attempt to develop limited minds through learning conducted upon large data sets.
Maintenance See Systems maintenance.
Management The process through which organisation is controlled.
Management information system MIS – a type of information system supporting management activities, particularly tactical decision-making.
Management-facing information system A front-end information system used by management. See Management information system and Executive information system.
Managerial hierarchy Organisations coordinate the flow of value by controlling and directing it at a higher level in management structures.
Market A market is a medium for exchanges between buyers and sellers.
Marketing and sales A primary process in the internal value chain. Marketing is the process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organisational goals. Sales is the associated activity involved in the management of purchasing activities of the customer.
Marketing analytics A battery of techniques employed to measure the value of eMarketing activity.
Marketing channel A channel for the communication of marketing messages.
Mega-byte 1,000,000 bytes (million).
Mega-package See Enterprise resource planning system.
Metcalfe's law A 'law' which states that the worth of a communication network to a user is proportional to the square of the number of users or members of the network.
Method See Information systems development method.
MIS See Management information system.
Model An abstraction of some domain.
Modelling The process of building abstractions to aid understanding and communication.
Mobile commerce The use of mobile access devices such as smartphones to conduct eCommerce.
Mobile device Any access device that can be used for access on the move.
Modulation The process of introducing variety (differences) into a physical pattern such as a signal.
MoSCoW prioritisation A way of categorising and sorting issues to be handled (See page 296).
MMS MMS (multimedia messaging service) allows image, video and audio content in a text message.

N

Narrowcasting The process by which content is targeted at specific individuals with certain profiles.
Negative feedback A type of feedback in which the control process takes action to reduce the variation between control inputs and sensed inputs.
Negentropy The process by which order is accomplished in a universe of disorder.
Neural net A neural net is built from interconnected layers of nodes and is trained through machine learning.
Non-repudiability A user of an ICT system should not be able to deny that they have used the system for some commercial transaction.

O

Observation The recording of the detailed work behaviour of people and machines.
Offshoring The relocation of one or more activity systems by some organisation to another country.
Ontology That branch of philosophy concerned with theories of reality. Also used to describe a systematic model of some area of existence.
Omnichannel retailing Retailing conducted through multiple channels of access.
Open system A type of system that interacts with its environment.
Operating procurement Procurement conducted to support all the operations of the business.
Operating system That piece of system software concerned with the management of all other applications on a computer system.
Operational management The lowest level of management involved with making structured decisions with detailed data.
Operations A primary process in the internal value chain involving the transformation of raw materials into finished products.
Organisation The patterned order evident in some domain of action. A complex, adaptive

system consisting of activity, communication and representation.
Organisation theory That body of knowledge concerned with defining the key features of organisations.
Outbound logistics A primary process in the internal value chain involving the storage of finished products in warehouses and the distribution of finished products to customers.
Output The things that a system provides to its environment.
Output device A device that outputs data.
Output subsystem That part of a computer system that outputs data to the user or to some other device.
Outsourcing The strategy in which the whole or part of the informatics service is handed over to an external vendor.

P

P2P eCommerce Partner-to-partner eCommerce. ICT enablement of aspects of the partnership chain.
Pervasive computing The idea of embedding computational and communication capability into everyday objects.
Pervasive objects Digitally enabled objects that are able to authenticate and identify themselves to systems.
PaaS Platform as a service – a form of SOA in which a platform is provided in the Cloud, typically for the development of software.
Package development In package development an organisation purchases a piece of software from a vendor organisation and tailors the package to a greater or lesser extent to the demands of a particular organisation.
Packet switching The process of breaking up message data into packets that are disseminated over a communication network by routers.
Partner A key type of organisational stakeholder. Key organisations in the same industrial sector or market that participate in some partnership arrangement with an organisation.
Partnership chain The chain of activities conducted with partners in delivering value to a common customer.
Participation A way of engaging with a problem situation by engaging in such practices yourself.
Pattern Elements which repeat across situations.
Pattern comic A representation of some story using comics for the purposes of analysis, design and implementation of systems of action.
Payroll information system That back-end information system dealing with the payment of employees of the organisation.
Performance The degree to which a system reaches specified levels.
Performance measurement The establishment of performance targets and the process of monitoring the achievement of such targets.
Personal computer A desktop computer used as a remote access device.
Personal identity management A term used to encompass all those issues involved with authenticating, identifying and enrolling individuals.
PESTLE PESTLE analysis considers the environment as a series of necessary systems that must be considered when contemplating any form of organisational change. These include the political system (P), the economic system (E), the social system (S), the technological system (T), the legal system (L) and the environmental system (E).
Phatic communication Communication used to bind people together in social networks.
Physical environment The ecological environment within which an organisation sits.
Physical symbol system A system that has the necessary and sufficient means for generating intelligent action.
Podcast A series of digital media files such as audio or video files that are released episodically to users.
Political environment That part of the environment concerned with power and its exercise.
Polity A political system centred on some geographical area.
Post-mortem evaluation Examining the reasons for some information systems failure.
Pre-conditions for electronic service delivery A range of social factors, expressed in a sequence, which affect the likely uptake of the electronic delivery of goods and services.
Primary activity Activities that constitute the core competencies of some organisation.
Primary key A unique identifier for each of the rows in a table.
PRINCE2 A structured method for project management.
A structured method for project management.
Privacy See Data privacy.
Problem-setting Establishing or setting the problem to be engaged with.

Problem situation A situation in organisational life that is regarded by at least one person as a problem.
Problem-solving Resolving some established problem.
Process re-engineering The process of analysing, redesigning and implementing organisational processes.
Procedural algorithm An algorithm which specifies every step of a procedure for solving a class of problems.
Procurement A secondary activity in the internal value chain. Procurement is the process of purchasing goods and services from suppliers at an acceptable quality and price, and with reliable delivery.
Producer A key type of organisational stakeholder. Teams of developers that have to design, construct and maintain information systems for organisations.
Product-based project planning A form of project management in which project planning and control is focused around information systems products.
Production That set of activities concerned with the creation of goods and services for human existence.
Production cost The cost of producing something.
Production-related procurement Procurement designed to support manufacturing operations.
Productivity paradox The paradox observed in the first three decades of computing that productivity did not rise with more investment in ICT.
Programme management The management of a suite of linked projects.
Programming language A language for instructing some computer system.
Project A project is an activity system established for a finite period to achieve a specified series of goals.
Project control Ensuring that a project remains on schedule, within budget and produces the desired output.
Project escalation The process in which decision makers become locked in an irrational course of action.
Project management The process of planning for, organising and controlling projects.
Project organisation How to structure staff activities to ensure maximum effectiveness.
Project planning Determining as clearly as possible the likely parameters associated with a particular project.
Prototyping The development approach in which prototypes are produced.
Provider of ICT A producer of hardware, software or communication technology.
Public key infrastructure An infrastructure for ensuring the security of electronic transactions that includes ensuring that digital keys are used only by legitimate holders and procedures for managing the assignment and storage of digital keys.
Purchase order processing information system The information system that records details of purchase orders to suppliers.
Purpose The goal of some system.

Q

Quantum computing The use of certain properties of quantum mechanics, such as superposition and entanglement to accomplish computation.

R

RACI matrix A way of classifying the impact a particular stakeholder group will have on a design project.
Radio frequency identification tag See RDIF tag.
Read An act of articulation that decodes the values associated with one or more data items.
Record A data element of a file.
Referent The real-world things referred to by the sign.
Refreezing Establishing new patterns of action.
Regulation The process of ensuring that a system remains viable.
Regulator A key type of organisational stakeholder. These are groups or agencies that set environmental constraints for an information system.
Reintermediation The process in electronic markets of new intermediaries developing between buyers and sellers.
Relationship An association between information classes.
Repeat commerce The pattern in which regular, repeat transactions occur between trading partners.
Representation The process of denoting something with a physical pattern.
Requirements analysis Negotiating and agreeing requirements with the various stakeholders.
Requirements elicitation The process of identifying requirements for the system from stakeholder groups.
Requirements specification Representing the requirements established in the requirements elicitation process.
RFID tag Radio frequency identification tag – an access device that can be incorporated into some object.

Rich picture A graphical representation of key elements of some problem situation.
Risk analysis The identification, estimation and assessment of risk.
Robotics The discipline devoted to the building of artificial actors able to perform activities such as manufacturing.
Role A package of expected (conventional) actions assigned to actors in certain social situations. A resource used by actors to guide action.
Role analysis Analysing the requirements of a particular role.
Role enrichment Increasing the scope of a role, giving workers more responsibility for making decisions about their own work.
Role enlargement Combining a number of different tasks within one role.
Role rotation Rotating roles among a group of actors.
Root definition A way of representing the perspectives of key stakeholders as to the core purpose of some activity system.
Router Hardware and software that directs packets to their indicated destination along a communications network.
Rules subsystem That part of an ICT system concerned with application logic.

S

SaaS Software as a service – a form of SOA in which clients request software components from the Cloud.
Sales order processing information system The information system that records details of customer orders.
Scrum An approach to agile software development.
Search engine A system that allows users to locate websites matching keywords.
Search engine optimisation The process of optimising the chances of marketed products and services returning as hits by a search engine.
Secondary activity Activities that are critical to supporting primary activities.
Secure socket layer Secure socket layer (SSL) is Netscape's attempt to offer a secure channel of communication. It is a framework for transmitting sensitive information such as credit card details over the Internet.
Security See Data security.
Semiotics The discipline devoted to the study of signs and sign-systems.
Sensor A mechanism that monitors the changes in the environment of some system.
Server That computer that supplies services to clients.
Service Some form of valued activity that is exchanged between actors.
Service-oriented architecture (SOA) SOA represents a way of designing ICT infrastructure in which the functionality of some ICT system is decomposed into small, distinct units known as services, which can be distributed over a network and can be combined together and reused to create business applications.
SGML Standard Generalised Markup Language is a generalised markup language for describing the formatting of electronic documents.
Sign A pattern of significance. Something which stands to somebody for something.
Sign-system An organised collection of signs and relations between signs.
Single-loop feedback A type of feedback involved in regulating the behaviour of an underlying operational process.
SMS Short messaging service or SMS refers to a text messaging protocol that restricts messages to a string of 256 alphanumeric characters.
SMART goal A goal that is specific, measurable, achievable, realistic and timely.
Social capital A feature of social networks that facilitates coordination and cooperation among actors.
Social environment That part of the environment concerned with the cultural life of some grouping.
Social network A network of people joined together with social relations.
Social networking site A website that facilitates social networking.
Social media The attempt to build and support social networks through the application of ICT.
Sociotechnical system The term is generally used to refer to a system in which patterns of work (social) are closely entangled with patterns of technology (technical).
Soft system A social system that is designed to meet certain objectives. The objectives of a soft system may be problematic or open to interpretation.
Software Programs of instructions for controlling hardware.
Speech act A term used within the philosophy of language to refer to a communicative act.
Stakeholder Somebody with a vested interest in some problem situation. A role is defined by active participation in the domain considered a problem situation; a stakeholder merely has an interest of influence in some domain.
Stakeholder mapping Analysing the types of and impact of stakeholders on information systems.

Stakeholder identification Identifying the group of people to which an information system is relevant.
State The set of all values assumed by the properties of a system at one point in time.
Stock control information system An information system for recording details of inventory.
Storage That part of a system concerned with the representation of data.
Storage device A device that persistently represents data.
Storage subsystem That part of the computer system concerned with the persistent representation of data.
Strategic decision-making Making less structured decisions, with summary information about courses of action with a long timescale.
Strategic evaluation The evaluation of the strategic benefit of some information system.
Strategic implementation Determining policies, making decisions and taking action.
Strategy The process of directing future activity.
Strong AI The search to develop intelligence in a machine that displays complex, cognitive abilities, which generate the phenomenon we generally refer to as conscious mind.
Strong link A relationship between two actors that are in regular contact with each other.
Subculture The set of behavioural expectations associated with some part of a larger social grouping.
Suboptimisation The idea that optimising the performance of a particular subsystem will not necessarily optimise the performance of the whole system.
Subsystem A coherent part of a system that can be treated as a system itself.
Summative evaluation Assessing a delivered information system against its strategic evaluation.
Superposition The strange property of a quantum bit in which it can take many different values between 0 and 1 at the same time.
Supplier A key type of organisational stakeholder. Organisations that supply goods and services to some organisation.
Supplier relationship management The management of supply chain activities. Sometimes referred to as supply chain management.
Supplier-facing information systems A type of information system supporting interaction with the suppliers of the organisation.
Supply chain The set of activities an organisation takes in relation to its suppliers.
Supply chain management The collection of an organisation's activities devoted to the management of the supply chain.
Swim-lane A visualisation technique used to indicate different partitions of action.
SWOT SWOT is an acronym standing for strengths, weaknesses, opportunities and threats.
Symbol A pattern of energy or matter used to denote something.
System An organised set of interdependent elements that exists for some purpose, has some stability and can be usefully viewed as a whole.
Systemics The study of systems. See also General systems theory.
Systems thinking See Systemics.

T

Table The major data structure in the relational data model.
Tactical management Middle management which interfaces between strategic and operational management.
Tactics Tactics belong only to the mechanical movement of bodies set in motion by strategy.
Tangible computing The idea that our interaction with tangible (physical) objects can replace traditional ways of interacting with computers via touchscreens or keyboards.
Target advertisement One-to-many active advertisements.
Task analysis Specifying the precise organisation of tasks associated with the use of some computer system.
TCP/IP Transmission control protocol/Internet protocol is the communications model underlying the Internet.
Technique Some systematic activity within the development process.
Telephony A category of access device which includes fixed audio and video telephones as well as mobile telephones and fax machines.
Tera-byte 1,000,000,000,000 (trillion) bytes.
Theory X According to this theory the average human being is perceived as disliking work and hence avoiding it wherever possible. The average human being avoids responsibility and has little ambition.
Theory Y According to this theory physical and mental effort are important and natural human functions. If humans are committed to certain objectives they will exercise self-direction

and self-control. The capacity to exercise imagination, ingenuity and creativity are widely distributed in the population.
Thought experiment A device of the imagination used to investigate things.
Three-tier architecture A client-server architecture divided into three layers: interface, business and data.
Timebox An agreed period of time for the production of a deliverable.
Tool Some software used to aid the development process.
To-be model A model of how things will be. An as-if model selected for implementation as a new business model.
TPS See Transaction processing system.
Transaction A logical unit of work which transforms a database, or more generally a data structure, from one state to another.
Transaction cost See Coordination cost.
Transaction processing system (TPS) A type of information system supporting the operational activities of some organisation.
Transaction subsystem That part of an IT system concerned with communicating between the interface and rules subsystem and the data subsystem.
Transactional data Data that record events taking place between individuals, groups and organisations.
Trust The glue that binds organisations together into a single cohesive unit and keeps them functioning. Trust is also critical to economic transactions between buyers and sellers. Trust is defined in the *Oxford English Dictionary* as 'a firm belief that a person or thing may be relied upon'.
Tweet A text-based post of up to 140 characters.

U

Ubiquitous computing The trend in which computation is sinking into the background, becoming invisible infrastructure supporting our interaction with all sorts of things in different places and at different times.
Unfreezing One of the three stages of planned change, involving breaking down or 'unfreezing' patterns of habitual action.
Universal resource locator (URL) a unique identifier for a document placed on the Web.
Update An act of articulation that changes the values associated with one or more data items of some data element.
Update function Individual components of functionality that are triggered by events in the interface and change the state of data structures.
URL See Universal resource locator.
Usability How easy a system is to use for the purpose for which it has been constructed.
Use A pre-condition of electronic delivery. Stakeholders must regularly use remote access mechanisms in core areas of life.
Use case A use case model provides a high-level description of major user interactions with some information system.
Use failure Failure of an information system after a period of use.
User interface That part of an ICT system that allows users to control the functionality of the system.
Utility The worth of an information system in terms of the contribution it makes to its human activity system and to the organisation as a whole.

V

Value A general term used to describe the worth of something such as the output from some system of organisation.
Value chain A defined set of activities that deliver value to the customer.
Value-creating system Organisations are best seen as systems directed at the creation of value.
Value network The network of actors within which an organisation sits and with which the organisation exchanges value.
Value stream A sequence of activities required to design, produce and provide a specific good or service to a customer.
Value added network (VAN) – A network that a third-party organisation sets up and maintains, selling the right to use it.
Variety A measure of the complexity of a system; the number of states a system can assume.
Vertical infrastructure A term used to refer to the three layers of infrastructure applicable to organisation and the way they are coupled.
Viable system A term used by Stafford Beer to describe a system capable of surviving in a volatile environment.
Viral marketing The idea of spreading product referrals through a social network in a similar manner to the way in which a virus might spread through a population.
Virtual community A community consisting of a

network of actors on some communication network.
Virtual organisation An organisation built on an ICT infrastructure that enables collaborative eWorking among members. Also referred to as network organisations. Organisations characterised by flat organisational hierarchies, formed around projects and linked together by ICT.
Vision statement A short list of key strategic objectives for an organisation.
Visualisation The process of building a visual representation of something.

W

Weak AI Weak AI seeks to build working but much more limited minds capable of acting intelligently but in much more limited domains.
Weak link A relationship between two actors that are in irregular contact.
Web See WWW.
Web 2.0 A collection of Web-based communities and hosted services which facilitate collaboration.
Web analytics Can be seen to be a subset of business analytics and refers to a battery of techniques employed to measure website traffic.
Web page A term generally used to refer to the presentational aspect of a web document.
Web unicorn Digital start-up businesses that rely upon the infrastructure of the Internet and Web with a market valuation greater than one billion US dollars.
Website A collection of HTML documents stored on some web server.
Wicked problems Complex problems in which the problem itself is open to interpretation.
Wide area network WAN – A type of communication network in which the nodes of the network are geographically remote.
WiFi A series of standards supporting short range, high bandwidth communication networks.
Wiki A shared web page or site that can be updated using easy-to-use tools through a browser.
WiMax A related technology to WiFi but designed to provide communication over longer distances.
Word One or more bytes treated as a unit.
Worldview A set of underlying assumptions held by a particular stakeholder group.
WWW The World Wide Web – an application that runs over the Internet supporting the use and transmission of hypermedia documentation.

X

XML Extensible Markup Language is a meta-language for the definition of document standards.

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