Paul Beynon-Davies

Business Analysis and Design

Understanding Innovation in Organisation

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Prologue

Introduction

A *logo* is usually some form of graphic—a visualisation used by organisations, groups or even individuals to aid and promote instant recognition. When we use logos within this book, they are designed to promote recognition of some of the fundamentally different ways of thinking you will experience.

As a logo for the current chapter we might use a corruption of the famous illustration by Leonardo da Vinci known as *Vitruvian Man* (Fig.). This drawing was an attempt by Leonardo to do a number of things. Overall, it was his attempt to relate man to nature. To do this, he illustrated the relationship of the human body to certain fundamental and abstract shapes: namely, the square and the circle. Such shapes demonstrate the association between certain proportions of the human body as described by the Roman architect Vitruvius and some fundamental key measurements from the world of aesthetics (the study of beauty in all its forms), particularly the idea of the golden mean or 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 is not only important in the mathematics of geometry, but also underlies many of the principles of architectural design, such as that used in the proportions of the Parthenon in Athens. For Leonardo, the golden ratio was evident in many significant aspects of proportion in nature, such as the structure of the spiral in a nautilus shell and that found in the dimensions of the human body.

In drawing this figure, Leonardo was inherently proposing, through means of visualisation, certain inherent linkages between naturally occurring phenomena and principles of good design. In a similar manner, we attempt to overlay some key principles upon the nature of what we shall call socio-technical organisation within this book and demonstrate how these key principles allow us to develop a better appreciation of the 'proportion' of such organisation: both what organisation is but more importantly what it can achieve.

Some have interpreted Leonardo's figure as one of the first attempts to break down barriers between art and science—to demonstrate that science has much to offer

artistic expression and that artistic expression can be used to make better sense of science. The framework (or what we shall later refer to as our design theory) used within this book is an attempt in a similar vein. Broadly we see no value in the intellectual gulf between the physical, psychological and social sciences and wherever possible attempt to demonstrate how socio-technical organisation is necessarily a physical (technical), psychological and social phenomenon: it is in fact an entangled combination of these three types of phenomena. We even propose that to engage with socio-technical organisation, particularly to attempt to innovate with ways of organising, is necessarily to engage with a third type of science—that of *design science*. The science of design must always take on board the goal of aesthetic excellence.

However, anyone knowing the original Leonardo illustration will have noticed some significant alterations that we have made to Fig. P.1. As well as of course being much poorer aesthetically than the original we have endowed the figure with three sets of raised arms as compared to two in the original. Also, at the end of each arm we have made the hand form a distinct gesture. Each hand gesture is a significant pattern in the sense that some actor can accomplish meaning with them through
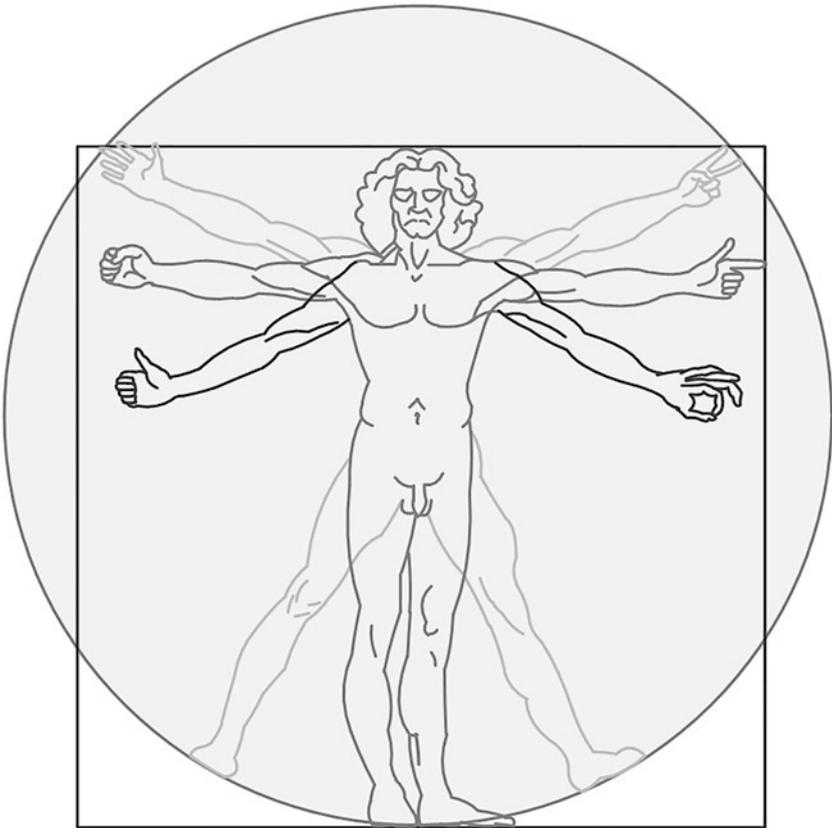

Fig. P.1 A modified Vitruvian Man

communicating intent. Such informed intent can also be used to stimulate and control patterns of performance between humans. As such, these signs exemplify the formation of resources within larger sign-systems which underlie all communication and which, in turn, support coordinated activity. This visual device signifies placing humans—what they do, communicate and represent at the centre of organisation.

Our purpose in this book is to demonstrate how understanding something of the nature of signs, patterns and systems as well as how they interact in various ways enables us to better understand the world of organisation and how it works, particularly the many and varied ways in which humans inter-act with machines and other artefacts. The combined use of these three *tools for thought* gives us enormous power not only for understanding how humans organise themselves as they do but how to change such ways of organising, hopefully to make such forms of organisation better (Note).

> **Note** There are lots of short exercises placed throughout the chapters of this book. We want to emphasise through this that business analysis and design is all about *thinking and doing*. The exercises are attempts to get you to think differently about socio-technical organisation and through such re-orientation to act differently in terms of such organisation. Some of these exercises can be done as both group and/or individual activities. A few can even be undertaken as 'business' games or games of organisation. One such game that we have used many times is described in the introduction.

Conventional Thinking

The current book takes something of an unconventional viewpoint on not only what business or organisation is but what business should be as an activity that must directly engage with the complexity of the contemporary global economy, society and polity. For us creativity must be at the very heart of modern business and creativity by its very nature is a challenge to conventional ways of thinking and doing. The psychologist Edward de Bono believes that '*Creativity involves breaking out of established patterns in order to look at things in a different way*' (DeBono 1969).

Established patterns are conventions. We normally think and act 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 Fig. P.2?

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 view of business 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 or what others typically do.

Fig. P.2 An optical illusion
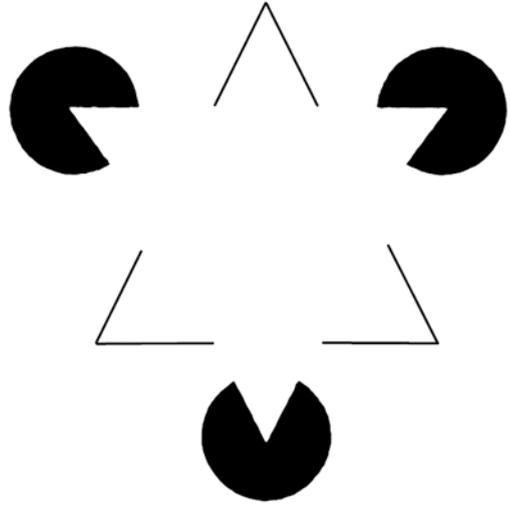
Fig. P.3 Another optical illusion
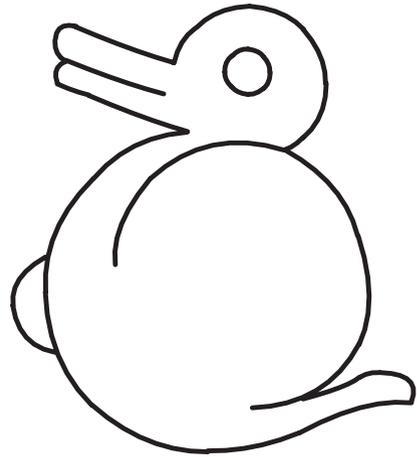
Or consider the further optical illusion in Fig. P.3, which is attributed to the philosopher Ludwig Wittgenstein. What animal do you see represented in this figure? The answer should be that you see either a *duck* or a *rabbit* depending on how you look. The lesson here is that frequently just changing viewpoint on the same thing elicits different action. For instance, you are likely to cook duck differently than rabbit—if you've got any sense!

We shall provide three different viewpoints on organisation in this book. Each of these viewpoints is designed to change your perception of organisation.

They will also change your ideas about appropriate action to take in relation to the design of organisation.

So, there are exercises throughout each chapter, which are not the typical type you get in business texts. They are all exercises in thinking differently. Here is the first one (Exercise P.1).

Exercise P.1

Thinking differently frequently demands 'thinking outside the box'—sometimes literally. Consider the matrix of dots below, sometimes called the Gotschaldt matrix after its inventor.

The challenge is to connect all the dots in the matrix with no more than four lines—this is the problem set. But you must not take pen off the paper and any dot should not be bisected by a line more than once. Most people approach the problem by trying to connect lines within the 'box' implied by the arrangement of dots. But to solve the problem you need to think of lines starting and ending way outside the 'box'. One solution is given below. Can you generate any of the other possible solutions?
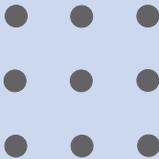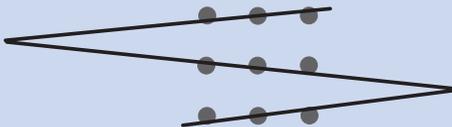

Thinking Differently

Creativity is discussed within business but usually is thought as being located in particular business specialities. Marketing and possibly developing business strategy are typically seen as the most creative parts of business work. Within the approach explored in this book I want to persuade you otherwise. Within this book I will persuade you that conducting business analysis and doing business design are in fact the most creative things you can do within a private, public or voluntary sector organisation.

This is because business analysis and design involve breaking down convention or what is better thought of as patterns of order or organising. Business analysis involves understanding established patterns of order and attempting to break down such patterns of order. Business design involves attempting to envisage and create new and hopefully better patterns of order—with the purpose, hopefully, of making a difference.

Creativity is business analysis and design because this endeavour involves breaking out of established patterns and thinking differently in order to make a difference. But getting people to think differently is difficult because we all carry around intellectual baggage with us that shapes our view of the world and as a consequence how we react to it. This baggage is particularly bundled up with the words (or more generally signs) we use to describe and understand the world.

The psychologist Abraham Maslow was echoing the work of the German philosopher Martin Heidegger when he said something along the lines of: *if the only tool you have is a hammer you tend to see every problem as a nail*. To get you to think differently we have to break down existing conceptions and provide you with new 'tools' for engaging with domains of organisation.

This is difficult because we all work with preconceived and often tacit conceptions about how to do business or what organisation means. To help us break down conceptions we have found it useful to use non-standard examples and cases; traditionally not considered in the business or technology literature. Hence, the ways in which the ancient Inka tied knotted strings have much to tell us about the nature of business data. Also, the ways in which honeybees coordinate their activity through complex dances has much to tell us about the relationship between information and performance (Beynon-Davies 2011) (Exercise P.2).

Exercise P.2

The German philosopher Jürgen Habermas argues that a society's traditions (conventions) are not necessarily in the best interest of individuals. The consequence of this is that individuals need to be able to question and change these traditions. They can do this by reasoning together in the public sphere, which builds consensus, brings about change and strengthens society.

Therefore, Habermas argues that a healthy society is one in which communicative reason is used to negotiate and enact continuous change. The same might be said of the healthy organisation. Society just like organisational action is a matter of conventions of action. Such action should be subject to continual inspection and to critique through communicative reason.

Think of some ways you might promote and operate such a process of continual inspection and critique in an organisation known to you. What barriers might there be to exercising communicative reason in such settings? Is it always true to say that there are always better conventions of action?

In considering such examples, we shall attempt to first shatter your ideas about what organisation is. We shall then re-constitute the nature of organisation using three core conceptual pillars: signs, patterns and systems. Using these concepts—which you have probably not come across in any other business or technical literature—we will offer you a creatively new way of thinking about the nature of organisation.

Developing different ways of thinking about something is the first step towards good design. The concepts we shall discuss are key tools of thought not only for better understanding how organisation works or is accomplished. Such thinking

also offers us practical ways of both analysing and designing organisation—whether such organisation is in the private, public or voluntary sectors.

Scope and Aims

The central aim of this book is to introduce the design orientation in business, which is impacting upon the way in which management is undertaken world-wide. The design orientation is inherently about change: changing things or changing ways of doing things. Design is a process in which there is some perceived problem by someone, the parameters of this problem have to be unravelled and some sort of change arrived at and agreed with key stakeholders in the problem (Exercise P.3).

> **Exercise P.3**
> We shall refer to the work of the designer Buckminster Fuller in a further chapter. He was one of the first persons to develop a new way of thinking about our planet—he referred to it as *spaceship earth*. Our planet is clearly travelling continually in space in an elliptical orbit around the sun. In this sense it is our ship for travelling through space. But what consequences arise from this different way of referring to and thinking about our planet?

This book provides a number of critical tools for design which enable both students of business and business professionals to systematically analyse existing ways of organising (business analysis) and to specify new ways of organising (business design). As such, the book provides concrete practices for constructing business strategy in terms of innovative and digitally enabled business models. The book also provides a way of thinking through how change management and innovation management should be conducted. The central role that information and communications technology (ICT) plays in transforming strategy and business models is addressed in terms of the tools and practices described in the book.

Therefore, on completion of the book the reader will be able to:

- Understand the design orientation in business and what it offers to both setting business problems systematically (business analysis) and solving such problems effectively (business design)
- Apply the lens of thinking of organisations as complex systems of inter-related activity, information and data
- Critically evaluate the notion of digital innovation by understanding the transformative potential of ICT for organising through the application of prototyping and modelling
- Develop a simple digital business model for some particular way of organising private, public or voluntary sector work
- Appreciate the relationship between business strategy, business models, innovation and change management

The material in this book is important because of the increasing importance of business analysis and business design to doing business in the digital age (Note). As evidence of this:

- A large number of texts have been produced over the last few years purporting to impart business design practice (Paul and Cadle 2020).
- A number of universities in the UK, on the European continent, in the US and also in Australasia offer modules and courses with the term business design or business analysis as either part of or the whole of their title. Such courses occur not only at the undergraduate level but also the postgraduate level (Sidorova 2009, 2013).
- There is now a professional association of business analysts—*International Institute of Business Analysis*—which has produced a business analysis body of knowledge and offers professional certification across many countries.
- Other professional bodies around the world, such as computer societies, project management bodies and certain management associations, promote design thinking and business analysis. This is either through their accredited courses or through special interest groups. For instance, the British Computer Society has a special interest group in business analysis, has published texts on business analysis and offers certification in business analysis (Yeates et al. 2007).
- Both business analysis and business design are becoming an important part of management consultancy. Not surprisingly, an increasing range of job roles are advertised with the title business analyst, business designer or even business architect.
- Business, public sector organisations and the voluntary sector increasingly demand the sorts of skills fostered within the practice of business analysis and design. These include the ability to think conceptually in terms of higher order abstraction, engaging with problems in a flexible manner and analysing and solving such problems systematically. Students, in response to these industry trends, are increasingly requesting teaching in subjects related to business analysis and business design.

> **Note** The terms business analysis and design are rather cumbersome. So, from here on we alternate between using the terms business analyst, business designer, business analysis and business design. The difference but also the relationship between analysis and design will become clear in further chapters.

Problems with the Existing Literature

Although much has been published over the last decade purporting to explain how to do business analysis and design, there are a number of problems with the existing literature, many of which are a consequence of the primary focus of this literature. Most existing texts on both business analysis and business design are directed

at the technical practitioner rather than the student and hence assume considerable business and technical background on the part of the reader. No attempt is made to establish the nature of business organisation as background against which business analysis and design takes place. Indeed, some texts seem to work with a rather naïve and unsophisticated view of what organisation constitutes. Many such texts also constitute a mere listing of established techniques for doing design work with some attempt to organise them against a life-cycle model of business analysis/ design work (Cadle et al. 2010). The descriptions of each technique are usually brief and where examples or cases are used of their application, they are frequently trivial in nature.

These characteristics make this literature unsuitable for recommendation as a core text on an academic module. In contrast, the proposed text is directed primarily at the student audience and will address these problems in a number of ways.

Existing texts lack grounding in the large amount of theoretical discussion that has taken place over the last decade which has critically examined the nature of business organisation and the effective use of ICT within domains of organisation. The proposed text takes the innovative approach of grounding its exposition in a conceptual framework that integrates together major aspects from such background theory. This background spine of design theory enables the reader to better understand both the context for and purpose of business analysis and business design.

Although they try to make the case for a more expansive conception of business analysis and design, most existing texts in this area fall back on a focus upon technical systems within business. The current text uses a model of business organisation which enables a more balanced rendering of business analysis and design as making sense of both activity and technology in business, through the mediating role of information.

The approach described will allow us to introduce key business analysis and design techniques in a staged and accessible manner. As we shall see, within many design disciplines the principle of *thinking with your hands* is important as well as *failing early and often*. To enable students to experience design as an embodied and iterative process we have created a toolkit which enables its users to quickly build design alternatives for particular patterns of organisation upon the tabletop. This physical toolkit for business prototyping is available as a complement to the book, in addition to a range of other online resources. Descriptions of the practical application of this toolkit enable us to provide a much more detailed rather than cursory coverage of the techniques of business analysis and business design. A central, detailed case will be used to illustrate concepts and techniques as well as providing material for exercises. But we also refer to a range of other case material from various domains of organisation to help acquisition of design skills.

To summarise our approach up-front here: we see business analysis and design as an act of sense-making—of making sense of some problematic situation, which we refer to as a domain of organisation. We make such sense by applying the inter-related ideas of systems, patterns and signs. Domains of organisation are considered as systems of significant patterns of action undertaken by networks of both human and technical actors. We make sense using these tools for thought to understand how organisation

currently works or is accomplished. We make sense also to identify problems with current organisational situations and suggest coherent visions of organisational change.

The phrase *making sense*, which we clearly use a lot in this book, is used by most people in two different ways. One usage of the phrase denotes the act of interpreting and understanding what is going on in relation to some domain—'*I need to make sense of what you are saying about this…*'. The other use of the phrase denotes proposing something sensible—suggesting a pragmatic approach to solving perceived problems—'*That makes sense to me as a way forward…*'. This suggests that making sense is a collective rather than an individual activity. Both our understanding of what is going on and of what might be done is a process of co-creation between business analysts and other actors.

In reading this book we shall introduce you to the core elements of a toolkit for co-creating organisation. Hopefully you will find this not only intellectually satisfying but also practically relevant to your own experience of organisation. We shall particularly demonstrate, for instance, how using our toolkit helps you better understand the nature of ICT and indeed to better position ICT within ways of organising—to get more value from ICT and to better innovate with ICT.

The Role of the Business Analyst

To reiterate, traditionally the business analyst/designer is seen as a role mediating between the developers of ICT systems and the users of such systems. Not surprisingly the key focus of the business analyst in this guise has been the analysis and design of technical systems such as ICT systems. However, within this book we make the case for the business analyst being concerned with two other forms of system within organisation: communication (information) systems and activity systems. Therefore, we shall portray the role of the business analyst/designer as a facilitator of sense-making within organisation. The key task of the business designer is to make sense of the entangled systems that constitute organisation in some domain and as an aid to this process to develop models of such systems.

In essence, the business analyst facilitates answers to a number of important questions that any organisation must respond to:

- What do we do?
- What do we communicate about what we do?
- What do we represent about what we know and do?
- What should we be doing?
- What should we be communicating?
- What should we be representing about what we know and do?

The first three questions relate to the current state of affairs within some organisation. But surprisingly, many organisations cannot provide coherent answers to these questions. This may be because accepted ways of doing things just happen. No one has taken time to step back and think about why an organisation does things

in a particular way; how it communicates about these ways of doing and what it records about this doing.

The last three questions relate to possible states of affairs that an organisation may aspire to. It sets up a challenge to existing practices of coordination, communication and articulation. In essence these questions are fundamental to business strategy. Indeed, we would argue that any business strategy-making involves debating with the entangled nature of these three issues.

We see business analysis as a coherent set of activities designed with the purpose of developing a *business model*. A business model should provide coherent answers to either the first three questions raised above or to the last three questions (in which case we would say we are engaging in business design).

The concept of a business model has become popular in recent times as a way of thinking about business change, particularly when such change incorporates some technological innovation. We use the term business model in a different sense which encompasses the traditional usage of this term, but which broadens its coverage.

Within our approach we define the core of a business model as a model of three types of system that interact, entangle or couple to produce and reproduce sociotechnical organisation. These include an activity system (a system of coordination) model, an information system (a system of instrumental communication) model and a data system (a system of articulation) model.

Management as Design

We shall make much use of the ideas of Herbert Simon at a number of points within this book. He very usefully defined design as '*courses of action aimed at changing existing situations into preferred ones*' (Simon 1996). A stream of inquiry within the management academy has recently called for design to be placed at the centre of what it means to manage (Boland and Collopy 2004). This has led to significant calls for management education to be reconfigured to encourage a design orientation (Egri 2014; Glen et al. 2014) or to promote design thinking (Dunne and Martin 2006; Starkey and Tempest 2009). Some have even suggested that management broadly as an academic endeavour should be conceived of as a design science (van Aken 2005; Martin 2009; Wastell 2014) (Chap. 2).

For Simon, as we shall see, design science is distinct from natural or social science in that it is directed at the production of artificial entities (artefacts) rather than something that occurs naturally or evolves socially. This means that design science is particularly focused on building design theories and design artefacts (these terms will become much clearer throughout the book) for action and such a science should be in Simon's words a '*tough, analytic, partly formalizable, partly empirical, <u>teachable</u> doctrine*' (our emphasis) (Simon 1996).

This book proposes practical ways of engaging with the design orientation in management. For us, you do design science by proposing design theories and evaluating such theories in practice. A design theory should provide the purpose, knowledge, constructs and principles relevant for engaging in systematic programmes of design work.

Design theories are often realised through design artefacts. Design artefacts instantiate a design theory in suggesting practical ways in which a design theory can be applied.

We spend much time in this book developing a coherent design theory for socio-technical organisation based around ideas of systems, patterns and signs. This design theory is instantiated in certain design artefacts such as tabletop prototypes and pattern comics. The production of these artefacts as means of making sense of socio-technical organisation offers a practical way of applying our central design theory (Exercise P.4).

Exercise P.4

Consider four key aspects of business organisation and consider why they are conventional—what value do we gain by adopting such conventions?

- How is money a convention?
- How are contracts conventions?
- How are jobs conventions?
- How are organisational routines conventions?

Main Audience

This text provides sufficient coverage to make it usable within both undergraduate and postgraduate modules in business analysis and business design, primarily within a business and management syllabus. It is also likely to be attractive as a reference within many other business courses such as operations management, organisational analysis, organisation design, management consultancy, change management and corporate strategy. Finally, because the topic of the book is a crossover subject, certain modules in information systems, information science, information management and computer science may adopt the text as core or reference.

Teaching materials for a 10-credit module in business design, which uses core content from this book, are provided on the book's website. The structure of this module and the relationship of teaching to chapters from the book are presented in Fig. P.4. Such a module is best presented as a practicum—a series of practical learning experiences with design—which we shall examine in more detail in the introduction. Hence, in Fig. P.4 routes which provide exposure to some of the key design techniques discussed in the book are provided from key topic areas. A central design project, similar to the one discussed in various chapters of this book (digital innovation in care for the elderly), may then be used within design workshops to explore the efficacy of doing design work within a delimited domain of organisation. A list of potential projects for such design work is provided in the case book appendix.
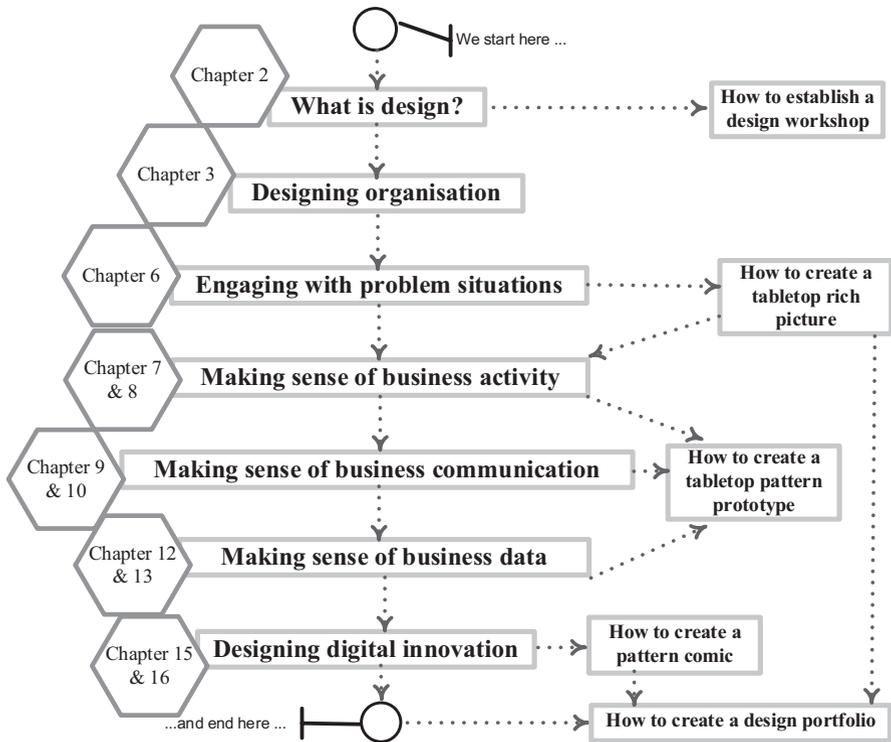
Fig. P.4 Structure of a module in business design

Conclusion

The Buddha is reputed to have once said, '*Do not believe in traditions because they have been handed down for many generations. But after observation and analysis, when you find that anything agrees with reason and is conducive to the good and benefit of one and all, then accept it and live up to it*.' Business analysis ideally should take stimulus from this adage—to critically examine the issue of organisation and where necessary and through the application of reason break with convention when and where it is needed. This book introduces a radical, theory-driven approach to business analysis and design founded upon the idea that any analysis of organisational life is an act of collective sense-making. To make sense of organisation in its various forms we need to unpack the ways in which significance is accomplished.

One way of thinking differently about business and organisation more widely is to consider it merely as a set of conventions. They are also arbitrary conventions—they are accepted ways of doing things which exist merely because of the weight of

precedent. In other words, people do things this way because they have always done things this way—they collectively accept that this is how to do things.

For this purpose, we need design theory located at the intersection of signs, systems and patterns. This conception suggests that the modelling of organisational life (which includes application of information and communication technology within information systems) must be based upon an appreciation of three entangled domains which we refer to as coordination, communication and articulation, and which we shall discuss in further chapters.

Within this book we shall also describe a number of simple approaches to visually representing such domains, as well as bringing together such forms of entangled patterns. This form of co-creation is meant to reflect some collective sense-making about the nature of a domain of organisation, both in terms of current organisation (as-is) and possible future (as-if) organisation. Potentially even definite future (to-be) organisation.

So, you probably never thought when you bought or borrowed this book that you would be playing with cutouts on a tabletop or drawing comics!!!

Theory

My book—*Significance: Exploring the Nature of Information, Systems and Technology* (Beynon-Davies 2011)—deliberately attempts to consider the problem of organisation as a cross-species, cross-cultural and cross-historical phenomenon and in doing so deliberately attempts to separate this issue from its inherent association with digital computing and communications technology in the modern world. The main aim of the current book is to move this work forward and demonstrate its applicability as a theory-driven approach to business analysis and design, particularly with digitally enabled organisations. A signpost, like this, is placed at the end of each chapter to relevant background theory discussed in my book *Significance*, as well as in other texts. This material does not directly form part of the book you are currently reading, but you might be interested in where these ideas come from.

Another accessible source for some of the theory discussed in this book is my companion volume *Business Information Systems* (Beynon-Davies 2020). This book also uses some of the cases discussed in this book to better understand the modern phenomena of digital business.

The idea of portraying business analysis and design as an act of sense-making takes its inspiration from the work of Karl Weick (Weick 1995). For Weick the term *sense-making* is used to denote the way in which particular circumstances are turned into some representation which in turn serves as a springboard to action. Taylor and Van Every (Taylor and Van Every 2000) provide a particularly good definition of sense-making—'*Sensemaking is a way station on the road to a consensually constructed, coordinated system of action*'. Therefore, there are clearly a number of key elements to the idea of sense-making. First, sense-making inherently involves

representation. For Weick and others the major forms of such representation are the written or spoken word. People tell stories of organisation through speaking or writing. In this book we shall particularly emphasise forms of visualisation as ways of representing organisation, because such visualisation is a major area of practice within business analysis and design. Second, representations are built as collective and consensual constructs—as 'maps' or 'models' of how people think things are or how they want things to be. Third, sense-making is directed at coordinated action—at changing things through collective activity.

Practice

The actual practice of business analysis and design, as mentioned earlier in this chapter, is somewhat fragmented in terms of approach. The business design literature at the current time is somewhat divorced from the business analysis literature, and vice versa. Since we see an inherent synergy between notions of analysis and design we have attempted to integrate many aspects of both literatures in the current book. To help make sense of the vast array of approaches utilised within contemporary business analysis and design we provide some pointers, like this, to practise at the end of each chapter. This involves linking aspects of our integrated approach to business analysis and design to other approaches and techniques adopted by professionals. Again, this material is provided merely for those who are interested. A compendium of the techniques that you will find in places such as the IIBA body of knowledge (IIBA 2015) is placed at the back of the book.

Both the terms business analysis and business design are continuously moving beasts. For instance, many finance people now call themselves business analysts; so, what is the correct definition of the term? We shall attempt to convince you that the definitions of business analysis used within this book and that used by financial analysts are not that incompatible. We shall argue that the focus of any business analysis is on the production of business models. Any business model, as we shall see, is necessarily a sign-system which helps us make sense of organisation. Financial business analysts build business models using primarily numbers as signs. They model the organisation using aggregate numeric measurements such as cash-flow, profit and loss. All such metrics are effectively signs, which are taken to stand for some significant part of an organisation's performance. Within this book we shall tend to use a more qualitative approach to building business models, using graphics or visualisations as signs. But the endpoint is or should be the same—making sense of organisation and where necessary suggesting change to organisation.

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Introduction

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1 Introduction

In the 1950s two management/computer scientists—Herbert Simon and Allen Newell—proposed that the computer was stimulating a new major branch of science which they called the *science of the artificial* (Simon 1996). Many people now refer to this science as *design science*. Design science is not directed at understanding the natural world or the social world. Instead, design science is directed at understanding the process by which the outputs of design—design artefacts—are produced. But the term *design artefact* not only refers to a physical product; it also refers to a designed way of doing things—a method or an approach. This is where the endeavour described in this book fits. We shall be engaging in design science—in fact considering some core elements of a new design theory for business analysis and design. The core design artefact for our design theory is a system or pattern of socio-technical action.

This chapter introduces the idea that design thinking is important to both making sense of and resolving many contemporary problems of organisation, within the private, public and voluntary sectors. It begins by considering the difficulties of breaking with conventional ways of thinking and locates business analysis and business design within the domain of design science. It then explains the nature of design science and how it differs from natural and social science. To help apply design science as it is applicable to business the chapter also examines the nature of design theory and design artefacts. We end the chapter with a roadmap to the further contents of the book.

2 Why Business Design?

Business as an area of activity is clearly much more complex nowadays. Here are some reasons for such complexity.

Doing business is no longer a local but a global activity. Companies have traded with other companies across the world for some time, but the scale and extent of this has increased substantially over the last decade. Supply chains now span continents, but customer chains have also become global. Because business is so inter-connected, companies must be more and more agile, responding to and reshaping themselves rapidly to market changes.

Information and communication technology (ICT) is normally seen as a way of helping to manage the increasingly global and agile nature of business. However, the application of ICT within business is also partly to blame for such increasing complexity. Doing business involves inevitably the work of human beings, but increasingly much work is undertaken by machines, including ICT systems. These machines and technical systems frequently interact with human beings to create the very notion of organisation, but many act relatively independently of human intervention.

Not surprisingly, 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 socio-technical complexity engendered by the increasing embeddedness of ICT within all forms of organisation. Some feel that the best response to this challenge is to view and teach business as a design discipline—perhaps even as an instance of design science.

3   Design Science, Design Theory and Design Artefact

Within this section we examine the nature of design science and how it relies upon design theories and design artefacts (Fig. 1.1).

The notion of science is traditionally directed at understanding *what is*. The natural or physical sciences such as physics, biology and chemistry attempt to understand what constitutes the physical world. They seek to explore and explain

Fig. 1.1 Design science, theory and artefact
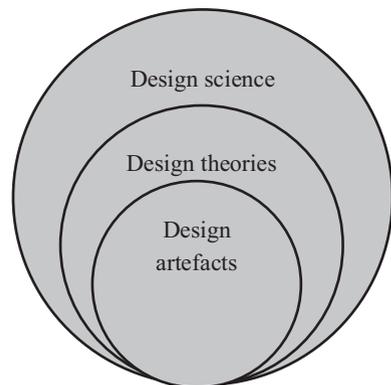
phenomena such as gravitational waves, the structure of viruses and the shape of inorganic molecules. The social/psychological sciences such as economics, sociology, psychology and politics attempt to understand what the psychological and social world consists of. They seek to explore and explain phenomena such as cycles of inflation, the depth of inequality in society and the development of human personality.

In the 1960s, Herbert Simon (1996), a founding father of both management science and computer science, proposed another type of science, which he originally referred to as the *science of the artificial*. Many now refer to this science 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 really be categorised in its conventional role not as a social science but as a design science. And, as a consequence, that managers are best seen as designers, as concerned with the contingent nature of organisation. This means of course that the manager needs to employ design thinking and needs, as a consequence, to utilise design theory in the production of design artefacts.

Design science is implemented through design theory (Fig. 1.1). Design theory tells the designer how to design certain things. Such theories provide explicit prescriptions as to how to design and develop an artefact. Design artefacts are the output of applying design theories in practice. As we shall see, design artefacts need not only be physical artefacts—they can be ways of doing or organising things.

So, what can you expect in terms of the design theory imparted within this book and the design artefacts it produces? Gregor and Jones (Gregor and Jones 2007) propose eight component parts of an acceptable and justifiable design theory (Fig. 1.2). Although not mentioned by these authors it is useful to divide these principles or components into two halves, which, borrowing from Simon's definition of design science, we refer to as the *doctrine* and the *application* of a design theory.

The first four component parts of a design theory (Gregor and Jones 2007) establish its doctrine—a set of ideas or beliefs that are taught or believed to be true. The doctrine of a design theory consists of (1) purpose and scope, (2) justificatory knowledge, (3) constructs and (4) principles of form and function. The purpose and scope of a design theory indicates what type of artefact the theory applies to and defines the boundary of applicability of the theory. Justificatory knowledge specifies the underlying sources of knowledge on which the design theory is based. Constructs provide representations of the entities of interest within the theory. Principles of form and function provide an architecture that describes artefacts produced by the design theory.

The application of a design theory (Gregor and Jones 2007) refers to how such theory may be applied in practice. Such application demands (1) principles of implementation, (2) expository instantiation, (3) testable propositions and (4) artefact mutability. Principles of implementation provide a description of the processes
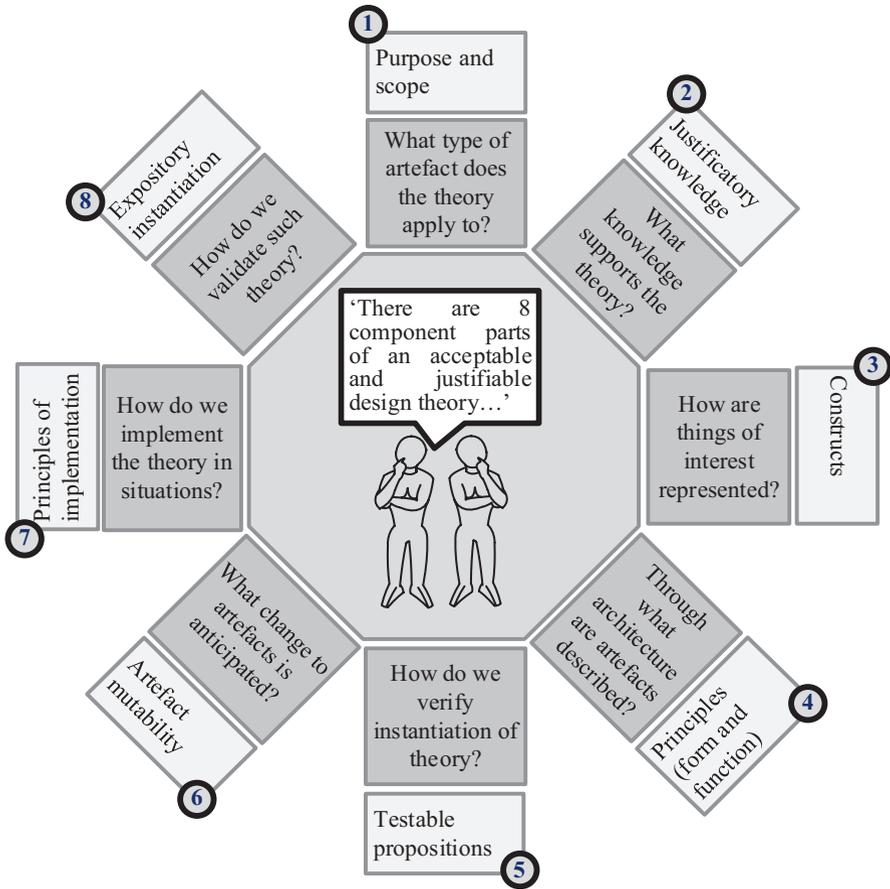
Fig. 1.2 Elements of a design theory

by which the theory may be implemented in specific situations. Expository instantiation indicates a physical implementation of the artefact that can be used both as a mode of exposition and for the purposes of testing theory. Testable propositions refer to the ways in which instantiations of a particular design theory may be evaluated in practice. Artefact mutability indicates the changes in the state of the artefact anticipated by the theory.

As we shall see in Chap. 2, the doctrine of our design theory is situated in ideas of signs, patterns and systems. In terms of purpose and scope we see business analysis involving acts of making sense of existing patterns of organisation, while business design involves ways of envisioning new patterns of organisation. As far as justificatory knowledge is concerned, we think of patterns of organisation as routines of socio-technical action. As constructs we think of patterns of organisation in terms of three layers of inter-related action, which we refer to as articulation,

communication and coordination. Finally, in terms of principles of form and function we see such patterns of organisation as entangled or coupled—meaning that although they can be separated analytically, they are actually coupled in continuous practice.

In terms of practical application we suggest that it is possible to 'implement' or instantiate our design theory through visualisations of patterned action. In terms of principles of implementation, techniques such as tabletop prototypes and pattern comics are proposed as useful techniques with which to express the narrative of business patterns that constitute some domain of socio-technical organisation. They are also proposed as a way of expressing new ways of organising. As testable propositions about the nature of socio-technical organisation, three types of model of business patterns need to be constructed: as-is (current), as-if (envisaged) and to-be (implemented). As expository instantiations these models serve to accumulate common ground between the business analyst/designer and organisational actors; such common ground is critical to changing patterns of socio-technical action. Finally, in terms of artefact mutability we suggest the importance of abstracting from patterns of organisation and utilising such abstraction within pattern reuse.

4   The Design Orientation

We summarised our design theory in the last section merely as a way of setting markers for the content of further chapters. You are not expected to take it all in at this stage—understanding will come as we move through the chapters of the book.

Many argue that there is a core set of principles common to all design disciplines that practice design science through the application of design theories in the production of design artefacts. This core is often referred to as the *design orientation* or sometimes as *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 or problem situations, engage with such problem situations, model problems and their potential solutions, prototype as much as possible, design with 'users' in mind and visualise things.

Problems

Problems or problem situations are at the heart of design. Most problems within domains of organisation tend to be what the American philosopher Charles West Churchman (1957) referred to as 'wicked'. Wicked problems are by their nature ill-defined and ill-structured—they are messy. This means that there is not one 'correct' solution to such problems, but a multitude of possible solutions. In a way, this is another way of expressing the complexity inherent in engaging with issues of contemporary organisation (Chap. 3).

Engagement

Designers cannot throw up their arms in the face of complexity. Instead, they must engage with the messiness of problem situations within domains of organisation. Typically, such engagement is conducted through dialogue, participation or observation of business situations (Chap. 6). Through such engagement, designers attempt to set problems and the direction of their solutions.

Models

Designers conduct 'experiments' in understanding by building representations or models of both problem situations and their potential solutions (Chap. 7). Such models are attempts to both distil and communicate the essence of problem situations as well as how to resolve such problems.

Prototypes

Designers frequently build prototypes as models of possible solutions to problems. In much of the recent design literature there is an emphasis on building physical models as a means of understanding the dimensions of problems and exploring possible solutions. Prototypes are particularly useful in the early stages of design work and are deliberately built to be thrown away after processes of exploration have concluded (Chap. 7).

Visualisation

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*' (Tufte 1990). 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.

Co-creation

There is a tendency for designers to design for other designers. Architects, for instance, frequently design with other architects in mind, rather than their clients. To help avoid this design trap, good designers like to co-create design solutions with organisational actors and formulate such solutions with the users of solutions in mind.

5   Types of Design Artefact

Within this section we look at different types of design artefact and highlight why our focus within this book is upon designing systems of socio-technical action. As we mentioned in the prologue, 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 originally by Harry Beck to communicate the topology of the underground railway network in this city. The symbolic design elements evident in this map have been emulated within metro systems world-wide.
- *Material design* involves the design of products or tangible artefacts. The Glaswegian Charles Rennie Mackintosh is famous for designing not only buildings but the interiors of buildings and artefacts such as chairs and tables. The sleek design features evident in Mackintosh's furniture has influenced generations of furniture designers ever since.
- *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. A number of brilliant software designers working for Rank Xerox in the 1970s and 1980s came up with most of the ideas embedded in the graphical user interface which we take for granted and use on numerous different digital devices today.
- Finally, *systems design* involves designing systems or patterns of action. There are crucial design decisions that need to be made in the systems by which we dispatch emergency vehicles to healthcare incidents or which we employ in care for the elderly within their own homes.

Within this book we have a clear focus on this last level of design artefact—upon systems or patterns of action. However, in the course of doing this we will touch upon symbolic design and interaction design as well. Systems design is the most complex of design domains or design artefact, but one of course particularly relevant to business. To engage with design in this way we shall utilise a particular design theory which we shall refer to as patterns of organisation. We shall give you a number of ways of engaging with the design of such patterns such as producing rich pictures, doing tabletop prototyping and drawing pattern comics. But there are numerous other techniques for doing design work with these design artefacts that we shall touch upon within the text (Exercise 1.1).

Exercise 1.1
Come up with two further examples of each type of design artefact

6   A Simple Game of Design

To introduce some of the central concepts of this book, let us begin with a game of design which can be played with one or more players and which I have run many times both within academic teaching and in workshops with organisations. To play the game you will need a set of coloured magnetic tokens, consisting of 4–6 red tokens, 4–6 black tokens, 4–6 green tokens and 4–6 blue tokens. You will also need a magnetic whiteboard and dry-erase black, blue, red and green pens (Fig. 1.3).

The aim of the game is simple. Using this material, you have to devise a way of coordinating the movement of 'material' through four different 'locations' by two groups of actors working in two different time-periods. Such 'material' might correspond to stillages (production containers) in a manufacturing setting or patients in a healthcare setting or students in an educational setting.

The rules of the game are as follows. Use only the whiteboard and coloured, magnetic tokens <u>but do not write anything</u> on the whiteboard or the tokens (you may draw using the pens). The people who use the whiteboard are not allowed to <u>verbally</u> communicate with the people that move the material—they communicate solely through the visual device of the whiteboard.

The visual device you design in this game must do two things:

- Inform a group of workers within a time-period how many things there currently are at each 'location' (assume that a maximum of six units of 'material' can be held within one 'location' at one time).
- Inform a group of workers which things need to be moved from one 'location' to another nominated 'location' in the next time-period.
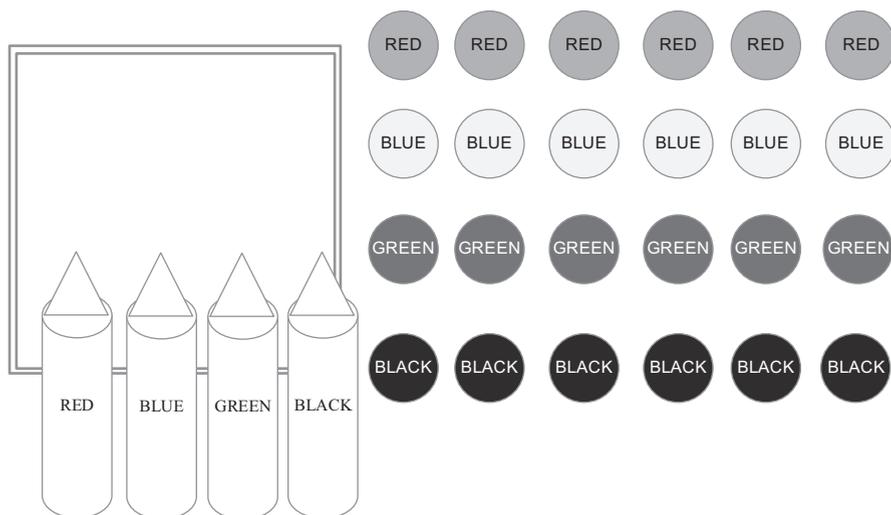
Fig. 1.3   Resources needed for the game

The 'workers' involved could be production operators, nurses or educational administrators working in shift patterns. The 'material' involved might be production containers, in-patients or educational modules. The 'work' involved might be locating and moving production material, locating or moving patients on hospital wards or locating and moving students on modules.

Once you have designed the device and its use, the device should be tested. If you play this game as a team, you might enact one or more scenarios in which two members of the group act as one shift and two members act as the next shift. You should use scenarios to experiment with signalling both current material and intended movements of material. Once you are happy with your design, appoint one member of your group to explain how the device works to others.

We shall return to this game in Chap. 7 where we shall provide a possible solution to the design challenge set. We shall also use this game in Chap. 4 where we review the nature of organisation. The game will also be useful as a means of revealing important aspects of our design theory in Chap. 7 (Exercise 1.2).

> **Exercise 1.2**
> In terms of the four types of design artefact discussed, decide what the visual device from the game constitutes as a design artefact

7   Designing Business Education

The majority of academic books about business emphasise factual knowledge over the development of skills—*knowing what* rather than *knowing how*. This book is unusual in focusing on knowing how—on developing ways of thinking and practice which enable both students and practitioners to better engage in a practical manner with the increasing complexity which is the world of organisation.

If we think business or organisation more generally is very much about design, then we need to re-think not only business education but also those aspects of technical education which work almost explicitly within domains of organisation—such as ICT. We need a means of encouraging design thinking and doing amongst prospective business people and technologists.

One way of doing this is through the idea of a *practicum*. A practicum is a course of study devoted to the practical application of theory. Practicums (or practica) are familiar in areas of professional training such as medicine, architecture, engineering, social work and law. So why not business? By the end of reading and using this book, we hope to convince you of the value of learning through a practicum within business education.

So, although this is a book on analysis and design of domains of organisation, it is designed not solely to be read but to be used as a workbook within a wider practicum. Throughout the book we set out some design challenges which can be used as exploration points within a practicum. Many can be used to develop design prototypes to engage with challenges and propose solutions. There is also the important

point of evaluating your design artefacts by yourself and others which is a critical part of the learning process within any practicum.

As we shall see in Chap. 5, design is typically undertaken by teams of both designers and system stakeholders for a delimited period of time within a location remote from normal places of working. Such events are typically referred to as design workshops which exploit ideas of 'clean rooms' and 'hothousing'. Clean rooms are places in which design teams can be insulated from normal everyday distractions of work and home life. Hothousing is a term originally used in the education of children in which small groups of such children are tasked with an intense period of study of a specific topic in order to stimulate their development. In design work, hothousing refers to ensuring that everything is in place to allow a design team to solely focus on the problem at hand.

To simulate some of this experience within an undergraduate or postgraduate module, a practicum is best organised as a series of workshop sessions in which students gain a mix of exposure to both design theory and design practice.

Exposure to the design orientation through a practicum can be achieved in a number of ways:

- A practicum is best held in a spacious open plan room with moveable tables, chairs and presentation aids such as whiteboards.
- Students are best assigned to a team or group throughout all the sessions of a practicum. This serves to simulate some of the features of hothousing.
- Each design team is assigned a specific table in the room which they should occupy in all sessions. Students should be encouraged to stand rather than sit at such tables and work with tangible design artefacts wherever possible such as drawings and/or prototypes.
- Each group should be given all the equipment needed to do the design work. A kit of design tools used by the author to enable students to produce the design artefacts described in this book is available from the author.
- Each session should be organised around exposure to a small chunk of design theory followed by the practice of one or more design techniques that implement such theory.
- Most of a teaching session should be devoted to students exploring and engaging with issues of design. This can be achieved by setting students a small number of design exercises in which they practice aspects of the design theory and/or technique(s) considered in the session.
- We have found it useful to organise a practicum around one central design problem (such as that of the care for the elderly case). The design practice within each session can then enable students to develop either an individual or a group design portfolio, which can form assessment for the module.
- Design portfolios should be assessed not only in terms of resolving the problem explored within workshops but also in terms of whether they communicate the analysis and design work succinctly but effectively.

8   A Roadmap to the Book

Here is a roadmap to all the elements we shall cover in this book:

Chapter 1: Signs, Patterns and Systems

In this opening chapter, we introduce the toolkit for thought which we hope will get you to start thinking differently about organisation. At a very high level, we define business analysis as well as business design as making sense of business—or organisation more generally. But to make sense we need concepts. For effective business analysis and design, we need three inter-related concepts to underpin our approach: signs, patterns and systems. These concepts are used to build models of some domain of organisation—as it currently is, or as we would like it to be.

Chapter 2: What Is Design?

To help centre the notion of design we first examine the work of some great designers focusing on an array of different design artefacts. We then ponder on the nature of design as an activity and consider what it means to design business. This leads us to consider a range of popular techniques used to both set problems and solve problems. This enables us to set the context for the toolkit of design techniques described in this book.

Chapter 3: Designing Organisation

In this chapter we examine the nature of organisation. We consider first two alternative viewpoints on organisation which we refer to as the institutional and action views. This enables us to demonstrate how these competing viewpoints can be unified through the systems concept of emergence. For us in this book organisation is best viewed as a complex and adaptive system. We propose that such systems are made up of patterns of action which regenerate institutional structure. This leads us to consider the essential elements of all patterns of organisation: actors, action, location and sequence.

Chapter 4: Projects of Design

Business analysis and design work is normally organised in terms of 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 objectives, usually with a set timescale. As such a business analysis project can be considered an activity system. A team of business actors is normally appointed to

undertake such projects. These actors not only communicate amongst themselves but also communicate with other actors in the process of business investigation. Hence, any project work relies upon an associated information system. Also, in undertaking business analysis work project members document results as models—this comprises the data system for the business analysis project.

Chapter 5: Investigating Domains of Organisation

The work of the business analyst is similar to that of the ethnographer, a style of research which seeks to make sense of social settings in a rounded or holistic way. The ethnographer tries to make sense of strange cultures or attempts to make strange her own culture and to enable this sense-making a whole range of investigation techniques are normally employed. In a similar manner the business analyst tries to make sense of existing business situations or future business situations. Investigation techniques such as interviews, observation, documentary analysis and workshops support such sense-making. Various forms of representation are then constructed to communicate common understanding between different business actors. Representations such as storyboards are used as an intermediate representation to communicate with business users and clients; more formal representations such as information models are used to communicate with other business analysts and technical actors such as ICT system developers.

Chapter 6: Engaging with Problem Situations

To begin to design you first have to establish what you wish to design. This means establishing or setting the problem to be engaged with. Problem setting involves exploring the problem space or problem situation and discovering its features. It also involves setting the boundaries around the problem—what you shall consider within design and what you shall not. However, problems of organisation are rarely straightforward. Problem situations in this domain exist for would-be improvers but vary depending upon the system stakeholder. Within this chapter we explore a number of techniques for engaging with the complexity of problem situations: brainstorming, affinity mapping, stakeholder analysis, rich pictures and MoSCoW prioritisation.

Chapter 7: Making Sense of Business Activity

In this chapter we look at what people do or should do to organise. We shall look at how actors within organisations coordinate their activities in the pursuit of collective goals. We shall show how goals relate to the issue of value and then unpack the notion of performance and relate it to goals and their measurement. Finally, we shall consider how we can design patterns of coordinated activity to achieve goals.

Chapter 8: Models of Activity

In previous chapters we establish that organisation relies on the patterning of conventional action. Actors perform their expected actions and in doing so constitute organisation. This chapter considers a number of ways of modelling such conventions of action. Modelling is critical to activities of both analysis and design. We particularly focus on ways of visualising patterns of coordinated activity in this chapter.

Chapter 9: Making Sense of Business Information

In Chap. 9 we examine the nature of information and argue that information is accomplished in instrumental (goal-directed) communication. Information, as we shall see, is the differences that some encounter with data makes to some actor. Information is accomplished in terms of both the intent and the content of communication and such communication occurs in patterns which can be both analysed and designed.

Chapter 10: Making Sense of Information Systems

Information is not stuff but an accomplishment of actors within acts of communication. To make sense of information we therefore have to unpack both the intent and the content of communication—what communication is trying to achieve and what things are being identified and described. But communicative acts do not occur in isolation—they form patterns that support coordination. Such patterns we refer to as information patterns or more generally as information systems. But the actors in modern information systems are not just humans. Information systems consist of humans, ICT systems and artefacts communicating in support of coordination.

Chapter 11: Models of Information

As we have seen in Chap. 10, a critical layer of organisation is what we referred to as an information system—made up of patterns that actors use to communicate about things of interest within some way of organising. In this chapter we consider such things of interest and how we can build formal definitions of such things—to which we shall assign the term information class. We shall explain how such information classes help provide structure to the content of informative acts. This enables us to establish a clear linkage between information models on the one hand and information system models on the other.

Chapter 12: Making Sense of Business Data

In this chapter we examine issues relating to the design of data and its articulation. Information and/or data is normally seen to be the stuff of information and communication technology. These two terms are thus used interchangeably but also in very loose ways. This chapter argues for the importance of being precise about the distinction between data and information and how this distinction matters to the design of organisation. The chapter centres on the concept of a data structure and demonstrates that data structures are not only informative but also performative (they get things done).

Chapter 13: Making Sense of Data Systems

In a similar manner to our definition of an activity system and an information system, we define a data system as a set of inter-related patterns of articulation. In turn, a pattern of articulation consists of a set of inter-related acts of articulation. In this chapter we examine issues relating to the design of data structures and their articulation. We then focus on ways of designing not only data structures but the life cycle of articulation that such structures have.

Chapter 14: Models of Data

A data model details the structure of data relevant to some domain of organisation. In contrast, an information model details the structure of information relevant to some domain of organisation. There should in principle be some apparent vertical coupling between the data model and information model relevant to a certain domain of organisation. This means that a data structure defined within a data model should correspond to one or more information classes expressed within an information model. These data structures will constitute the primary 'material' transformed in a data system model.

Chapter 15: Understanding Digital Innovation

In this chapter we consider issues of innovation and change, particularly digital innovation and its effect on organisation. Innovation involves thinking differently with the aim of doing things differently, hopefully to make a difference. We demonstrate how it is impossible to just design ICT—whenever technology is designed, we inherently re-design patterns of communication and activity. Hence, digital innovation involves the design of business models which outlines the sequences of action necessary for the achievement of certain goals which may have strategic consequences.

Chapter 16: Building Digital Business Models

The concept of a business model is much used in both business literature and practice. However, it is very poorly defined and conceptualised in many domains. We spend time in this chapter explaining not only what a business model is but what it is not. In terms of a design orientation it is productive to view a business model as a complex of business patterns appropriate to some domain of organisation.

Chapter 17: Business Motivation, Change and Strategy

Our way of thinking about organisation in terms of design also gives us a clearer way of thinking about business change. Business motivation involves the need to document explicit reasons for changing an existing (as-is) business model. 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 amongst as-if business models and specifying courses of action to implement a new (to-be) business model.

Epilogue

In this short chapter we round off our message and explain the purpose of our compendium of 'magic' tricks as aids to design work.

A Compendium of Business Analysis and Design Techniques

A compendium of magic tricks contained not only artefacts needed to conduct the tricks themselves. It also contained detailed instructions as to how to perform each trick. In much the same vein we present a compendium of the 'tricks of the trade' associated with the contemporary practices of business analysis and business design. The techniques are presented in alphabetical order with a brief description of what each technique involves and how it helps design. We also cross-relate techniques to those covered in the book.

A Case Book

Within this part of the book we describe in more detail the domains of organisation used as material for many of the examples cited in the body of the text. We include a number of examples of application of key techniques against the patterns of organisation evident in each case. Contained in the case book are a number of other examples of areas that may act as the basis for further exploration.

9   Conclusion

This work thinks of business as a design discipline which works under the umbrella of design science and is best taught within a practicum. Design science is a science of future—of how things might be. Design science is implemented through design theory, which tells the designer how to design certain things, referred to as design artefacts. Design artefacts are the output of applying design theories in practice and come in four different forms varying in complexity: symbols, products, interaction and systems. We focus upon systems of socio-technical organisation within this book. The design orientation refers to a core set of principles common to all design theories. Such principles include the engagement with problems and their solutions through modelling, prototyping as much as possible, designing with 'users' in mind and visualising things. The next chapter (Chap. 2) introduces the toolkit of concepts with which our design theory is built: signs, patterns and systems.

10   Theory

My book *Business Information Systems* (Beynon-Davies, 2020) forms a companion volume to this work and introduces the notion of applying a design orientation to business. The current book much expands upon this orientation and provides detail of both our design theory and how to apply it in practice.

Another book of mine also published by Palgrave—*Significance: Exploring the Nature of Information, Systems and Technology* (Beynon-Davies. 2011)—is an attempt to build a conceptual framework for making sense of the notion of socio-technical organisation. The large number of examples considered within *Significance* deliberately steered clear of discussing modern organisation and its interaction with digital computing and communications technology. This was because we wished to establish some fundamental principles about the nature of organisation and its relationship with information, systems and technology across human history and across human cultures.

Within the current book we take the theory developed and demonstrate its relevance to understanding and dealing with problems experienced within modern socio-technical organisation. This means that we directly engage with the way in which organisation in the twenty-first century is a complex mix of action performed by human, machine and artefact. It also means that we discuss in some detail certain practical techniques and approaches developed directly from our design theory, which allow us to make better sense of contemporary socio-technical organisation.

11   Practice

A good introduction to what designers do is the book by Brown (2009). The way in which business is taught has been questioned in a range of publications such as by Boland et al. (2007) and Dunne and Martin (2006).

Both the ideas contained within this book and the ways these ideas are presented here have evolved over a number of years. In terms of teaching, the approach taken has been honed within MBA modules taught by the author as well as on undergraduate modules in business. In terms of work with industry, the overall framework described has been verified and validated within exercises of engagement in both private and public sectors. Finally, a substantial amount of the core framework proposed in the book has been subject to peer-review through the process of academic publication.

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Signs, Patterns and Systems

2

1   Introduction

During the seventeenth century a major innovation was introduced onto the streets of London—the coffee-house. This public venue selling brewed concoctions of a newly imported and exotic substance—coffee—was the innovation hub of its day. People gathered in these settings to converse and debate but also to transact and to trade. Many of the business conventions we take for granted nowadays such as contracts, credit, securities and insurance were all created as new patterns for doing business within such settings.

In this book, we want to break with convention and introduce you to new ways of thinking about business and organisation generally. We want to hold a conversation about the nature of organisation and then debate and work through new ways of tackling business problems. Since this exercise is very much in the tradition of the seventeenth-century coffee house, perhaps we should refer to the proper setting for business analysis and design as the twenty-first-century (probably virtual) 'coffee house'.

In this chapter, we shall introduce the toolkit for thought which will get you started in thinking differently about domains of organisation. We shall suggest that this toolkit can be used to form models of organisation or more precisely models of domains of organisation. We also want to impart the notion that these models can be used to make better sense of what we mean by organisation.

At a very high level we define business analysis as well as business design as making sense of business—or organisation more generally. Business analysis is making sense of current organisation, while business design is making sense of future organisation. But to make sense we need concepts. For effective business analysis and design, we need three inter-related concepts which underpin our design theory: signs, patterns and systems. These concepts are used to build models of some domain of organisation—as it currently is, as we would like it to be or as we plan it to be.

2   Signs

In *Alice's Adventures in Wonderland* Lewis Carroll has one of his characters speak the words—'Take care of the sense, and the sounds will take care of themselves.' Question: what does the image in the photograph say? (Fig. 2.1). Answer: *signs mean business*.

It is interesting that you can read and interpret this message accurately even though the image is incomplete. Just like the perceptual tricks we experienced in the last chapter, in your *mind's-eye* you 'fill in' missing lines and form written words which you recognise the meaning of.

In doing, so you are engaging in a process of sign-use—known more formally as semiosis—because a *seme* is another name for a sign.

Fig. 2.1   Signs mean business

Signs do actually mean business—in fact they mean (if we treat <u>mean</u> as a verb) all forms of organisation. Through signs we make sense (impart meaning) within business. But we don't just make individual sense. Through signs we accomplish collective meaning—we make sense between ourselves. Through such collective meaning we coordinate our activity.

Now examine the two graphics in Fig. 2.2. Here we have illustrations of two pointing hands. The pointing hand is a classic example of a sign—an embodied sign: a sign produced by manipulation of the human body. The pointing finger is a sign because it stands for something else. In this case, it directs our gaze to some other thing. A human smile is another common example of an embodied sign—the smile tells us something of the inner state of the actor making the smile. A smile is taken to stand for an inner state such as an emotion of happiness or joy.

According to the American philosopher Charles Sanders Peirce (Atkin 2016), a sign is (A) some thing (B) that stands to somebody (Γ) for some other thing. The three signs utilised here to segment out parts of the definition of a sign correspond to the first three letters of the Greek alphabet (alpha, beta and gamma). In the first example described in the preceding paragraph, a pointing finger is the thing that stands for the thing being pointed at to both the actor producing the gesture and the person observing the gesture. In creating this collective *stands for* relation we produce or accomplish meaning. Hence, to read written Greek we need to agree on the meaning associated with the signs of the alphabet—what each sign stands for.

There is one problem. Within English we tend to use the term *sign* in the common spoken and written word to refer solely to visual and particularly graphical representation (hence sign-making businesses such as the one referred to in the photograph in Fig. 2.1). But as our examples demonstrate, signs should not be restricted to refer solely to visual representation.

Signs move beyond graphical images to refer to human spoken and written words; they also cover so-called non-verbal forms of representation (body language) as well as including non-human representation such as the dance of the honeybee or the dolphin whistle or the 'song' of the humpback whale.

Therefore, signs are the central elements of communication for many different types of actor and come in many different forms.
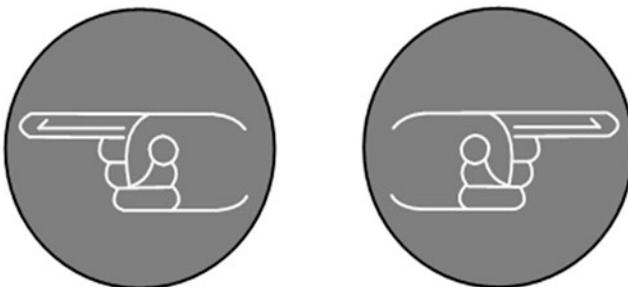
Fig. 2.2 Signs

3 Patterns

Signs sustain organisation through patterns. A sign is a classic example of a pattern since a pattern is anything which repeats across more than one situation. A key part of human cognition is pattern recognition. But the term recognition presupposes that there are patterns to be recognised. Some cognitive psychologists argue that we construct the world through patterning—that both our perception and our memory are inherently bound to such patterning. That perhaps even human conscious thought is a stream of patterning—perhaps a patterning of signs (Exercise 2.1).

In terms of the issue of organisation, our primary focus, a sign crosses three inter-dependent layers of patterning in the world which we refer to, for convenience, as articulation, communication and coordination (Fig. 2.3).

In Fig. 2.3 we use three visual signs to stand for these three inter-dependent or coupled layers of patterning. The grasping hands are a sign we use to stand for coordinated performance or activity. This visualisation is meant to signify that somebody's activity is bound to somebody else's activity.

The inter-connected speech bubbles are used to stand for communication. These bubbles are meant to signify that some message is being communicated between a

Exercise 2.1

Consider the sign used by the person in the figure below:

- What constitutes the sign in the image?
- What is being communicated in this image?
- How do we know what this person intends by using this sign?
- Are any signs like this used within business?
- Can you think of other contexts in which such signs are used?

What are they used to accomplish or do?
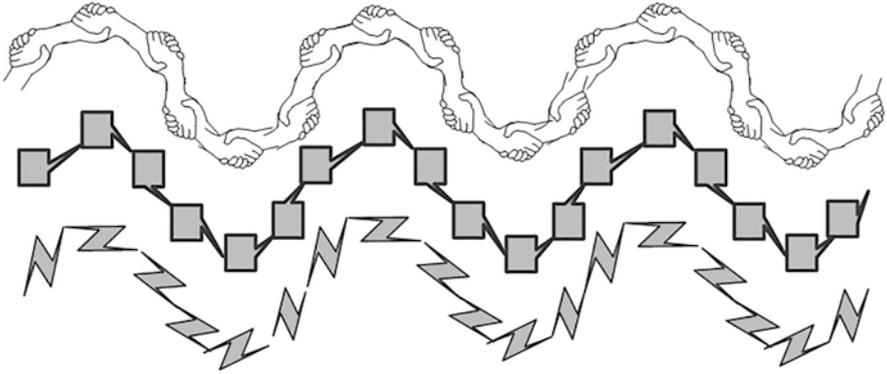
Fig. 2.3 Layers of patterning

sender and a receiver. Finally, the linked signal symbols are used to stand for articulation. They signify that a message is coded as a signal which is transmitted through some physical medium.

The issue of articulation or representation is frequently discussed in terms of *data*, the issue of communication is frequently discussed in terms of *information* and the issue of coordinated performance is frequently discussed in terms of *activity*. We too shall use these terms, but we shall do so in a more precise way than is commonly the case. This is because terms such as *information* have some conventional connotations and usages which mis-direct our sense-making—for example, the notion that information is *transferred* between speaker and hearer within communication. We shall try to convince you that information is never *transferred* in communication. In the sense of information as the transfer of some content, as we shall see, information does not exist (Exercise 2.2)!

> **Exercise 2.2**
> You may have heard of a piece of music called Pachelbel's Canon (try to search for an audio recording of this piece and play it). All music such as this piece consists of patterns. What are the component elements of such patterns and what repeats in such a pattern? A canon is a particularly important pattern in classical music. Try to find out how this pattern in music is organised?

Take the 'strange' case of the Sumerian clay token—described in some detail in my book *Significance* (Beynon-Davies 2011). What has archaeology got to do with business you might ask?

Well, business as a mode of human activity emerged quite far back, probably in our prehistory. Some archaeologists claim that doing business as the trading of goods and services is an innovation in organisation that emerged in parallel with the rise of the first human cities in an area known as Sumeria. How do we know this?

Many thousands of examples of small pieces of baked, shaped clay have been found in archaeological sites in the near east. The archaeologist Denise
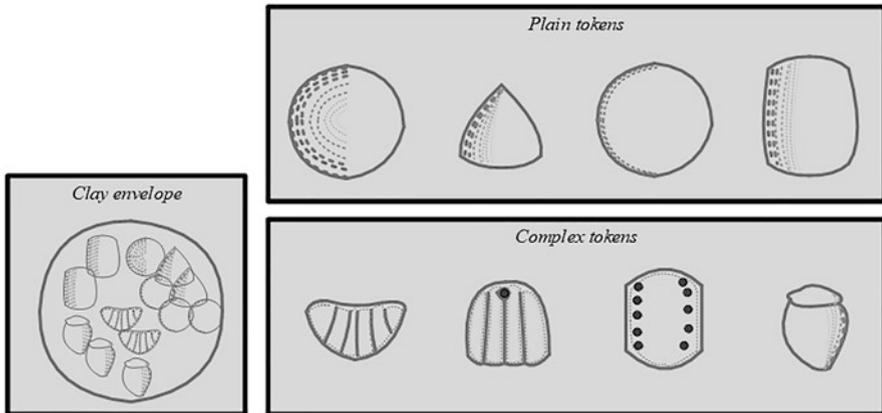
Fig. 2.4 Clay tokens

Schmandt-Besserat (Schmandt-Bessarat 1992) argues that these amount to some of the earliest examples (dating back to 8000 years BCE) of accounting for things: particularly accounting for goods in transactions of distribution and supporting human relationships of ownership and debt (Fig. 2.4).

This accounting for things using physical substance to form signs we shall refer to more broadly as patterns of data. All patterns of data are used to make sense of the world by multiple actors in collective action.

Many distinct patterns of clay tokens have been identified—consisting of simple and complex shapes—sometimes incised with punches and impressions. Archaeologists have identified the probable *meaning* of some of these shapes by the way in which they become reproduced in later pictographic writing.

This relationship between a pattern formed using some physical substance (data) and what it is conventionally taken to stand for (information) is part of the makeup of all signs. Signs are units of communication which typically have three parts—as illustrated in Fig. 2.5:

- The symbol or designation
- The concept or intension to which it refers
- The objects or referents to which the concept refers—sometimes referred to as a symbol's extension

Hence, in Fig. 2. 5, it is likely that the clay token on the left was used to represent or stand for the concept of one amphora (an ancient type of clay utensil) which had many examples or instances in the storehouses of the first cities in ancient Sumeria.

But why do people use what we shall call persistent forms of data such as clay tokens to communicate? Why was this act of creation such a significant innovation for humankind? They do so because the use of such signs within communication supports coordination of activity amongst multiple actors.

When you have small groups of people coordinating themselves—as we organised ourselves during our long period of hunter-gatherer prehistory—you can do so
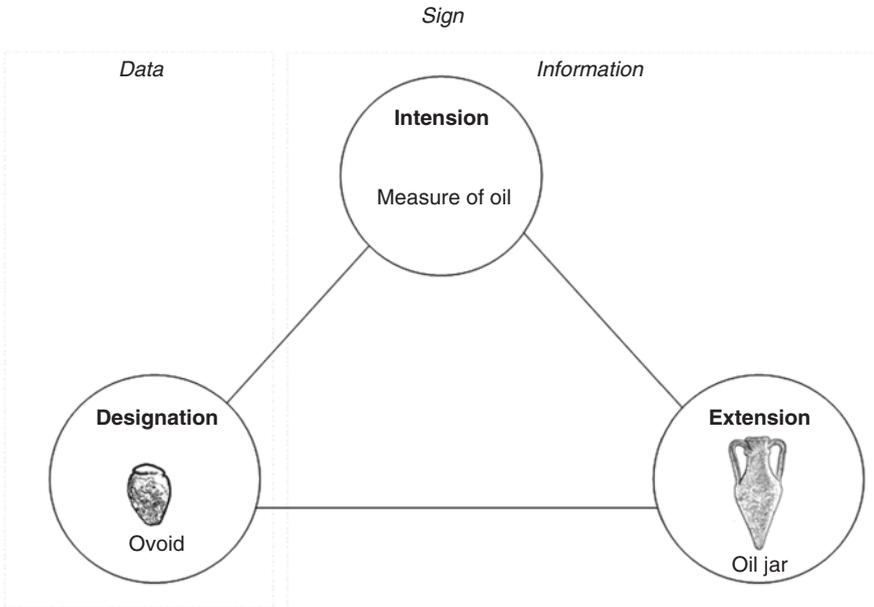
Sign

Fig. 2.5 Components of a sign

merely using speech or perhaps non-verbal communication such as facial expression and gesture. When the size of groups needing coordination grows you need to represent aspects of communication within physical substance—as records (Exercise 2.3).

Clay tokens seem to have been used amongst inhabitants of the first cities to coordinate activities necessary for the collective management of material surplus arising from early agriculture (another significant innovation created in this area of the world, at this period). The tokens appear to have acted as records of exchange, ownership and debt to the state—to represent what we would now refer to as taxes.

Exercise 2.3
Any sign can be analysed in these terms. For instance, making faces is a surprisingly neglected aspect of organisational life. In the figure below there are illustrations of the most common human facial expressions. The facial expression itself is the symbol, designation or data. But try to identify the concept, intension or information in each case. In other words, what does each facial expression stand for to you?

BUT REMEMBER: this is before the invention of graphical 'writing' and before any notion of money. Some archaeologists have even argued that writing developed from the need to account for things—that record-keeping came before the use of data for representing narrative (stories).

Let's consider briefly another strange case from a different time-period and human culture (the case of the Inka *khipu* is also considered in some detail in my book *Significance* (Beynon-Davies 2011)). The Inka were a sophisticated society which existed in the high Andes of South America for a comparatively short time (c. 1200–1572 AD). To administer their large empire the Inka maintained a large and sophisticated 'bureaucracy'. This bureaucracy sent and received many messages daily in support of the activity of the empire.

Typically, such messages contained details of resources, such as items required or available in store houses, taxes owed or collected, census data and the output of mines or the composition of workforces. Messages had to be clear, compact and portable. For this purpose, a form of artefact known as the *khipu* was used, consisting of an assemblage of coloured, knotted cotton or camelid (llama or alpaca wool) cords.

Khipu in the language of the Inka means *to knot*. To create a *khipu* a specialist known as a *khipucamayuq* (*keeper of the knots*) tied a series of pendant cords onto a main cord. Pendant cords could be of many different colours and upon these cords different types of knots were tied at different positions. We shall see later in this book how these assemblages of knotted string were used to 'write' accounts. An illustration of a *khipu* is given in Fig. 2.6.
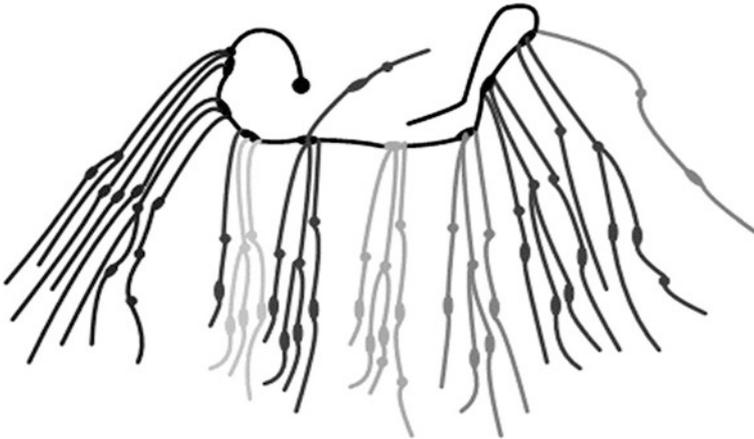
Fig. 2.6 An Inka *khipu*

4   Systems

Grace Hopper was the inventor of the one of the first programming languages designed for business—the COBOL programming language. She once said that 'life was simple before World War II. After that, we had systems.'

We have hinted in the previous discussion that signs fulfil three purposes. This is because they are patterns that cross three levels of action—articulation, communication and coordination—and which couple together to help constitute some domain of organisation. Another way of saying this is that signs cross three distinct layers of patterning which define three inter-dependent or coupled layers of *system*.

We use the term *system* (Chap. 4) in this book to set a boundary around some coherent collection of patterns. Within business analysis and design, we are particularly interested in patterns of acts of articulation, patterns of acts of instrumental communication and patterns of acts of coordinated activity. Another way of thinking of this is that a domain of organisation involves the articulation of data structures, for the purpose of communicating both content and intent, which. in turn, supports the process of coordination (Exercise 2.4).

> **Exercise 2.4**
> Consider some aspect of an institution known to you; perhaps an institution within which you work. How would you describe this institution as a system? What patterns of organisation are continually reproduced within this institution? What patterns of communication are used to enable coordination between multiple actors? What does coordination mean in this context? What records are created and used by the actors in the institution? What are these records used for?

As we shall see, we take the core of what we mean by organisation to be the ways in which these three layers of patterned action *entangle* or *couple*.

5   Business Modelling

But how do we make sense of the complex entanglement of order that constitutes organisation? Answer: *we build models*.

One view of models is that they are objective constructs—they abstract from certain agreed features of some reality. Hence, natural scientific theories, such as Darwin's theory of evolution, can be seen as models in this light. They all are attempts to describe and predict the material or physical world, which is the same for everyone.

Another view is that models are subjective constructs—we all work with different models of reality. For instance, we would argue that managers always work with models of their business. But managerial models are rarely explicit models. They are subjective models which managers use to make sense of their own situation of organisation. These models are tested in the realm of management decision-making and the outcomes resulting from such decision-making.

In practical engagement with domains of socio-technical organisation models are best viewed as both inter-objective and inter-subjective constructs. This is because models are constructed using systems of signs and for signs to work there must be some collective agreement about what the signs are, what they mean and how such meanings shape activity.

We shall use the idea of a model (or more realistically a series of models) as a way of *negotiating collective belief* as to either how things are in some domain of organisation (*as-is model*) or how we, as a collective, might like things to be (*as-if*) in this domain of organisation.

In the introduction we mentioned the work of Harry Beck in designing the London Underground map. A map of an underground, subway or metro system (Fig. 2.7) is a particularly good, everyday example of the use of models within socio-technical organisation.

What is significant for the user of the London Underground, Paris Metro or New York Subway is the topology of this system. In other words, how stations within the underground railway system are connected.
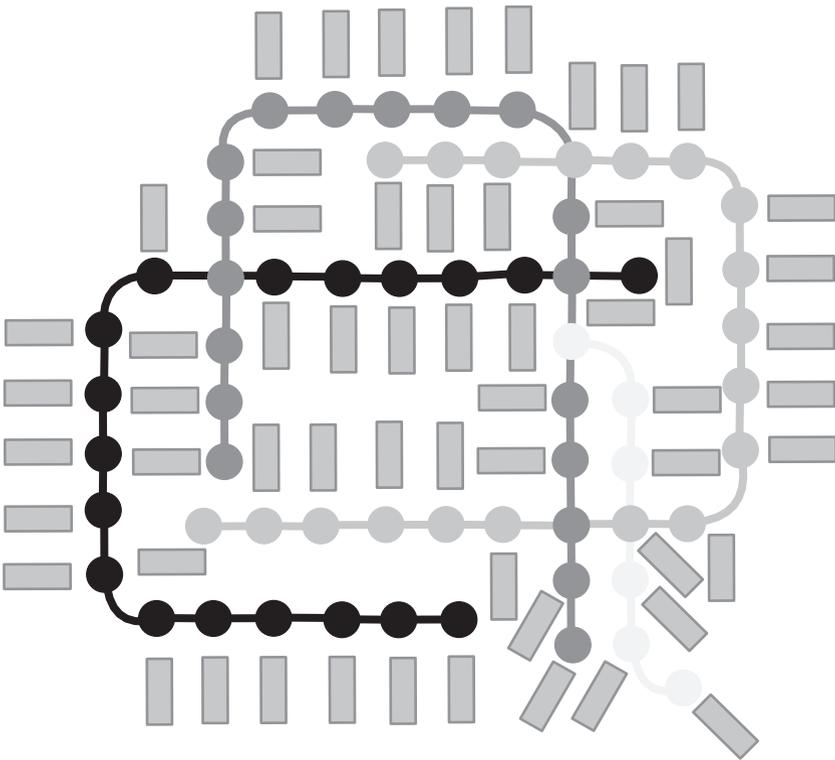
Fig. 2.7 Model of a metro

Such a map is hence a model of the actual technical system—the underground railway network—in the sense that it highlights or abstracts key features of the network for its users, typically by representing them as a sign-system: a series of circles (for stations) and coloured line segments (for tube or metro lines).

Such maps communicate to potential users the affordances of the tube or subway as an actant (what you can do with it) and thus in turn act as an aid to mutual and coordinated performance by a multitude of human actors—to enable them to travel between points using this network.

What is also interesting is that this model as a sign-system is designed for specific actors: the users or passengers of the underground system. It is not designed for other actors such as engineers of the underground who have to maintain the physical infrastructure of this network. For such actors different models will be required. This means that all models are created through systems of signs with a purpose in mind, which is normally as waystations through communication to further collective action. This is the essence of what we mean by sense-making.

6   Sense and Non-sense

You have probably guessed by now that I have great love for the works of Lewis Carroll—partly because his novels are narratives about sense and non-sense. Consider a line from Lewis Carroll's *Alice in Wonderland*: 'What is the use of a book' thought Alice, 'without pictures or conversation?'

We make sense through using signs in patterns of activity, communication and articulation. What we mean by organisation comes down to a continuous stream of such sense-making. Business analysis and design is part of the same stream. The models we build though business analysis and design are also systems of signs. The models are created typically as a means of making sense of some problem situation within some domain of organisation. But they are also created as a means to communicate change to organisation.

There is hence a clear relationship between models and signs (Waddington 1977). Models need sign-systems in the sense that models are created through signs and effectively act as an external communicative resource amongst a group of actors. This means that all such representations are models and all models are forms of representation. Natural language is clearly the richest of sign-systems with which we model or represent our 'world'. For analysis and design of business organisation, more restricted and formalised sign systems are typically used. This is the reason that visualisation—the pictures that Alice desires—are much used as a means of presenting such models. We can even use such models, as we shall see, to represent and stimulate the conversations that Alice also desires (Exercise 2.5).

Exercise 2.5

Consider the sign in the figure below. You may have seen a sign such as this somewhere. Does it make sense or non-sense to you? What is wrong with this sign? Taken literally the instruction it contains is non-sense. If the door must be kept closed (at all times) then why do we need a door at this point in the building?

So be careful, the very act of modelling does not guarantee a creative solution. But it may help you understand why your current ways of doing things are non-sensical.

Any model is a 'tool' for debating or negotiating about the nature of some reality: the aim being to achieve mutual understanding and joint action. This means that we assume that modelling involves negotiation between what we shall call the differing worldviews (Checkland 1999) of both participating actors in such systems and 'would-be improvers' of such systems (Wagner and Piccoli 2007). In this sense, the models we produce within our approach to the nature of organisation become representations that serve to accumulate and communicate common understanding amongst organisational actors. Such common understandings are formed in co-creation between the business analyst/designer and organisational actors. They become the basis for further organisational activity; perhaps even incorporating change to the 'infrastructure' (Bowker and Leigh-Star 1999) of articulation, communication and coordination within the domain of organisation being made sense of (Weick 1995).

7   Ontologies

Within business analysis and design the models we use are sometimes referred to as ontologies. The term *ontology* derives from the ancient Greek *ontos* for being and *logos* for study of. Within philosophy the term ontology refers to that branch of this discipline that deals with the nature of being or reality. More recently, the term has been used within Computer Science and Cognitive Science to refer to a model for representing the world or more readily some specific domain within the world. In its most general sense then, an ontology can be considered an organised and symbolic representation of some real-world domain—what we would refer to as a sign-system.

Signs as social constructs rely on a shared ontology amongst a group of actors: the context within which a group of symbols is used in continuous communication by a social group or groups. Hence, a shared ontology is a necessary pre-condition for joint communication and effectively frames or controls such communication.

An ontology provides a shared vocabulary, which can be used to 'model' a domain of organisation in terms of the type of objects or concepts that exist, as well as their properties and relations. We can use the term to denote a common set of representations used by a group of communicants by which they transfer intent from one actor to another. Like worldviews (perspectives on the world), ontologies are not fixed; they are continuing and communicative accomplishments and in effect emerge within any system of communication (Exercise 2.6).

> **Exercise 2.6**
> Think through another example of an ontology which helps support the practice of some other professional such as a lawyer, an architect, a teacher, a lecturer or even a person working in IT.

Ontologies are important because they help support practical action. Consider the case of medicine. When you visit a general practitioner (GP) she will use a number of ontologies to help her diagnose your illness, decide upon your treatment and record your prescription. For instance, a conversation about your symptoms will lead the GP to propose a number of possible illnesses you may be suffering from. Each such illness will have a generic name in a standardised, structured vocabulary of medical terms. These terms will have relationships with a range of possible medical treatments which will also have standard terminology. Medical treatments may involve prescribing certain drugs. Such drugs will be given a generic name within a formulary. This document lists not only the generic names but also possible proprietary names, the normal uses of the drug and likely side-effects of drug use (Exercise 2.7).

Exercise 2.7

Let's consider a commonly used sign within business, essential to the coordination of much activity, but which is rarely discussed—at least in the business literature. That sign is the barcode:

- In what organisational domains are barcodes used?
- See if you can analyse a barcode in terms of the component elements of a sign.
- In what sense is a barcode data—a pattern of physical symbols?
- What does information mean in the context of a barcode and what coordinated activity does it typically support?
- How does the information and activity associated with a barcode vary across domains—for instance, manufacturing, the health service and supermarket retail?

Try the same exercise with the notion of a QR (quick retrieval) code.
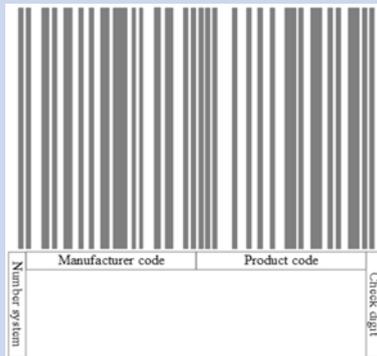
8   Conclusion

When people are asked what the facial expressions illustrated in Exercise 2.3 relate to and *mean* across the globe, they frequently come up with similar answers. It appears that facial expressions, such as the ones illustrated, are generally associated with some common human emotions and that the making of such faces is a major way in which humans communicate emotion or affect. Facial expression A, for instance, is normally seen to stand for something like 'happiness' while facial expression D is typically seen to stand for something like 'sadness'. Facial expression B stands for something like 'anger', facial expression E stands for 'disgust', C stands for 'fear' and F is a neutral expression—one which is not meant to signify any emotion.

Facial expressions are signs and signs mean business. Through signs we make sense (accomplish meaning) within virtually all human settings, including business

settings. Signs sustain organisation through patterns. A sign is a classic example of a pattern. A sign actually crosses three inter-dependent layers of patterning in the world: articulation of data, communication of information and coordination of activity. Another way of saying this is that signs cross three distinct layers of patterning which define three inter-dependent layers of system.

A facial expression results from one or more movements of the muscles of the face—this is effectively a data structure. Each of the six common facial expressions communicates something different about the internal emotional state of the person forming the expression—this is information. As such, facial expression is an important part of affective communication (the communication of emotion) Such communication is an important motive force to human action. For instance, there is evidence to suggest that emotion is contagious in the sense that the signals given off as to the emotional state of certain significant actors have an impact upon the emotional state of the group of actors this human regularly interacts with. Hence, smiling in the workplace may have an impact upon productivity!

Signs take their shape within systems of various forms and such systems can be seen to constitute the continuing patterning of order or organisation in the world. The term system is therefore used to refer to not only the patterning of signs. It is also used to denote the patterning of activity, communication and representation.

We make sense of the complex entanglement of order that constitutes organisation by building models of such patterns or systems. In Chap. 4, we examine the issue more precisely of what we are attempting to model—what socio-technical organisation is. But first let us look more closely at the nature of design (Chap. 3).

9   Theory

We take business analysis and design to be founded on three core concepts: signs, patterns and systems. The idea of a sign and the discipline of semiotics which studies this concept are introduced in Chap. 1 of *Significance*. The idea of a system and the discipline of systemics, which studies the general properties of all systems, are discussed in Chap. 2 of *Significance*. Patterns are discussed in Chap. 3 and are used particularly in that chapter to help understand the notion of a sign-system. Within the current book we use the idea of a pattern much more widely as a design concept.

10   Practice

Modelling is very much what business analysis and design is about. However, there is a vast array of models of various facets of business organisation produced by practitioners such as process models, stakeholder models, information models, data models and so on. We focus upon discussing just three major types of models in this book, but we shall relate these models to various others used within business analysis and design practice throughout the work. A compendium of techniques at the back of the book lists some major modelling approaches. Other works which cover

some of these techniques include (Blais 2012; Cadle et al. 2010; Paul and Cadle 2020; Kupersmith et al. 2013; Podeswa 2009; Yeates et al. 2007).

We particularly think of models in this book as ways of representing stories or narratives of organisation—of what people, machines and artefacts do or want to do. Taken in its literal sense a story is simply a recounting of events. But stories frequently involve the weaving of character, context and the events themselves into a form of expression which is greater than the sum of its parts. Simmons (Simmons 2001) provides a traditional Jewish allegory to demonstrate the power of narrative. 'Truth is turned away from every door in the village because her nakedness frightens the people. When Parable finds her huddled in a corner, she has pity on her and takes her home. There, Parable dresses Truth in story and sends her out again. Clothed in story, Truth once again knocks on the villagers' doors, and this time is readily welcomed into their houses.' Comics or storyboards are particularly good vehicles for conveying narrative in an easily understood manner. It is for this primary reason that we use comics as one of the main ways of building models of organisation. But to build these quickly as a means of exploring some domain of organisation we use a form of prototyping known as tabletop prototyping.

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What Is Design?

3

1   Introduction

In making the case for the importance of design thinking, Rawsthorn (2013) uses the example of the first emperor of China, Ying Zheng. Ying Zheng became king of Qin in 246 BC. Fifteen years later he had conquered all of his more powerful neighbours. He did this not only through his inherent ruthlessness and guile but also through the power of design. He implemented a massive programme of re-designing his troops weapons and training them in their effective use. For instance, he standardised the design of both bows and arrows, making them not only easier to produce in mass volume but also reusable by any of his troops in battle. This design strategy was to prove effective in numerous military campaigns.

To help centre the notion of design this chapter examines the work of some great designers focusing on an array of different design artefacts. It then ponders on the nature of design as an activity and considers what it means to design domains of socio-technical organisation. This leads to a consideration of a range of popular techniques used to both set problems and solve problems. Considering such enables us to set the context for the toolkit of design techniques described in this book. We place our toolkit against a lifecycle model of analysis and design and explain how these techniques relate to other techniques available in the armoury of the business analyst and business designer.

2   Great Designers and Their Lessons

To appreciate the nature of design it is important to turn to the work of good designers in a number of different areas. We consider four here: Buckminster Fuller, Lloyd Wright, Wedgewood and Beck. In the next section we also consider the work of Stafford Beer.

Richard Buckminster Fuller, the twentieth-century American polymath, is best known for his invention of the geodesic dome. But Fuller believed that design was

an attitude or orientation needed to confront some of humankind's greatest problems. Such problems are 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. Buckminster Fuller believed that a design orientation is important because the solutions to many such problems demand that we organise ourselves differently—such as reorganising our patterns of water conservation and consumption as one way of better managing our finite source of freshwater. So, the key message here is that whenever we change our ways of doing things such as this, we inherently design.

Frank Lloyd Wright was one of the greatest American architects of the twentieth century. He is best known for his approach to enhancing nature with human architecture. Above the entrance to one of his most famous buildings, Taliesin, are the Welsh words *y gwir yn erbyn y byd*, which translate as *the truth against the world*. The message here is that design should defy convention, indeed the whole notion of a design orientation demands engagement with current conventions and the exploration of new, hopefully better, conventions. This we made plain in Chap. 2.

Josiah Wedgewood is of course known for his famous pottery but what is less known is that when Wedgewood lost most of his first production of pottery due to transportation by horse and cart, he was instrumental in designing and building one of the first industrial canals in Britain. The message here is that design is always goal-directed at resolving certain problems that need to be defined as clearly as possible. The art of setting problems well and suggesting a variety of ways of solving problems, as we shall see, is critical to innovation. Design is or should be at the heart of all digital innovation (Exercise 3.1).

Exercise 3.1
Explore some of the work of these designers. What else does such work tell you about the nature of design and the relationship of design to innovation?

We explored the notion of a metro map as a model in Chap. 2. Harry Beck created the design for the first such map—a user map of the London underground. Beck's map was innovative in reworking the topology of the underground to make it usable by the traveller looking for connections between tube lines. The message here is that design is frequently a matter of finding innovative ways of communicating. However, what we referred to in Chap. 2 as symbolic design is not just about designing ways of representing data for information. Any design of data must be done with activity in mind.

3   **Ways of Organising**

Stafford Beer (1966) was a British cybernetician (cybernetics is the study of control, a topic we shall consider in Chap. 4) 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 as the institution of organisation emerges from patterns of action that serve to constitute organisation. As we shall see, 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.

To enable us to develop a design attitude we shall follow Beer and think of organisations as systems. In fact, we shall think of the issue of organisation as a complex, adaptive system. 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 things that are related or set together. Things that are set together also lead to systems that are dynamic in the sense that the things potentially influence each other.

But organisation is not an isolated entity. An organisation exists within a surrounding environment which can be thought of as a 'heaving landscape' (Kaufmann 1995). This is a way of visualising the volatility of the environment. Imagine that it is like a region of many hills and valleys. The hills correspond to good places for an organisation to occupy while the valleys correspond to a bad place within which to settle. But the surface of this landscape is malleable. As more and more organisations climb to the peaks, they push down these hills and raise the valleys surrounding them.

Any domain of organisation is thus an open system in that it continually interacts with this environment. It adapts to but also impacts upon its environment. Actions that actors within the organisation have effects upon this heaving landscape. In turn, the actions of the organisation must change to improve its 'fit' with the environmental landscape. For instance, a business organisation might pursue a strategy that changes the competitive landscape of its market. Competitors will naturally react, and their actions will cause the organisation to reflect upon its strategy, and probably make further changes.

So, organisations are open systems in the sense that they interact with things in their environment. Organisations are also complex systems that need to regulate themselves and adapt to changes in their environment. The open and adaptive nature of organisation means that organisations are complex systems. By this we mean that the number of possible states that the system may be in are immensely large.

We might conclude from this that it is impossible to understand and describe the workings of any organisation. But one way of handling the complexity of systems is to apply the notion of hierarchy to understanding, representing and designing them. In this way, systems can be seen 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 a pattern of 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, sub-system, sub-sub-system and so on.

A systems viewpoint is important because it makes us think about the inter-connectedness of things. This viewpoint is sometimes referred to as a holistic view-point, since we attempt to think about wholes rather than parts. Take a critical example which helps set in context many grand challenges. 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 system, such as changes to global climate. This, in turn, is likely to influence melting of the polar ice caps, which is likely to increase sea levels and further exacerbate changes to global climate (Exercise 3.2).

> **Exercise 3.2**
> Explore one of these grand challenges and try to describe the inter-connected-ness of things that make up the challenge. For instance, how is increasing water scarcity a systemic problem? Or, how does rising inequality contribute to pollution?

4   Thinking About Design

But when we say we design something what do we mean? Designers like to visual-ise things to help conceptualisation, understanding and explanation. So how might we visualise design itself?

If you were to visualise what design is, it might look like Fig. 3.1. Kat Holmes (2020) believes that 'a design has an intent. It is meant for a purpose. The act of designing inherently requires thinking about the future ways that someone might use a solution. And it's successful only when the recipient of a design confirms it has achieved is purpose.' Design always begins with some perceived problem, which is represented by the question mark in the figure. Next, the shape of the
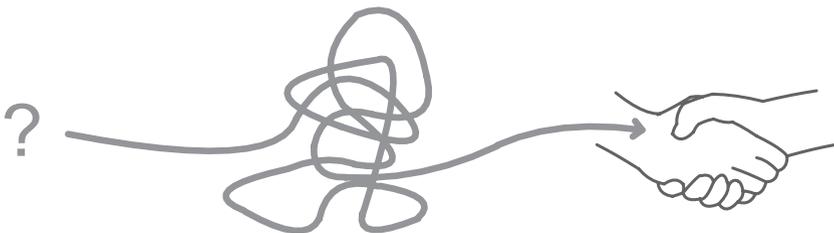
Fig. 3.1 Visualising design
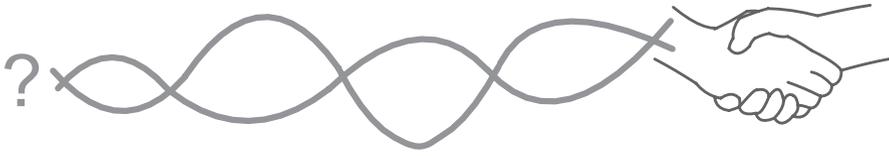
Fig. 3.2   Smoothing design through the application of design theory

problem must be unravelled—this is represented by the wiggly line. Finally, some sort of design solution must be arrived at and agreed with 'owners' of the problem. In other words, it is insufficient just to produce some design; the design must be verified and validated by persons with a stake in the problem established and the solution reached. This stage is represented by two shaking hands in the illustration.

But within this chapter we are going to try to consider design as something more like the visualisation in Fig. 3.2. In order to make design more coherent we follow a designated design approach—sometimes referred to as a design method. Taking a design approach means applying some design theory to a design artefact. And, 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.

So, to smooth out the process of design and make it teachable to others we must have a design theory. Our design theory, as we considered in the [introduction], is focused upon offering a way of thinking about the design artefact of organisation. More precisely, it provides a coherent way of building models of organisation— either as things stand now or as we might want them to be. This design theory also offers a way of thinking about the place of technology within organisation and therefore is a useful platform for considering the important issue of digital innovation. The design theory, as we have seen, is built around the conceptual pillars of signs, patterns and systems introduced in Chap. 2.

5   Design as an Activity

But design is a lot more than a squiggly line. There are a lot of different ways of thinking about design as an activity dealing with problems of some form. Some people divide design up into two activities, such as problem-setting and problem-solving. The British Design Council sets problem-setting and problem-solving within two phases of divergence and convergence—this is referred to as the double-diamond model of design work—and is illustrated in Fig. 3.3.

Within this model, problem-setting involves establishing what the problem or problems being dealt with are. The designer first needs to explore the problem-space and discover what the problem is. This is divergent activity. She then needs to define precisely as she can what the problem consists of. This is convergent activity. The problem-solving phase then involves the development of a range of possible solutions (divergent activity), from which one is chosen to deliver as the eventual design artefact (convergent activity).
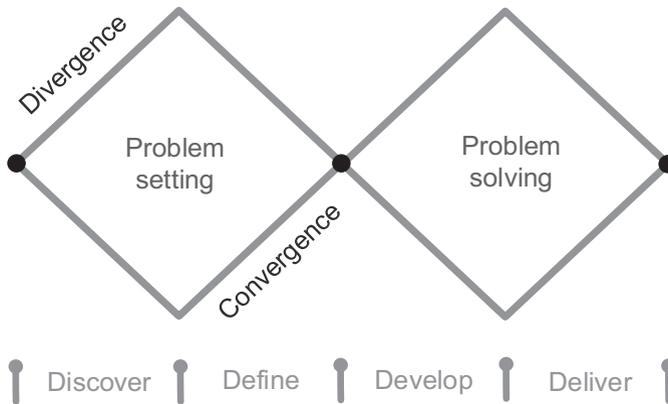
Fig. 3.3 The stages of design

Many others divide design activity into at least four parts, such as discover, define, develop and deliver: or exploration, ideation, evaluation and implementation. The designer must first explore or discover the problem-space and frame the parameters of the problem to be solved. This leads to the generation of ideas as to possible solutions and development of prototypes to model such ideas. Possible solutions are then evaluated, and one chosen to develop into a full design. Finally, the agreed design is implemented or delivered.

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'; and 'wicked' rather than tractable.

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; and
- 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 as systems of action 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. 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 is primarily a matter of analysis and 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, understanding what they feel the problem is and what they prioritise in terms of the parameters of some solution.

In contrast, problem solving is largely a matter of design. It involves coming up with a range of possible solutions, communicating their features to stakeholders and deciding upon likely changes to patterns of organisation. Design may also lead into the implementation of a solution or the actual resolution of the problem.

6   Design as Abduction

Analysis and design of any design artefact tends to employ a way of logical thinking known as abduction. Charles Sanders Peirce (Atkin 2016), the founding father of semiotics, originally introduced this form of logical thinking and contrasted it with the more familiar forms of deduction and induction. All three words are derived from the Latin *ducere*, meaning 'to lead'. The prefix *de* means 'from', the prefix *in* means 'to or towards' and the prefix *ab* means 'away'.

Deduction is the formation of a conclusion through a process of inference based on generally accepted facts. For instance, suppose you have a 10 am appointment with a general practitioner. This is one fact. You also have the fact that it takes 30 minutes on average to drive to the GP surgery. From these two facts you deduce that you need to leave home no later than 9:30 am. Deduction derives one conclusion from generally accepted facts.

Induction in contrast does not guarantee a deterministic conclusion from facts. Instead, it involves deriving a probable inference or generalisation from a set of observable instances. For example, at lunch you observe that 8 out of 10 colleagues order the same sandwich. From these observations you induce the probable inference that the sandwich is good to eat. You do not know this for sure but accept that probabilistically 80% of people are making a good choice. Induction leads you towards a generalisation from observations.

Abduction involves deriving the best possible conclusion based on limited but known evidence. It is a form of logical inference which starts with a set of observations and then seeks to find the simplest and most probable conclusion from these observations. A familiar example is the detective forming a conclusion as to the likely criminal based on evidence from the crime scene. In abduction you take away the best explanation of something. However, you might continuously refine this explanation in continuous engagement with the phenomena in question (Exercise 3.3).

Analysis and design of organisation is typically a form of abductive reasoning because normally the problem-space engaged with is much too large for the designer to be in receipt of all the facts. Also, there may be some instability in what facts are

important. Therefore, analysis and design is always a process of exploring a problem-space in terms of various forms of investigation, deriving a series of possible solutions that potentially resolve the identified problem and then coming to some optimal conclusion as to best courses of action.

There is clearly a suggestion here that unlike deduction and induction, abductive reasoning is inherently incomplete. This helps explain why analysis and design is not a linear pattern of activity. Instead, it is more accurately seen as iterative or cyclical, as illustrated in Fig. 3.4. This figure also emphasises that design is a pattern of co-creation between the designer and stakeholders of the system in question. Once a problem has reached a certain level of definition it is important to start prototyping potential solutions and evaluating such solutions against criteria which should be established within problem setting.
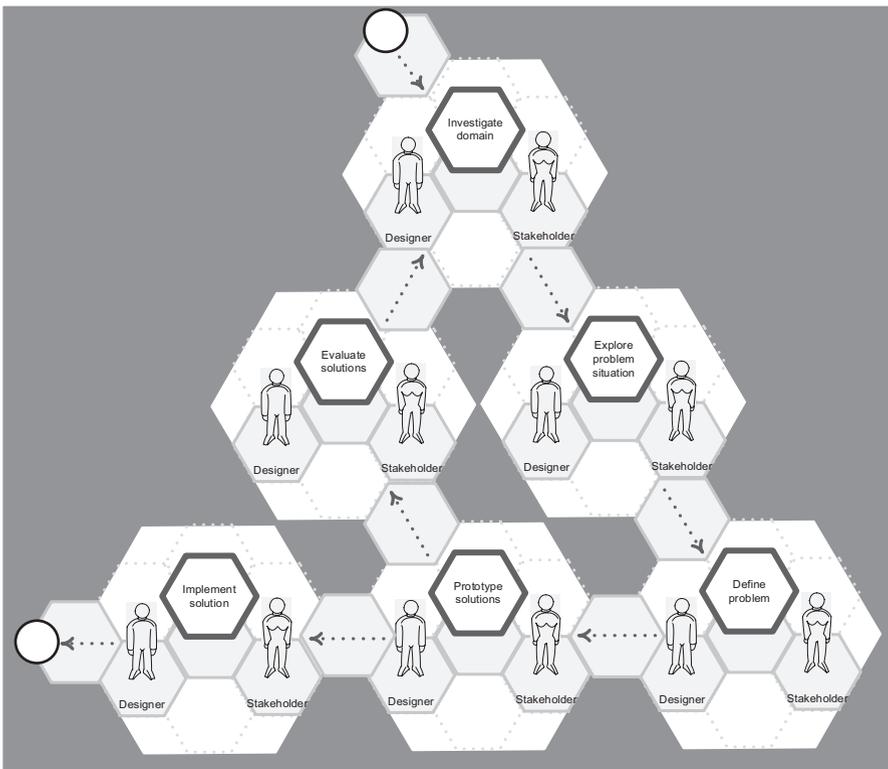
Fig. 3.4 The cyclical nature of design

This prototyping may suggest that further investigation and problem setting needs to be done. At some stage, the co-design team must come to some conclusion as to the optimal solution based on the available understanding of the problem situation. The eventual solution is then delivered or implemented.

This cyclical nature of design work in which abductive reasoning is employed enables this activity to be undertaken in parts, rather than in one whole. This is very much central to so-called agile philosophy, which has been employed widely within software design, but now has been adopted more widely within business analysis and design. Agile approaches use a phased approach to the project management of analysis and design work (Chap. 5). Once the problem has been defined to a sufficient level it is broken down into smaller pieces known as increments or 'products'. Each increment is then analysed and designed separately within a fixed period of time known as a timebox, which is typically defined in terms of a fixed deadline by which a product is designed. At the end of each timebox a review is conducted, which may cause changes to be made to the problem definition of the next design increment or product.

7   Returning to the Design Game

So, design is always a mix of divergent and convergent thinking. Another way of putting this is that design demands that people not only *make sense* but *break sense*. In thinking divergently designers must break with sense and challenge existing convention. In thinking convergently designers must make sense by establishing new forms of convention.

To understand some of the ways in which this dichotomy works within the practice of design, remember the simple design game we set in Chap. 2? Here are some questions about this design exercise:

- What difficulties did you experience with this design exercise?
- What actually are you designing in this game?
- How would you know that your solution is better than somebody else's?
- How would you best explain how your design works to others?

Let us assume that we come up with the design in Fig. 3.5 as a starting point. One design 'solution' is to assume that the entire whiteboard represents the area or work. Four squares are then drawn upon the whiteboard in different colour pens to represent the four locations within the area or work. This means that each square of the visual device is colour-coded to signal a particular location. Hence, the first location might be thought of as the red location, the second the green location, the third the black location and the fourth the blue location…

The number of magnetic tokens of a particular colour within all four squares on the whiteboard would then be used to signal to workers the number of units of material currently at the location of this colour. A token which is non-standard for its area (of a different colour from its coloured location) would signal that an item should be moved to the area it colour codes in the next time-period. Hence, the presence of a
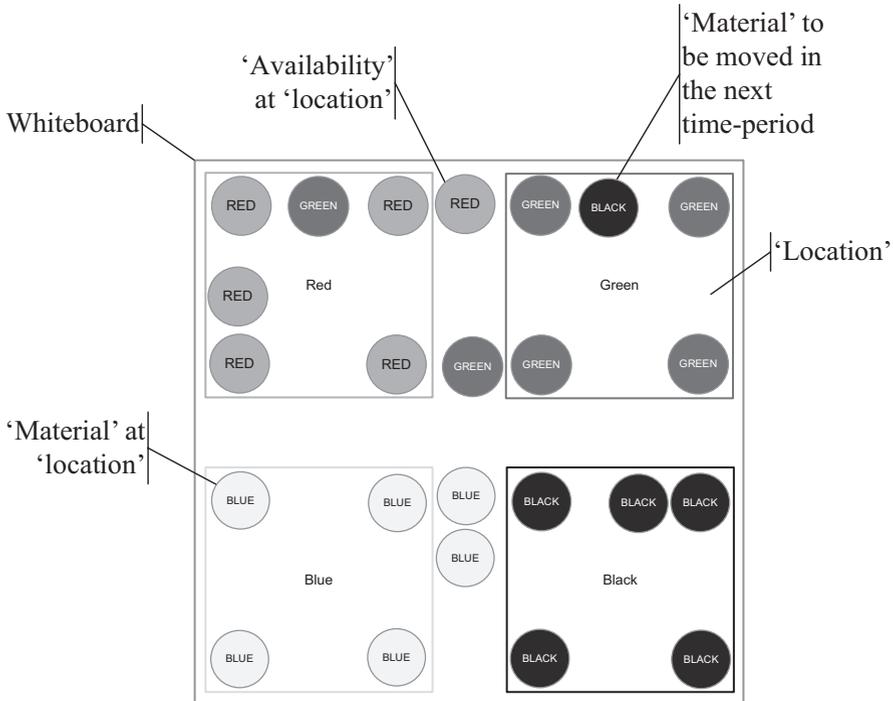
Fig. 3.5   A design for the whiteboard

green token in the red box should signal that one unit of material should be moved to the red location from the green location in the next time-period.

The design could also be used to communicate to workers the availability of a particular location for moving material. Hence, if one coloured token is placed outside of its coloured location, then this would signal that one unit of material can be moved to this coloured location… Hence, in the figure, one red token place outside the red box communicates that one and only one item of material can be moved to this location in the next time-period.

Figure 3.6 illustrates how the whiteboard and the tokens might be manipulated through four time-periods (a test of this particular design):

- Time-period 1: five units in the red location, five units in the green location, six units in the black location, four units in the blue location…
- Time-period 2: the indicated units at location are the same as for time-period 1. The presence of a green token in the red box indicates that one unit should be moved to the red location from the green location. The presence of a black token in the green box indicates that one unit should be moved to the green location from the black location.
- Time-period 3: The movements have occurred, and the tokens have been manipulated/articulated to reflect this. There are six units in the red location (a movement has occurred and fills the location to capacity)—a red token replaces the
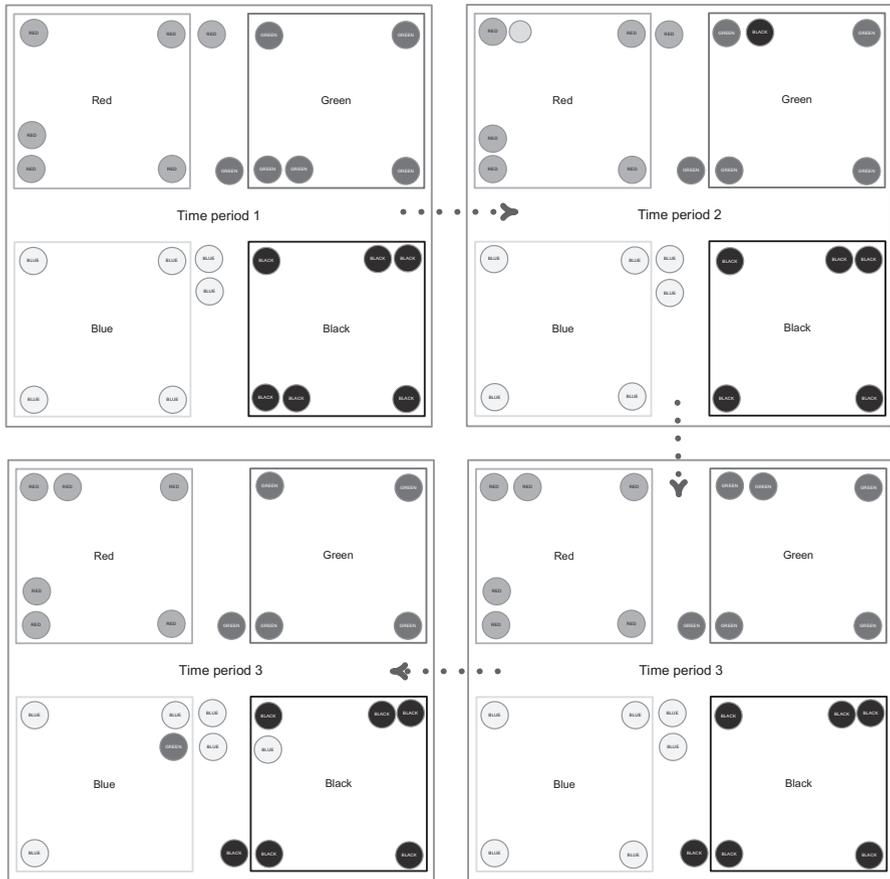
Fig. 3.6 Moves with the whiteboard

green token and the green token is returned to availability. There are five units in the green location (a movement has occurred)—a green token replaces the black token and the black token is returned to availability. This means that there are five units in the black location, and four units in the blue location (where no movements occurred). No further movements are signalled in this time-period.

So here are some answers to the questions set:

- *What difficulties did you experience with this design exercise*? Design, at least in its early stages, is inherently confusing because the problem situation might not have been that clear to you. To make sense of situations you have to question. Many people struggle to set the problem at the centre of this design game appropriately. All the parameters to the problem are actually given to you in the rules of the game. However, many people attempt to make additional assumptions or add extra requirements.

- *What actually are you designing in this game*? There is a tendency to think you are designing just the visual device—the whiteboard. In fact, what you are actually designing is a pattern of activity in which the whiteboard is a key actor. You will see in a later chapter how playing the design game involves the need to consider three types of coupled action: articulation, communication and coordination.
- *How would you know that your solution is better than somebody else's*? There is not one design which everybody arrives at, even for a simple situation such as the one considered. Designs must be evaluated. But there are numerous different ways you might evaluate any one design. So, you have to be clear about goals, objectives—and use such to form criteria for evaluation. You cannot judge a design artefact unless you set some criteria for its evaluation. Such criteria might be a crucial aspect of problem setting. For instance, you might assess the design in terms of its simplicity, coverage or applicability.
- *How would you best explain how your design works to others*? Designs are nothing if they cannot be communicated and understood. It is actually quite difficult to explain patterns of activity through verbal or written discourse. That is why designers frequently use visualisation.

8   Techniques for Business Design

To help the designer in problem-setting and problem-solving various techniques are applied. Such techniques effectively act as 'crutches' helping the designer to move towards an appropriate design. However, there are a vast number of techniques employed in business analysis and business design—some of which are listed below:

- PESTLE analysis
- SWOT analysis
- Serious Play
- Brainstorming
- Affinity mapping
- Mind mapping
- Fishbone diagramming
- Stakeholder mapping
- Role mapping
- Role playing
- Rich pictures
- Writing scenarios
- Producing a storyboard
- Prototyping
- Desktop walkthroughs
- Journey maps
- Service blueprints

We cover a range of the techniques listed above within the body of the text but place them within the infrastructure of our design theory. At the end of the book we

provide a compendium of a larger range of techniques which you can use as a start-ing point for further investigation.

Techniques We Shall Cover

We cannot expose you to all available techniques for conducting business analysis and design. Therefore, we shall use three main techniques and a few of other com-plementary techniques which bear a close similarity to those listed. We shall also provide a more focused and integrated account of how these techniques can be used within business analysis and business design than you will find elsewhere.

Affinity Mapping

This technique is particularly useful within problem setting and involves first iden-tifying a range of issues that relate to a problem situation. The issues are written on post-it notes or pieces of card and then grouped or clustered together in terms of their affinity. From this a broad appreciation of both the extent and the parameters of a problem can be gained.

Rich Pictures

A rich picture is a loose or informal visualisation of some problem situation. Such visualisations attempt to capture the essence of a complex situation within which some stakeholders perceive a problem, and some form of business analysis work needs to take place.

Stakeholder Mapping

A stakeholder map is a tool utilised within stakeholder management. It lists for each stakeholder the relevant details needed to inform the conduct of a business analysis project such as the name of the group, it's power or influence, it's level of interest in the work of some business analysis project, it's likely attitudes to change and so on.

Tabletop Prototypes

A tabletop prototype involves positioning various icons on a tabletop to represent various patterns of action. It can be used as a means of documenting analysis of existing patterns of action or specifying the design for a new system of action. The advantage of this technique is that patterns can be built quickly and thrown away easily.

Pattern Comics

This is a way of visualising patterns of action as storyboards and can be used as a means of communicating patterns both to design teams and to actors more gener-ally. Such visualisations can be converted from tabletop prototypes once some level of stability occurs within design work.

The tabletop prototype in Fig. 3.7 shows when these techniques are typically used within the activity system of design.
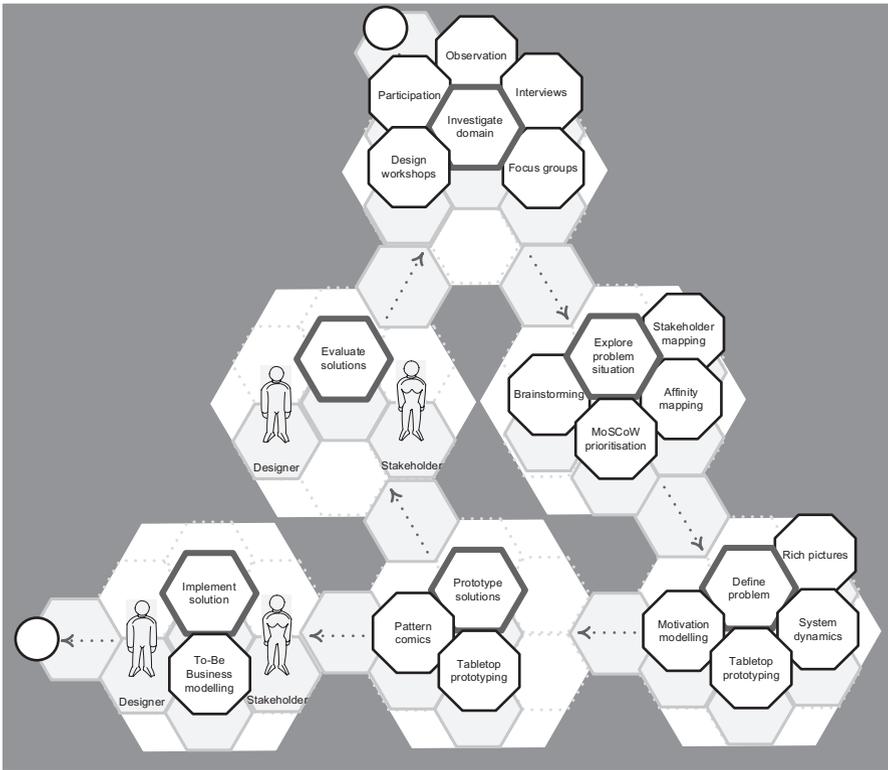
Fig. 3.7 Techniques within the cycle of design

Important Aspects of Design Work

As we mentioned in Chap. 2, to get the most from this book you should use it within a *practicum*—a course of study devoted to the practical application of theory. This is because there are three important aspects of design work that can only be fully experienced by doing: prototyping, thinking with your hands and failing often.

It is generally accepted within design disciplines that the development of design models or prototypes is a good way of doing design. Prototyping involves building a model of some proposed design and then evaluating the model. This leads to refinement of the model and the cycle of improvement continues until a satisfactory model is achieved. This is a classic abductive process in which the search for an optimal solution to a problem is conducted systematically.

Prototyping or the building of models generally should be an embodied experience. It is important to try to construct a physical representation of a prototype as we think not only with our brains but through our whole bodies. We have found within design workshops that creativity is enhanced if groups of actors stand and

manipulate physical objects rather than sitting down individually and playing with computer screens or jotting on a piece of paper.

It is important, particularly within the early stages of design, to build something quickly and always be prepared to throw it away and start again. The message here is to fail early and often. This means that the prototype is a learning exercise and not an end in itself. Prototypes should be deliberately low-tech, making them easy to learn and inexpensive to create. Low-technology prototypes should also be easy to throwaway and to change. This is critically important in situations in which you co-create prototypes quickly with business stakeholders.

9   A Grand Challenge

So, within a practicum we want you to consider our ageing society as a grand challenge. Care for the elderly is a problem situation which forms part of a significant grand challenge for many nation states—the ageing society. Such care is also an important aspect of public value, seldom accurately engaged with in terms of monetary value. Many societies globally, including the UK, are experiencing a growth in their elderly populations. Figure 3.8 shows the estimated growth in the UK population up until 2030. The graph also shows the number of millions of the population over 60. It is evident from demographics such as this that the UK experienced a tipping point recently where the actual number of over-65s in the UK is now greater
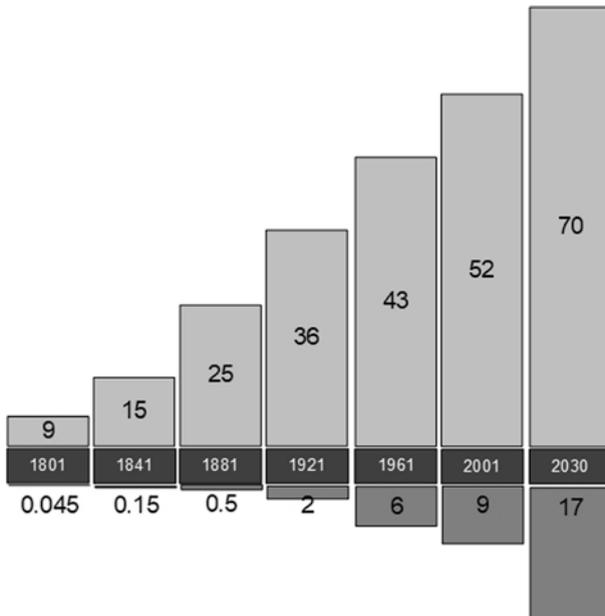
Fig. 3.8 Growth in the elderly population in the UK

than the number of under-16s. Of more concern, the graph in Fig. 3.8 shows a 60% increase in the number of over-65s by 2030.

So here are some inter-related problems associated with this growth in the elderly population:

- Lack of affordable care homes
- Lack of effective health and social care for the elderly in their own homes
- Increasing demand on healthcare—the older you are the more likely you will make demands on healthcare services
- Increasing demand on social care——families no longer care for the elderly, so the state has to take over their care
- Increasing bed-blocking—unnecessary occupation of hospital beds by the elderly because of lack of suitable care at home

Take just one of these issues: bed-blocking. This is the long-term occupation of hospital beds in general hospitals, chiefly by elderly people. Bed-blocking happens because such patients cannot be discharged back home because of a lack of support in the community or conversely, they cannot be discharged into a care-home because such places are in short supply. It is estimated that on a typical day more than 2500 beds are taken up by patients within the NHS in England that could be discharged. This problem situation is estimated to cost approximately £400 a day for each hospital stay in bed. This means that bed-blocking costs the UK National Health Service (NHS) overall somewhere of the order of £820 million per annum. Estimates of how much it costs to provide effective care for the elderly in their own homes varies but is something of the order of £180 million per annum.

But bed-blocking is of course not an isolated issue—it is a systemic issue which is clearly part of a wider problem landscape or situation. As we shall see, like most problems of organisation it is systemic because it relates to or is inter-connected with a host of other issues (Exercise 3.4).

Exercise 3.4
We do not want you to re-design all of this complex system of action. We want you to be creative in considering the re-design of some small aspect of the services provided to the elderly in their own homes. Here are some relevant questions:

- What are the key motivations for changing ways of organising social care for the elderly?
- How can digital innovation be used in the provision of health and social care for the elderly in their own homes?
- Are there better ways of organising the provision of health and social care for the elderly in their own homes?

10   Conclusion

Design teams frequently get together at the end of the working day in a *wash-up session*, which acts as a review not only of the work completed, but also of work to be done. So here are key lessons from the current chapter:

- Design is central to many areas of life.
- The design attitude or orientation is equally important to business.
- It is useful to think of design in terms of problem setting and problem solving.
- There is a vast array of techniques available to help people both set problems and solve problems.
- We shall employ a more limited set of techniques which impart key design principles and integrate together well.
- These techniques are used primarily to build prototypes which help us think through business design.

In the next chapter we shall look at the focus of our analysis and design work—the issue of organisation.

11   Theory

In Chap. 4 we shall propose that domains of organisation are best viewed as complex, adaptive systems. We shall also propose that most forms of organisation are also socio-technical, implying that they consist of both human and technical actors inter-acting in the pursuit of goals. The attempt to promote distinct approaches to the design of socio-technical organisation has a long and distinguished pedigree, originating in the work of Trist and Bamforth (1951). The pioneering work of Enid Mumford (2006) during the 1960s, 1970s and 1980s first began to explore the relevance of socio-technical thinking to digital innovation. This work overlaps with that of Peter Checkland (1999) at Lancaster university and his development of Soft Systems method.

12   Practice

A lot of material has been published upon the issues of analysis and design. This material tends to fall into two camps. The first camp derives from the technological domain and is a reincarnation of what used to be referred to as systems analysis and design (Yeates et al. 2007). Many technologists concerned with interaction design have also contributed various approaches to the design of technology. The second camp derives from the business domain. Traditionally, the area of operations management has been the natural home for those concerned with the analysis and design of business organisation (Curedale 2016). More recently, the areas

of marketing, strategy and service management have taken on the tenets of design thinking and have proposed techniques such as customer journey mapping to help them design services (Kimbell 2014).

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Designing Organisation

4

1 Introduction

Mandala is a geometric pattern much used in Buddhism and Hinduism to represent the universe symbolically. The logo used for this chapter (Fig. 4.1) might be seen as a Mandala representing not the physical universe but the domain of socio-technical organisation. The mandala consists of three inter-related cycles that disappear into infinity. These cycles consist of patterns of articulation, communication and coordination.

The focus of business analysis and design is upon organisation or some part of organisation, which we refer to as a business domain or more generally a domain of organisation. We mentioned in the prologue that within most existing literature on business analysis and design, little or no attempt is made to establish the nature of organisation as background against which these activities take place. In this book we shall depart from this trend and critically examine the focus of both our analysis and our design work—a delimited domain of organisation. We start by considering two alternative viewpoints on organisation to be found in the social sciences, sometimes called the institutional and action views. Within this literature the term *organisation* is typically used to refer either to a human institution or to a network of actors and actions. But this same term *organisation* is used in subtly different ways within the physical sciences. Things display organisation when they are ordered—when repeating patterns of order can be observed in some domain.

Within this chapter, we shall explain how these three viewpoints are in fact complementary and how these competing perspectives can be unified through the systems concept of emergence. We shall then relate the notion of human organisation to that of value and introduce the idea that the creation of value emerges from the entanglement of three forms of patterned action that we alluded to in the previous chapter.

Throughout this book we shall take the position that organisation is best viewed as a complex system. Because of our interest in digital innovation we also focus on a specific form of complex system known as a socio-technical system. We propose

Fig. 4.1 The mandala of organisation

that such socio-technical systems consist of patterns of social and technical action which regenerate institutional structure but are always catalysts for change. This leads us to consider the essential elements of any pattern of organisation: actors, action, location and sequence. We define the concept of role in terms of actors undertaking packages of conventional action and make the case for considering not only technologies such as ICT systems as playing key roles within contemporary ways of organising but also data structures.

2   The Nature of Organisation

Within the social sciences or a branch of such sciences known as organisation theory, the term *organisation* is used in one of two ways. Either it is used as a *noun* (a referring word) or it is used as a *verb* (an action word). When used as a noun, the

term organisation refers to an institution or social structure. When used as a verb, the term organisation is used in the sense of to organise or performing ways of organising. As a verb, organisation denotes a system of action.

Organisation as Noun

The most commonplace use of the word *organisation* refers to an institution—a social structure. This institutional perspective sees organisations as entities which exist independently of the humans belonging to them. The actions of the human members of such institutions are directed or constrained by larger social structures and such institutions have a life over and above the life of their members. In this sense we might speak of the central cases in this text—Goronwy Galvanising, University Short Courses (USC), the ambulance service and Cwmni—all as institutions.

Goronwy Galvanising is a manufacturing company which galvanises steel products for other manufacturers. University Short Courses is an offshoot of a university, established as a company to provide packaged and bespoke short courses to industry. The emergency ambulance service is a critical part of the National Health Service in the UK. Our description is a composite of the way in which such services are run by different parts of the country. Cwmni is an organisation established by a regional administration within the UK to provide business support to small- and medium-sized enterprises (SMEs) (Exercise 4.1).

> **Exercise 4.1**
> Modern life is organisational life. Jot down the number of organisations you feel you are an active member of. Can you list the number of organisations you are not a member of but interact with on a regular basis?

Organisation as Verb

The term organisation can also be used as a doing word—to organise or as a way of organising. In this action perspective an organisation is continually constructed or recreated through the continuing actions of its members. This viewpoint focuses on 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.

Goronwy Galvanising as an organisation is continually reproduced by inbound logistics staff handling of steel product from customers, production staff galvanising these products and outbound logistics staff dispatching galvanised product back to customers. The ambulance service involves numerous workers handling emergency calls, dispatching ambulances to incidents, providing healthcare to patients

and taking patients to general hospitals. University Short Courses (USC) as a way of organising is constructed through actors such as bookings clerks taking action such as making bookings and lecturers giving presentations of courses. We use the term *actor* for anything that can act; not just to refer to dramatic actors. Actors include humans and other animals as well as machines.

3   Emergence

For many years these two viewpoints were considered incompatible and organisation theorists argued over which provided the best viewpoint on the nature of organisation. We take an alternative systems viewpoint on organisation within this book, which we think helps resolve the puzzle of organisation through the concept of *emergence*. This viewpoint offers a way of unifying the polar positions of action and institutional viewpoints and suggests that an organisation is best seen as a system in which structure emerges from action.

   We can use a famous analogy to help understand the concept of emergence—because making analogies is a good way of stimulating different ways of thinking. The ancient Greek philosopher Heraclitus argued thousands of years ago that 'change is the only constant'. By this he meant that what we think of as constant is in fact continually changing. He used the analogy of, 'you can never step in the same river twice', to help explain this. We normally consider a river merely as a physical structure and describe this structure in terms of 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 and changing. 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. USC 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 this organisation providing short courses to industry. The action of lecturers and students reproduces the roles they enact, and through this the structure of the organisation itself.

   But how does emergence actually take place in terms of domains of organisation? The apparent duality of organisation can be reconciled through the idea of *structuration*, which is a concept created by the sociologist Anthony Giddens (Giddens 1984). In this view, organisations are both institutions and collectives of action. The institutional and action perspectives on organisation are not incompatible. They are merely different viewpoints on a continuous process of *structuration.*

   On the one hand, the structure of social institutions such as organisations is created by human action. Through human inter-action, social structures are reproduced but may also change. On the other hand, humans utilise institutional structure as a resource in interpreting (making sense of) their own and other people's action. This means that institutions act as a constraint on human action.
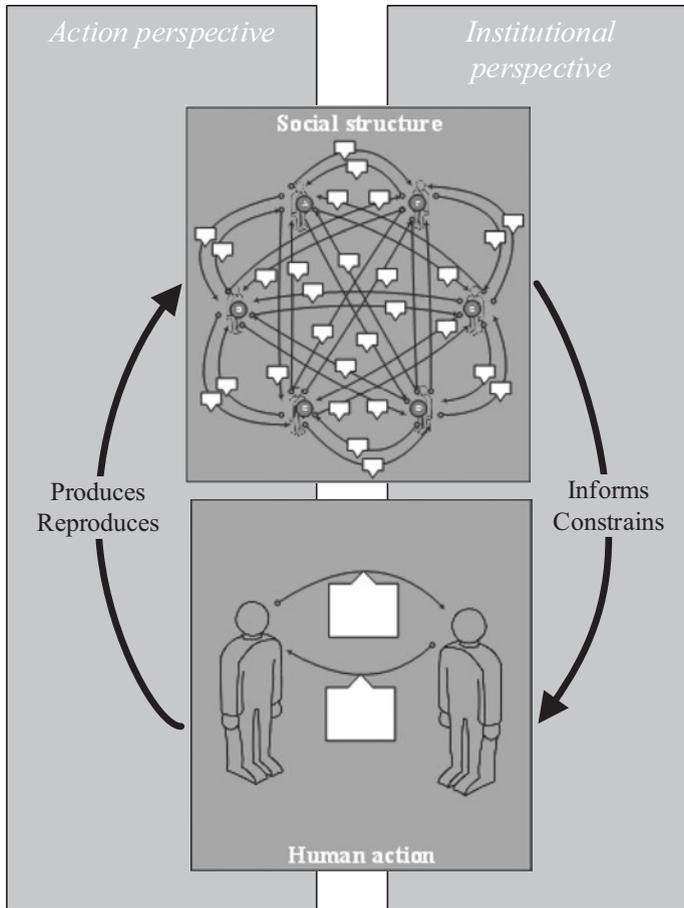
Fig. 4.2   The process of structuration

This cyclical process Giddens calls the process of structuration, which is illustrated in Fig. 4.2. It is the process through which the patterned order we consider as human organisation is constituted and re-constituted.

4   Language as Organisation

In our usual style, let us take a slightly different example to explain how organisation as structure emerges through action. Let us look at human language as patterned order—as an instance of organisation.

Human spoken languages (which are examples of the general concept of a sign-system we considered in Chap. 1), such as English, have many features in common with human institutions—indeed many scholars think of languages as institutions. This is because languages can be considered as systems of patterned order.

A necessary precondition for conversation (or what we shall refer to as communicative acts later in the book) is that people have a common language. We can talk about the features of a language without talking about specific conversations: for instance, by discussing the vocabulary, grammar and syntax of a particular language. In this sense, English as a spoken language has an existence independent of the people who speak it. The language constrains the communicative actions of its users in the sense that to speak English you must utilise the grammar, syntax and vocabulary of this language.

However, spoken language is only really evident in specific acts of communication. People use language as a resource for communication; they produce and re-produce it through communicative acts. Over time the innovative use of communicative acts changes the structure of a language. New vocabulary, grammar and syntax evolve. In this way, the language is recreated or reconstructed through acts of language use.

Exercise 4.2
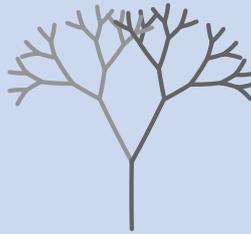
Organisation is never static—it is a continual accomplishment. The figure above displays the idea of fractal order or organisation—how a tree grows by reproducing patterns—fractals. This representation of a tree as organisation is accomplished by repeated application of a particular shape. *What is this shape?*

Or consider the nautilus shell as a pattern of organisation as illustrated above. What governs the production of this pattern of organisation? Hint: *it has something to do with a key proportion relevant to Leonardo's Vitruvian man.*
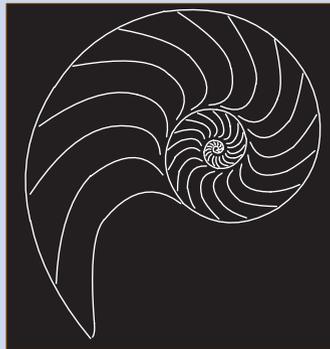
For example, the English used in Shakespearean plays is recognisably the same language as that spoken today, but many of the words Shakespeare used have fallen out of favour today, and many other words have different meanings in the modern context. Many English words now in common use were also actually invented by Shakespeare himself. Believe it or not, the word *manager* first appears in his play *A Midsummer Night's Dream*. Hence, the acts of communication enacted in his plays actually changed the nature of the English language (Exercise 4.2)!

5   Patterns of Organising

Inherently we are going to use a model of organisation based upon the ideas of both emergence and structuration. Our model of organisation sees it as a set of significant patterns that entangle or couple to produce and reproduce ways of organising.

People (or more generally actors) use such significant patterns to help construct three forms of action: articulation, communication and coordination. Re-enacting these types of action, in this manner, recreates significant patterns which observers recognise as constituting organisation.

So, organisation consists of actors enacting acts and drawing upon significant patterns (frequently bundled up, as we shall see, as roles) to construct such action. Take the example of routine action within organisations. This is repetitive instrumental activity performed by one or more actors—that is, activity directed at the achievement of goals. In such terms, there are two sides to routines: (A) their use as a *resource* by actors (B) to help guide individual *performance*. Part of the difficulty of joining any new organisation is in understanding and learning new and expected ways of doing things—conventions of action. These are what we call activity patterns (Exercise 4.3).

Exercise 4.3

Here are some examples of patterns of action to be found within business:

- Producing a good
- Taking a customer order
- Providing after-sales service for a customer
- Delivering goods to the customer
- Taking customer payments

Identify a significant pattern of activity within some business organisation known to you. How do you know it is a pattern? What are the component elements of the pattern? How do the elements inter-relate? What might cause breakdowns in such patterns?

The patterned order of organisation emerges from actors undertaking three forms of action:

- They make or articulate data structures.
- They use such data structures to communicate with other actors and in doing so accomplish information.
- On the basis of such communication they perform coordinated, instrumental activity.

Take the Sumer case we considered briefly in a previous chapter. Human actors in association probably with animal actors performed coordinated, instrumental activity in areas such as agriculture within the first cities. To manage the production and storage of foodstuffs produced by such agriculture numerous different actors needed to communicate. At some time in the development of the early city-states, which was itself based upon this agrarian revolution, actors decided to make records of communication and performance. For this purpose, they invented the clay token. They formed such artefacts by shaping and incising small pieces of clay and then proceeded to bake them to make their qualities persistent. Such clay tokens were then used by human actors to communicate both the type and the amount of goods transacted between them.

But we should not forget that action in the modern organisation is no longer a solely human achievement. Much action within contemporary organisation is not enacted by humans but by machines, particularly by ICT systems. So, machines, or technology systems more generally, are significant actors within any notion of organisation. But we should perhaps broaden this out further and refer to any data technology as acting within the re-production of organisation. It makes sense, as we shall see later, to see organisational records, or in fact any form of representation, as having agency—the ability to act in limited circumstances (Cooren 2004).

To make this point consider another example—similar in nature to that of the metro map considered previously (Chap. 2). Imagine a visual sign placed in the reception area of an organisation building—as illustrated in Fig. 4.3. This sign acts in the sense of directing people to do certain things such as swiping their entry pass at the entry gate or visiting reception to authorise their entry. The sign also supports the work of security personnel responsible for controlling organisational entry. It allows them to instruct people without re-iterating the same thing time and again in acts of verbal communication.

Or take the simple artefact of a railway ticket. How does it make sense to think of a railway ticket 'acting'? Well, most mainline railway stations in the the UK and

Fig. 4.3 A sign displaying agency

Please swipe your entry pass for admission.

the European Union use some form of automatic ticket barrier. To gain access to trains arriving or departing from such stations you have to enter a valid ticket into the barrier or scan it upon some reader. The barrier 'reads' the ticket and opens its gates if it deems the ticket 'valid'. The ticket is clearly inter-acting with the automatic barrier here to make a difference: to allow entry to trains. The same function can of course be fulfilled by a human actor inspecting tickets at the entrance to the station.

6   Roles and Action

We tend to bundle actors and the acts they undertake into organisational *roles*. By doing so we are inherently making the analogy between organisational life and drama. There is a perspective in Sociology which is referred to as the dramaturgical perspective. This perspective adopts the stance familiar in this quote from the play *As You Like It* by William Shakespeare: '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 therefore a package of expectations as to the actions appropriate in particular settings. My role as lecturer is subtly different from my role as consultant and very different from my role as husband or father or grandfather. Roles are resources for actors. Much like organisational routines they help guide decisions about what action to take—what to do, how to communicate and what to record. Therefore, we make the argument that a role is a convenient device to define as a 'package' of articulation, communication and coordinate acts as illustrated in Fig. 4.4. Such packages are 'assigned' to particular actors acting in particular settings and as such are a crucial element of what is meant by the structure of organisation.

Within business settings many expectations will be formalised in representations such as job specifications. However, many expectations will be semi-formal or

Fig. 4.4 Roles and action
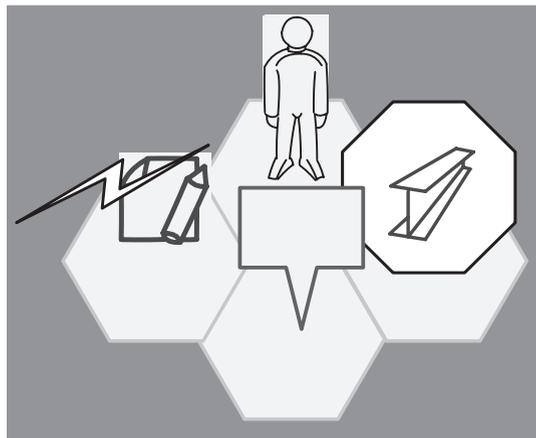
informal: no-one has written down what is expected; people learn how to 'perform' a particular role over time in interaction with other business actors. Roles, as we shall see, form a critical part of the business models we shall build (Exercise 4.4).

> **Exercise 4.4**
> Can you think of some examples of actions that ICT systems now take independently and relatively autonomously—actions which used to be undertaken by humans? What roles do they fulfil as actors within organisations? Come up with one specific example from an organisation known to you.

7   Domains of Organisation

As we mentioned in Chap. 2, a domain of organisation is best made sense of as a system. We use the term *system* as a convenient sign to refer to some patterning or ordering of things. We are particularly interested in the ways in which both humans and machines as actors enact patterned action. This encapsulates the idea of sociotechnical organisation—the idea that what we mean by organisation is a complex mix of 'soft', human systems and 'hard' technology systems.

Recently, management theorists have stressed the importance of the speed with which adaptation is important to organisational survival. They have stressed that *business agility* is needed in the modern business environment to sense change and respond to such change rapidly. This notion of the agile organisation, sometimes called the agile enterprise, is very much a view of the organisation as a complex, adaptive system.

Within this book we show how considering organisation as a complex, adaptive system allows us to relate together many of the issues critical to modern management—including strategy, control, performance and change. A system's view of organisation is also important because it suggests practical ways of analysing the dynamics of existing domains of organisation, and of designing new ways of organising. So, we consider throughout the book approaches for modelling aspects of organisations within activities of analysis and design.

To summarise, by the term *domain of organisation* or organisational domain we mean some coherent collection of patterns of action. Such a domain may comprise patterns of action that currently exist; in which case, we refer to it as *as-is* organisation. We may also be interested in defining a collection of patterns of action that some persons would like to exist. We refer to this envisaged state as *as-if* organisation. We can even think or organisation as a plan for change—as *to-be* organisation.

8   Elements of a Pattern of Organisation

So, we think of organisation as recurring patterns of action undertaken by actors through time (sequence) and space (location). Let us consider the component elements of such patterns in more detail.

Actors

Within modern-day examples of organisation instrumental activity is rarely accomplished by humans alone. Work is conducted by humans in inter-action with 'machines' or entirely by 'machines', such as vans, cranes and even ICT systems. Most office work is now clearly performed by humans working in inter-action with ICT systems. But much action is performed independently and autonomously by ICT systems, such as in the case of automated security trading. It therefore makes sense to include such machine actors within our accounts of ways of organising.

But we also believe that it important to think of data structures as key actors within domains of organisation. So, how can a student record or record of patient admissions be said to act? Data structures act because they prescribe or proscribe things and prescription and proscription are both related to action. Having a student record serves to designate you as a student of a further or higher education institution. As such, 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.

Action

There are three distinct but inter-related types of action important to any patterns of organising: articulation, communication and coordination. Consider medical emergency response as a system of organisation. This system consists of three inter-related 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 at expressing what they mean through speech or in writing. We shall see in Chap. 13 that both the spoken and the 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 ambulance service actors create many data structures to identify and describe things important to them. A calls data structure identifies and describes phone and mobile calls received, an incidents data structure identifies and describes ongoing emergency incidents; a resources data structure identifies and describes ambulances and their crews.

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 ambulance service case, data structures inform actors not only what has happened (such as emergency incidents that have closed) or is happening (such as ongoing emergency incidents) but also what should happen (such as a resource plan detailing the positioning of ambulance resources).

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 ambulance service case, communication enables different actors to take joint action (such as handling emergency calls, dispatching ambulances, treating patients and transporting patients to hospital) in achieving the goal of providing emergency healthcare.

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 the mandala with which we began this chapter. It is important to 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.

Sequence and Location

Action is undertaken within some spatial and temporal (time-related) order. Action always takes place at a certain time and at a certain place. In Fig. 4.5 we have added symbols to indicate locations A, B, … and times 1, 2, ….

Actions occur as events which take place before and after other events. In Fig. 4.5 a pattern of events is illustrated with which you should be familiar. Actions such as a student receiving a coursework brief, completing a coursework and submitting a coursework must always appear in this sequence. You cannot submit a coursework until you have completed it and you cannot complete a coursework until you know what it is about. The dotted arrows in the figure indicated the sequence of action. Likewise, events always happen somewhere—a student will submit a coursework at some place (perhaps in the student's residence), a lecturer will mark a coursework 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). Note, we have also indicated that this sequence often turns into a cycle. Once the student has completed one coursework and had it marked, then another cycle of assessment is due.
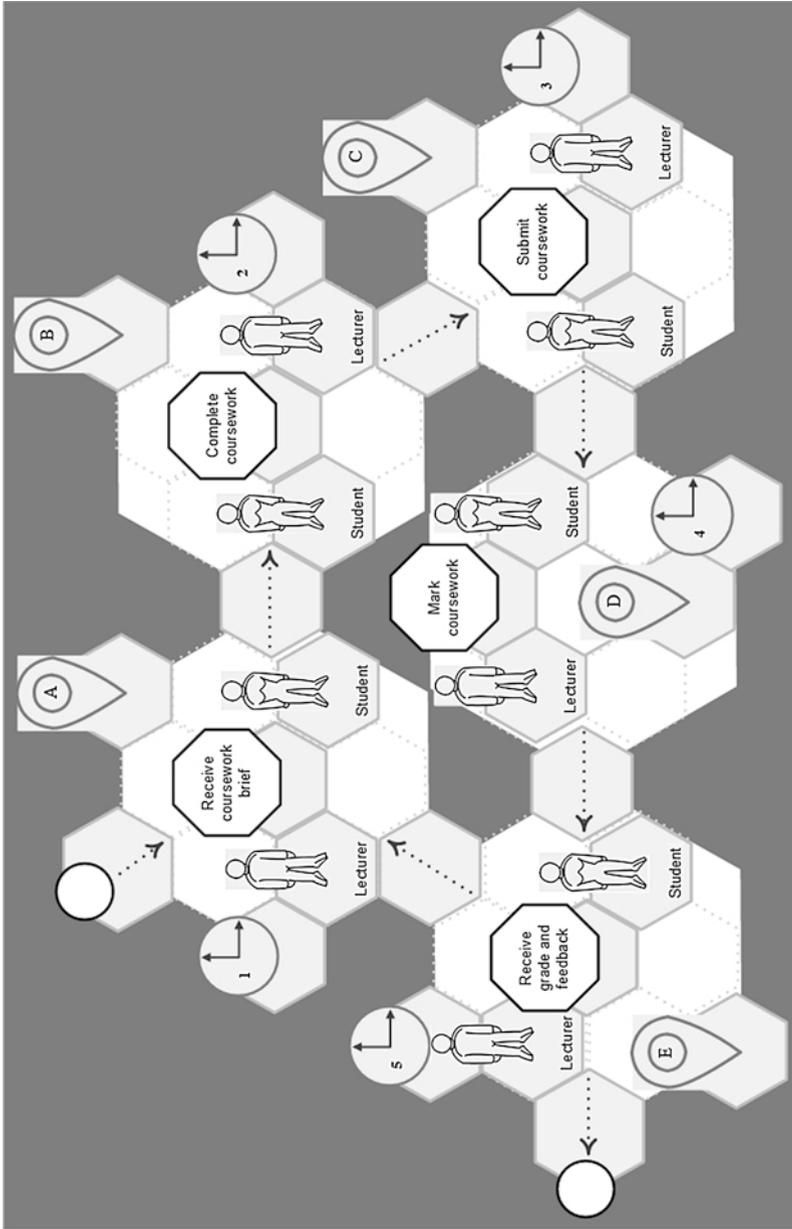
Fig. 4.5 A pattern of action

9   Socio-technical Organisation

Within most business analysis literature, the idea of organisation is portrayed in rather simplistic terms, often as an aggregation of people, processes and ICT (Paul and Cadle 2020). Implicitly in defining organisation in terms of patterns of action taken by both human and technical actors we are proposing that modern organisations are best seen as socio-technical systems. The term socio-technical system was coined by Eric Trist, Ken Bamforth and Fred Emery while working for the Tavistock Institute in London. They developed the idea particularly in their study of British coal mining as a problem situation after the Second World War. At that time coal was a critical source of energy for the country but the industry itself was experiencing problems. Despite investment in new production technology productivity was in decline. Also, the workplace was subject to high rates of absenteeism and high rates of staff turnover were evident throughout the industry.

Trist, Bamforth and Emery investigated a number of ways of working at different mines and concluded that the way of organising work adopted by convention at most mines did not take advantage of the opportunities afforded by developments in technology (Trist and Bamforth 1951). Most mines organised work in large teams where each worker was allotted a specific task to perform. This was a type of work organisation inherited from the so-called long-wall method of production dictated by the technology of the day. In such settings worker motivation and satisfaction was extremely low. This they contrasted with a type of organisation experienced in an innovative mine in South Yorkshire that had taken advantage of improvements in roof control to re-introduce a so-called short-wall method of working. Miners here worked in relatively autonomous groups, inter-changed amongst roles and shifts and regulated their affairs with the minimum of supervision. In this mine worker motivation was high, staff turnover was low and productivity was significantly above the norm.

The key conclusion they drew from this was that the integrated design of the social or work system with the technical or technology system is critical to achieving performance. As we shall see, this idea of socio-technical organisation permeates modern business analysis and design—particularly the notion that work systems need to be designed with the proper positioning of information technology in mind. Hence, the notion of socio-technical organisation is central to digital innovation.

10   Returning to the Design Game

Remember the design game we set in Chap. 1 and considered again in Chap. 3. This game actually demonstrates how signs cross three levels or layers of action that serve to constitute organisation. Signs have to be 'formed' from a number of substances given to you as resources—the coloured, magnetic tokens, the whiteboard and the coloured pens. These substances are used to make differences. Two differences can be made with the coloured tokens in relation to the whiteboard—we can select the colour

of the token and position the token somewhere on the whiteboard. These differences in communication are used to communicate differences in meaning. In particular, these differences can be used to communicate different types of intent—to assert that some material is located at some place or to direct actors to move material to some place. Differences in communication are used to initiate differences in coordinated action. Workers read the differences in intent signalled by the state of the whiteboard and this causes them to decide on undertaking particular types of coordinated action. They enable people to locate material and to re-locate material. This is illustrated in Fig. 4.6.

In the way we have described it the design game is an example of a socio-technical system, consisting of both humans (social) and the whiteboard (technical) taking action. Therefore, it might surprise you to know that the design of the whiteboard in this design game has many elements in common with the design of ICT systems for a multitude of ways of organising. Articulating a magnetic token is no different in its essentials from articulating (creating) an electronic record in an ICT system. The electronic record consists of signs which are used to communicate something to particular actors. Such communication is important to coordinating ways of doing things amongst multiple actors in work.

11   Advantages of This Way of Thinking

As we shall show in later chapters any digital innovation involves considering change to patterns of articulation, communication and coordination. Therefore, 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 Chaps. 15 and 16).

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. Thinking of organisation in systems terms also offers managers practical ways of engaging with or intervening in organisations for which they are responsible. This is not only so they can ensure operational effectiveness, but also to understand environmental uncertainty, plan strategy and manage change.

12   Introducing the Tabletop Prototyping Toolkit

We need a concrete way of engaging with the analysis and design of patterns of socio-technical organisation. For this purpose, we have created a toolkit of tangible components that can be used to prototype such patterns upon the tabletop. It is deliberately physical, in the sense of enabling prototypes to be built quickly upon the tabletop, to encourage failure, to reduce visualisation anxiety and to encourage reuse.
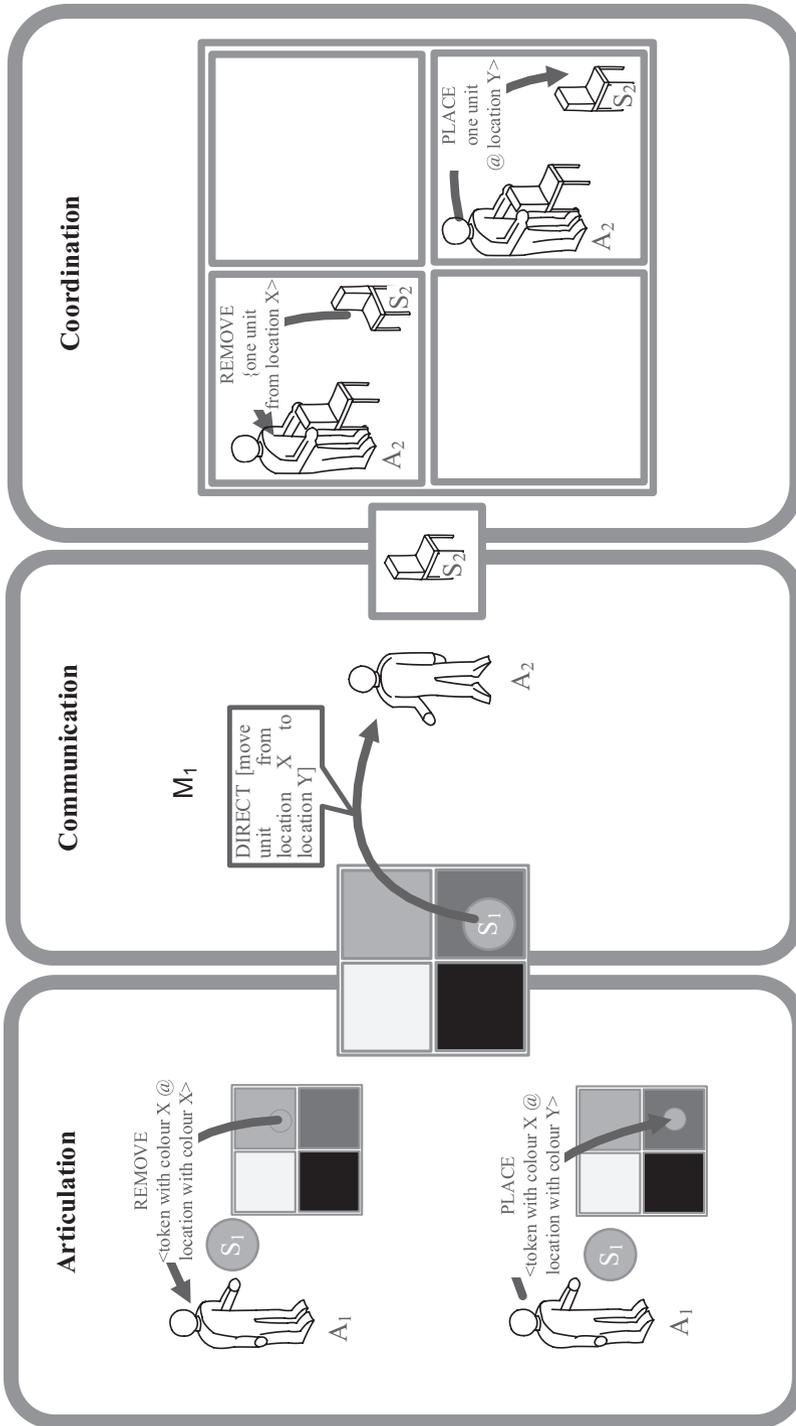
Fig. 4.6 The design game as a way of organising

Throwaway Design

The kit is assembled from a small number of elements which are relatively easy to learn but which emulate many contemporary design practices in deliberately utilising low rather than high technology. The design elements within the kit make it easy to move things around and re-position elements without the need to re-write or re-draw the elements each time. Since the kit is low-technology, users of the kit are encouraged to throwaway and change designs frequently. In other words, the kit is meant to encourage the principle promoted in much design practice of *failing early and often*. There's evidence to suggest that design is an embodied experience meaning that we 'think' through our whole body rather than just our brain when engaging with problem situations. Hence, the key reason we use the table-top as our design space is that we deliberately encourage workshop participants to act as a group, to stand during design work and use their hands as well as their brains to enact design work, with and through tangible artefacts.

Visualisation Anxiety

Much design practice focuses upon visualisation, but many people experience visualisation anxiety (the belief that they cannot draw). The kit is designed to enable its users to produce a visualisation of some design artefact without the need to do much drawing. Although workshop participants are given guidance in using the kit to perform certain design techniques the kit itself is deliberately open-ended. Workshop participants are advised to select what they need from the basic kit and are asked to supplement this with whatever they think is needed to make sense of some problem situation in terms of design. When running our design workshops an individual tabletop prototyping kit is given to each design group and each such group is encouraged to reuse aspects of their prototyping within distinct episodes of exploration and experimentation. This helps provide structure to what we referred to in Chap. 1 as a *practicum*.

Reuse

Our early attempts at creating such a toolkit involved providing design workshop participants with a series of printed paper sheets from which they could cut out key elements to form their prototype. However, it soon became evident that people took too long assembling the elements of the kit before embarking upon actual design work. This served to get in the way of design thinking. Hence, we now provide design workshop participants with a reusable kit of components as illustrated in Fig. 4.7. This consists of a ferrous mat, a series of hexagon landscape cells, component magnetic bases and various laminated icons that can be attached to magnetic holders fixed to bases.

	Landscape cell		Boundary connectors
	Actor		Data structure
	Action		Communication
	IT system		Decision
	Transitions		Issue
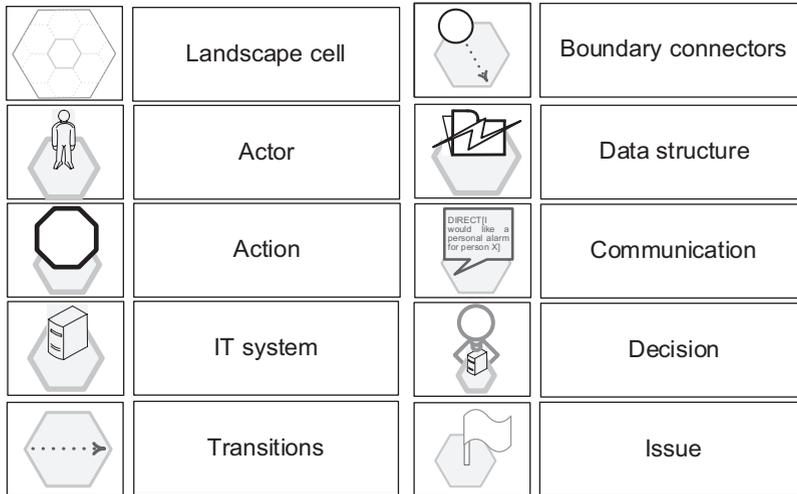
Fig. 4.7 Elements of the table-top prototyping kit

The kit is designed to fit upon two seminar tables pushed together. Laying down a mat upon such seminar tables is meant to form a design landscape for each design group. A series of hexagonal, magnetised bases are then laid down upon the mat to define the extent of the design landscape. The cells are deliberately hexagonal to allow tessellation, that is, completely cover the two-dimensional space of the landscape. Each hexagon is normally considered a cell within the design landscape.

Various icons can then be mounted in holders and placed somewhere within the cells of the design landscape. The holders each have magnetic hexagonal bases which allow them to both be easily positioned upon a particular cell and to hold their position when placed upon the design landscape. An icon is a type of sign in which the symbol bears a similarity with that which it refers to. Icons placed in such holders are deliberately open-ended, but a basic set is supplied as laminated card for students to quickly use to assemble a design prototype. This core set of icons includes mannequins, used to represent individuals or roles, and various other icons that represent technology actors such as ICT systems and websites, dotted arrows, start and stop connectors, and decision points.

Start and stop connectors are used to signify the boundaries of the design pattern under consideration. Actors are represented by mannequins for human actors; or appropriate icons for technology actors such as Websites. The three types of action appropriate to various ways of organising (described in previous sections) are indicated upon a table-top prototype in different forms. Coordinated joint activity as well as articulation of data structures is indicated with a standing, inscribed hexagon. In contrast, instrumental communication is indicated with a labelled speech bubble. Cells of action are joined by dotted arrows to indicate the sequencing of action. Decision points are represented with a standing diamond. Alternative routes (swim-lanes) of action then arise from any one decision point. Figure 4.8 shows how these components can be laid out upon a tabletop [Note].
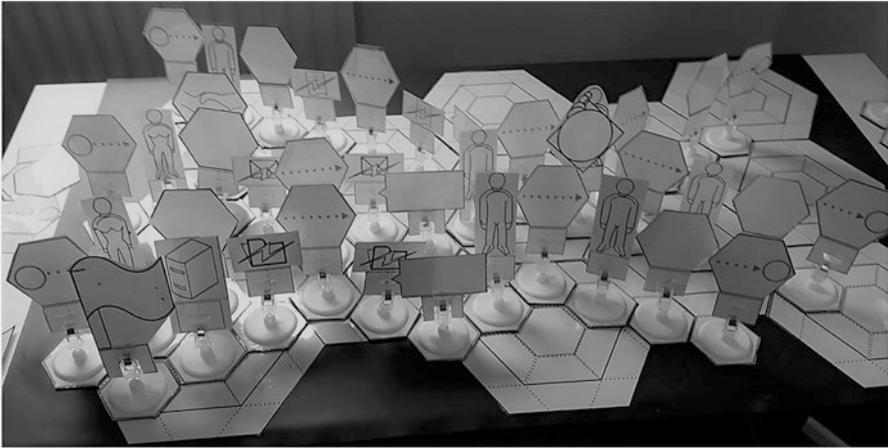
Fig. 4.8 Prototyping components laid out on a tabletop

> **Note** The tabletop prototyping kit is available as a PDF which can be down-loaded from the Palgrave website. This consists of the series of icons described in this chapter which can be printed, cut out and mounted upon a tabletop. If you are interested, please contact the author for details of how to get hold of the more robust and reusable kit mentioned.

13   Conclusion

The focus of business analysis and design is upon organisation or some part of organisation which we refer to as a business domain or more generally as a domain of organisation. There are two viewpoints on human organisation. One views organisation as an institution or a structure. The other perspective views it as a continuing process of human action. These two perspectives on organisation can be brought together through the idea of structuration. On the one hand, the structure of social institutions such as organisations is created by human action. Through human inter-action, social structures are reproduced but may also change. On the other hand, humans utilise institutional structure as a resource in interpreting their own and other people's action. This means that institutions act as a constraint on human action.

This idea has similarity with the idea of organisation evident in literature on complex, adaptive systems. For instance, the inventor of the term cybernetics, Norbert Wiener, was convinced that organisation is what all organisms demonstrate. In relation to the notion of a human being as a type of organisation he stated: 'we are not stuff that abides, but patterns that perpetuate themselves.' By this he meant that the biological structure of a human being is not permanent; cells die but are replaced on a continuous basis. The notion of a human emerges from such cellular reproduction.

We utilise a model of organisation based upon both the idea of structuration and that of a complex, adaptive system. Our 'model' of organisation sees it as a set of significant patterns that entangle to produce and reproduce organisation. People (or more generally actors) use such significant patterns to help construct three forms of action: which we call formative, informative and performative action. Re-enacting these types of action in this manner recreates significant patterns which observers recognise as making up organisation.

Consider the analogy of organisation as a fabric. Fabric is woven from warp and weft: horizontal and vertical threads. So how do we weave the fabric of organisation? The conventional fabric of organisation is portrayed as a two-dimensional fabric—the warp consisting of processes and the weft consisting of information and communication technology. But we propose that organisation is best portrayed as a three-dimensional fabric—perhaps best referred to as tapestry rather than fabric. Organisation is constituted in the entanglement of coordination and articulation but only through the mediating threads of communication.

14   Theory

For much of its history, the study of human organisation—otherwise known as Organisation Theory—has tended to portray the institutional and action perspectives on organisations as mutually exclusive (Morgan 1986). Structuration theory was created by the sociologist Anthony Giddens (Giddens 1984) as an attempt to reconcile the action and institutional perspectives. The question of what constitutes organisation is considered in Chap. 12 of my book *Significance*.

Interestingly in his book *The Constitution of Society* Giddens writes that 'action depends upon the capability of the individual to "make a difference"'. This means that an actor is defined in terms of his or her capability to make a difference. We would of course not restrict the notion of an actor to humans. Machines and ICT systems make a considerable difference to modern organisation. Data structures such as records also have a part to play in making difference.

15   Practice

Business analysis tends to ultimately think in terms of organisations as systems. This viewpoint on organisation is also discussed in my other book Business information systems (Beynon-Davies 2020). Often the term enterprise is used as a synonym for the term business or organisation and specific techniques are applied to enterprise analysis including: SWOT (strengths, weaknesses, opportunities and threats) analysis, benchmarking, identifying business goals, stakeholder analysis, assessing capability gaps and defining business cases. We shall cover some of these techniques, but in an innovative way, within further chapters.

There is a burgeoning literature on organisation analysis and organisation design. So how does the account of business analysis and business design provided in this

book fit with such literature? Much of organisation analysis and organisation design takes its impetus from the academic disciplines of organisation theory and organisational behaviour. In contrast, business analysis and design, as portrayed here, takes its impetus from systems thinking, semiotics and design thinking. However, there are some areas of overlap, particularly in areas such as business modelling, business motivation and change management, which we examine in Chaps. 16 and 17.

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Projects of Design

5

1   Introduction

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 and design work is normally organised as projects. Within the current chapter we consider a project as any concerted and systematic effort undertaken by a group of actors to achieve a set of clear objectives. All projects consist of teams of people engaged in the achievement of explicit objectives, usually within a set timescale.

A business analysis project can be considered as an activity system. A team of business actors is normally appointed to undertake such projects. These actors not only communicate amongst themselves they also communicate with other actors in the process of business investigation. Hence, any project work relies upon an associated information system. Also, in undertaking business analysis work project members document results as models—this comprises the data system for the business analysis project. So, a project is a way of organising work.

In this chapter, we primarily consider business analysis and design primarily as a system of activity. Further chapters are devoted to considering this as an information system and as a data system. The current chapter considers first several key activities making up the typical pattern of business analysis work. It ends with a consideration of the difference between a method for doing business analysis/design and a tool or a technique for doing business analysis and design.

2   Projects and Problems

Business analysis and design work is normally organised in terms of 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 objectives, usually with a set timescale. As such a business analysis project can be

considered an activity system. To achieve the goal established a system of activities must be performed usually within a set time. Projects tend to have a timescale in the sense that once the problem is resolved, the project and its team are dissolved. A team of business actors is normally appointed to undertake such projects. To coordinate their activities these actors not only communicate amongst themselves but also communicate with other actors in the process of business investigation. Hence, any project work relies upon an associated information system. Also, in undertaking business analysis work project members document results as models—this comprises the data system for the business analysis project (Exercise 5.1).

> **Exercise 5.1**
> Not all activity systems are best organised as projects. Come up with three areas of work known to you which are not organised as projects.

3   Life Cycle of a Typical Business Analysis Project

Since a project is effectively an activity system, the conventional way of planning a project is to segment it into several 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. This follows the idea of system hierarchy described in Chap. 4.

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 Fig. 5.1.

Conception involves setting the problem to be considered and establishing a team to solve the defined problem. We consider the issue of problem setting in Chap. 7. This activity also bears a relationship with the idea of expressing business motivation which we will cover in Chap. 18. The next section considers the other major part of business conception: how to establish a team for a business analysis project.

Analysis involves investigating the domain and usually specifying how existing patterns of action work. For example, in the case of a project which considered inventory checking at a large manufacturing plant, analysis involved interviewing key stakeholders and observing actual inventory checks conducted at different production units within the manufacturing plant. This enabled the business analyst, along with other members of the team, to document the current model for this domain in some detail as a series of diagrams. Various approaches to investigating business domains are considered in Chap. 6. Techniques for building models of existing domains are discussed in further chapters.

But analysis also involves identifying why we need to change things. Another way of expressing this is defining the motivation for change. This is the topic of Chap. 18.
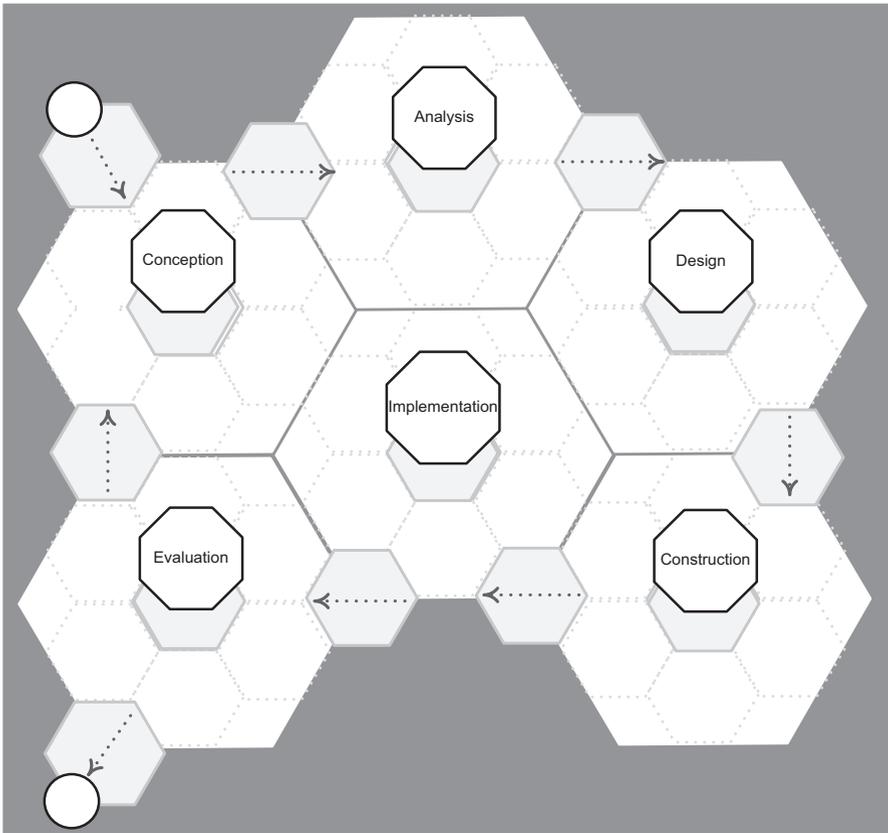
Fig. 5.1   Business analysis as an activity system

As we have mentioned previously, the socio-technical systems with which busi-ness analysis deals are subject to a characteristic known as equifinality. This means that any such system can achieve its goals or purpose in a number of different ways. In other words, there are likely to be several different ways of designing a new busi-ness model to meet defined objectives, such as resolving problems identified with the current domain. Therefore, design involves conceiving of new patterns of socio-technical action and specifying these as models. It also involves selecting amongst alternative patterns of action—a technique sometimes known as options identifica-tion. The techniques used for documenting existing aspects of a business model are equally applicable to expressing the designs for new business models. These tech-niques are described in Chaps. 8, 9, 10, 11, 12, 13, 14, and 15.

Construction involves creating new systems of socio-technical action. It involves both building technical systems such as ICT systems and specifying new roles and procedures for actors to work. This is not a book about the construction of ICT

systems. An introduction to this topic is provided in my book *Business Information Systems*. We consider the issue of stakeholder/role analysis in Chap. 9.

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 the topic of Chap. 16.

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 Chap. 18, 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 Fig. 5.1. 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.

4   Establishing a Business Analysis Team

Business analysis can be conducted as a solitary activity but is always best conducted as teamwork. This is because the best results are typically achieved in projects in which problems are set and solved as acts of co-creation between the business analyst and with stakeholders from the domain in question. Such teamwork builds upon the differing strengths of team members. The business analyst brings subject expertise to the business analyst project—knowledge of business analysis as an approach to organisational sense-making. Representatives of stakeholder groups bring domain expertise—knowledge of how things currently work in some organisational domain as well as problems and issues relating to this domain.

As a first step, it is therefore important to identify stakeholder groups that are likely to influence the success of the business analysis project. Doing some prior work in defining the problem to be considered and the stakeholders that need to help define the problem is critical. One useful idea is to categorise stakeholders in terms of both their interest in a business analysis and design project and their power to influence a successful outcome. Those stakeholders that have high interest and power need constant engagement with. Those with high power but low interest can be kept informed of developments.

The next step is to select representatives from such stakeholder groups to become part of a business analysis team that will be given responsibility for completing the project. Such representatives might be involved in the project in some way or they might participate in critical aspects of the project. The major difference between stakeholder involvement and stakeholder participation relates to the question of decision-making power already raised. In stakeholder involvement representatives of stakeholder groups are typically consulted about the shape of the current business model or the design for a new business model but the final decision on the shape of such models is left in the hands of the business analyst/designer, normally working

to the goals set by some business client. In stakeholder participation, power is placed in the hands of the stakeholders themselves to make decisions about the direction analysis should take as well as the design of a new business model.

Stakeholder representatives that become involved in or participate in a business analysis project can be selected in several different ways. Representatives might be selected by management or by stakeholders themselves. In both cases, representatives would normally be expected to communicate results back from the business analysis project to the wider stakeholder population. This, as we shall see, is a critical part of change management.

Ideally, the business analyst should have some input into the selection of stakeholder representatives. This is because there are a number of desirable properties that stakeholder representatives should have in any good business analysis project. First, representatives should have the requisite power or authority invested in them by their organisations to make design decisions independently. In other words, stakeholder participation is always preferable to stakeholder involvement. Second, representatives should be knowledgeable about the domain under consideration. Third, representatives should have the vision to be able to see beyond the current situation and be able to envision improvements to such work. Fourth, representatives should be able to take ownership of the problem situation and have enthusiasm for making change. Fifth, representatives should be committed to participating in a business analysis exercise. Finally, representatives should be available for the degree of involvement or participation required of them by the project. Sixth, it is good, particularly within the divergent phase of a design project in which problems are set to have as diverse a mix of people as possible in terms of attributes such as age, gender, socio-economic status, ethnicity and place of birth. It has been shown (Syed 2019) that participants, who each bring different perspectives to the design work, is more likely to come up with innovative ideas about the sources of problems as well as their solutions.

Another way of thinking about the mix of stakeholder representation is in terms of developing a RACI matrix for the domain under consideration—sometimes referred to as a responsibility assignment matrix. Such a matrix is used particularly to think about the ways in which stakeholders need to participate or be involved in some business analysis project. This is particularly useful when the domain under consideration crosses existing functional or departmental boundaries (Exercise 5.2).

Exercise 5.2
Investigate the link between stakeholder involvement and participation and the idea of co-creation in design.

Stakeholders are thought of as having one of four different types of responsibility in relation to the action evident in some domain. A stakeholder is responsible (R) for the performance of some activity if the stakeholder must engage in work to complete the activity. A stakeholder is accountable (A) if it is ultimately answerable for the correct and thorough completion of the specified activity. This type of stakeholder is therefore normally expected to sign off the activity before it becomes

effective. A stakeholder is consulted (C) if it is necessary to seek its opinion on the exercise of some activity. In other words, two-way communication needs to occur with people fulfilling this type of role. Finally, a role is informed (I) if he or she needs to be kept informed of the progress or performance of some activity. In other words, one-way communication needs to occur with this role.

If the business analyst must rely upon clients or management choosing representatives, then representatives may lack many of the desirable properties expressed above for the ideal type of stakeholder to participate or be involved in a project. Frequently managers will assign those they can most spare from day-to-day operations. They will rarely assign themselves to the team. Such persons are typically the least knowledgeable and are likely to be the least committed to getting the work done. Generally speaking, the business analyst will want the opposite. This is summed up in the adage: 'If you can't afford to lose the person for three days, then that's the person I want for my business analysis project.'

The form of involvement or participation by stakeholders can vary between an intensive mode and a phased mode. In intensive mode representatives of stakeholders will be assigned on a continuous basis for the entire duration of the project. They will form a permanent part of the business analysis project. In phased participation stakeholders are invited to join a project effort at regular intervals, usually in collaboration meetings.

5   Planning a Business Analysis Project

There are a number of different ways of planning and managing a business analysis project. The first decision is whether to plan and execute the project in a linear or iterative manner—this is the issue of sequencing project activities. The second decision is whether to produce a new business model in an intensive or phased way—this is the issue of team assignment.

In a linear project the phases discussed in the previous section are strung out in a linear sequence with outputs from each phase triggering the start of the next phase. The project is completed with the implementation and possible evaluation of a new business model for the domain in question. The linear approach is particularly appropriate to a large business analysis project because the clear linear sequence makes for easier project planning and control. The major disadvantage of conducting business analysis in a linear manner is that it becomes difficult to change decisions at later stages into a project.

In an iterative project the activity of conception triggers an iterative cycle in which various versions or components of a business model are analysed, designed, constructed and possibly implemented. Such versions or components are sometimes referred to as prototypes. An iterative approach is particularly suitable for small- to medium-scale business analysis projects and seems to reduce the risk associated with business innovation. However, because it is frequently uncertain in an iterative approach how much resource will needed to be devoted to the project, iterative approaches generally appear to suffer from more difficult project planning and management.

In an intensive project the business analysis team are closeted away for a defined period and are expected to produce a working business model at the end of that time. In contrast, within a phased project work on a business model is managed in terms of a series of defined timeboxes or cashboxes. A timebox or cashbox can be thought of as a set of 'products' that must fit in a finite container. The walls of the container are defined in one of two ways: amount of time; amount of resources ('cash'). Timeboxing is generally more popular than cashboxing for defining project phases.

Timeboxing means setting a fixed deadline by which a set of business objectives must be met, rather than specifying when a task must be completed. The rationale for timeboxing is two-fold. First, that timeboxes enable the customer to see concrete examples of progress being made on a regular basis with the delivery of products. Second, that frequent small deliveries are preferable to one large delivery. Timeboxes are usually between 60 and 90 days' duration. If, as the deadline of the timebox approaches it proves impossible to deliver against the planned business objectives, the timebox is never extended. Instead, the scope of the timebox is reduced—business objectives are removed from the plan for the timebox.

6   Defining Project Scope

Our discussion in the previous section suggests the importance of specifying in as clear a way as possible the intended scope of the business analysis project, either at the outset or at least at the start of some timebox. Scope can be expressed in a number of ways.

One way is to define the boundaries of the system to be considered—in other words the analysis team need to know what to consider as part of the system and what to consider as the surrounding environment of the system. The boundary between the 'system' and its environment then sets the initial scope for the project. For example, in the case of the project mentioned earlier, the project was briefed to consider purely the activity system of perpetual inventory checking. It excluded from consideration all other activities performed by this organisation such as the movement of stock through the plant or the operations of production.

Another way is to express scope as a series of products or requirements. The International institute of Business Analysis (IIBA) define a requirement as 'a condition or capability needed by a stakeholder to solve a problem or achieve an objective'. In terms of business analysis, a requirement is a desired feature of some business model.

If your purpose is merely to analyse some existing problem situation, perhaps by developing an as-is model of some activity, then you do not need to worry about requirements. This is because requirements are desired features of some future situation and hence typically come into consideration when the objective is to design some future state of socio-technical organisation.

Within ICT work the notion of a requirement is typically portrayed as unproblematic in the sense that requirements are out there waiting to be captured, particularly through structured conversations with key stakeholders, as in the case of interviews (see Chap. 6). The conventional view is that requirements are objective; they will be the same for each actor or stakeholder you talk to.

In practice, of course, this view of requirements is untenable—particularly when the analyst moves from 'hard', technical systems to 'soft', social systems. In terms of socio-technical systems, requirements will vary depending on who you talk to. This is typically because requirements are relative to a stakeholder's perspective or worldview on the situation considered (Vickers 1965). Frequently, the analyst will find that requirements as expressed by representatives of different stakeholder groups will be in conflict. The task then becomes one of attempting to reach some level of inter-subjective agreement amongst stakeholder groups about requirements.

A distinction is also normally made between so-called functional and non-functional requirements. Functional requirements are expected features of some system. Non-functional requirements are constraints set on the project. The set of functional and non-functional requirements establish the scope of the business model to be tackled.

But scoping is not an activity reserved to the initiation stage of a project. The business analyst and the analysis team will continuously need to manage scope. As business analysis progresses the team may find that to adequately address a particular problem, they need to re-scope the domain under consideration. But in doing this the team should always beware of *scope creep*—the tendency for a problem to grow beyond the resources assigned to its solution. Another term for this is project escalation, which we consider in more detail in Chap. 18.

As we have seen, one way of dynamically managing scope is to think of them as products in a 'container'. Each such product is then defined to be one of four possible types—must haves, should haves, could haves and won't haves. Must haves are products that satisfy the critical success factors for the project. Should haves are products that will directly benefit the business in a cost-effective way. Could haves are products that will not directly benefit the organisation but would be nice to have. Finally, won't haves are products that the organisation would like to have, but probably will not have. These are products where it is not known if they will be of any use to the organisation. These four types of product are frequently phrased in terms of the mnemonic MoSCoW—must have, should have, could have, won't have.

As part of the process of defining the scope of a cashbox or timebox the products need to be ordered in terms of criticality or desirability. It is useful to visualise each type of product as a liquid of different density. Must-have products are the 'densest' type of product and hence can be regarded as sinking to the bottom of the container. Should haves are the next densest and so on. At the top of the container we have the least dense 'liquid'—the would-like-to haves or the could haves. As the timebox/cashbox progresses, other requirements may be identified or some of the products may take longer to develop. Thus, the would-like-to haves and the could haves need to get displaced by the more critical must haves and should haves.

7   The Control of Project Work

Project control is a type of evaluation known as formative evaluation (see Chap. 18). 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. This contains data 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 weekly timesheets, which indicate the tasks performed by development staff and their duration. They are also useful in highlighting time spent on unplanned work. 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.

In product-based project management, project control is normally exercised through daily wash-up sessions and periodic user review sessions. User review sessions are scheduled events at the end of each timebox at which versions of a developing design are demonstrated to representatives of the user community. This might lead to the parameters of the design being renegotiated for the next timebox.

Product-based project management tends to make great use of visual management, an approach to the management of operations applied in diverse settings such as manufacturing and healthcare. In recent times visual management has been much used in software development circles. Visual management is normally implemented in terms of ideas of the visual workplace and notably through systems of 'visual' devices (Galsworth 2005). The visual workplace employs the idea of using certain artefacts situated within work settings to communicate with 'doers'—the actual people performing work within these settings. One of the most popular of visual devices is the kanban board in which various physical cards are placed upon various parts of a physical whiteboard to indicate the flow of project work.

Figure 5.2 illustrates a task board used in the agile software development method Scrumban (Ladas 2009). Ladas describes a simple scenario of applying Kanban principles to agile software development based around use of this task board, which has many possible configurations, one of which is illustrated (Fig. 5.2). Physically, the task board consists of a grid into which various task cards are placed. Scrum assumes that a software product can be broken down into a number of distinct features which can be implemented in a defined unit of time known as 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 software feature amongst 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 used.

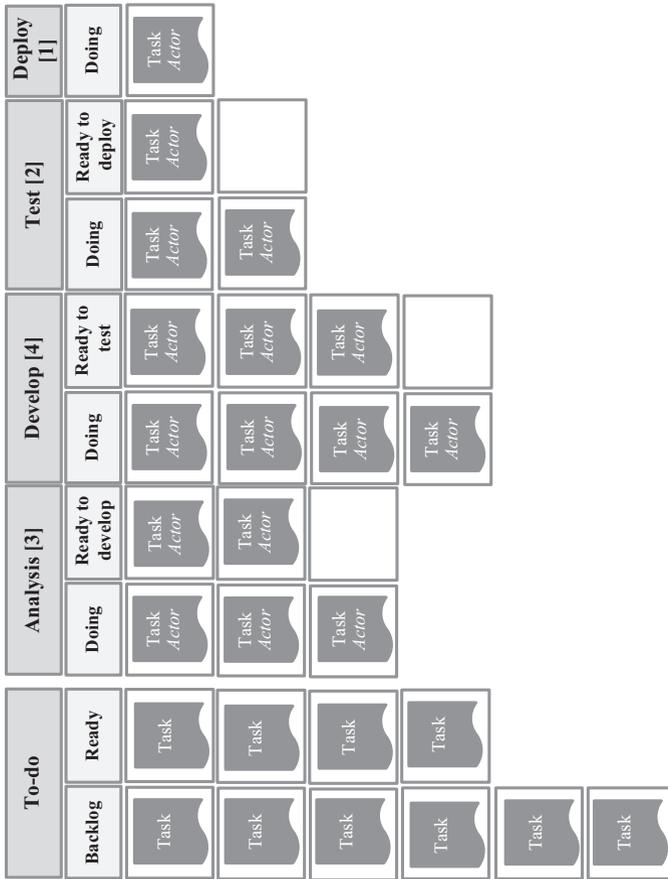| To-do | | Analysis [3] | | Develop [4] | | Test [2] | | Deploy [1] |
Backlog	Ready	Doing	Ready to develop	Doing	Ready to test	Doing	Ready to deploy	Doing
Task	Task	Task *Actor*	Task *Actor*	Task *Actor*	Task *Actor*	Task *Actor*	Task *Actor*	Task *Actor*
Task	Task	Task *Actor*	Task *Actor*	Task *Actor*	Task *Actor*	Task *Actor*		
Task	Task	Task *Actor*		Task *Actor*	Task *Actor*			
Task	Task			Task *Actor*				
Task								
Task								

Fig. **5.2** A Scrumban task board

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 board to represent the allocation of work. The *To-do* section is used to represent the tasks or features that must 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.

Both the Scrumban manager and Scrumban workers within the 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 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. Such acts of articulation communicate to other actors in the team what has been done, what is being done and what remains to be done.

8   Methods, Techniques and Tools

In previous sections we have focused on the idea of business analysis as an activity system with the end-goal of either analysing an existing domain of organisation and/or designing a new domain of organisation. Another way of looking at business analysis is as a set of professional practices. Business analysis as a body of practices is frequently seen to be made up of three key things: methods, techniques and tools.

Methods are frameworks which prescribe, sometimes in detail, the tasks to be undertaken in a given business analysis project. Methods are used to guide the whole or a major part of the process of setting and solving business problems. In essence, the theory-driven approach outlined in this book can be considered a method. But other methods exist for doing business analysis such as Soft Systems Method (Checkland 1999).

Techniques form the component parts of methods in that they constitute ways of undertaking given activities within the process of business analysis. In this sense, techniques are normally used to guide activity within one phase of a business analysis project such as conception, analysis, design and construction. A large encyclopaedia of such techniques forms the IIBA business analysis body of knowledge (BABOK). We describe some core business analysis techniques throughout this book. A compendium of the core techniques found within the IIBA BABOK is included at the end of the book.

Most techniques adopted within business analysis use some form of visualisation. In other words, graphics or pictures are typically used to represent aspects of some domain of organisation. This is done for several reasons: you can generally express more through a visual and it is more easily understood and remembered.

This is perhaps no surprise in that around a quarter of our brain is devoted to vision. This means that our visual sense is the most developed of our senses and uses more 'brain power' than all our other senses combined.

In terms of most visuals the adage 'a picture is worth a thousand words' generally applies. A picture can typically encapsulate more of the workings of some domain in a minimal use of space than any other medium of representation. In other words, you can generally be more concise as well as precise with a picture than an equivalent description in words. Second, humans tend to be extremely good at using visual signs as compared to other signs such as words—there is evidence that some idea expressed visually is more easily understood and remembered than something expressed through the written or spoken word. The success of picture-books or comics as a popular printed genre testifies to this fact as does the use of icons within visual or graphics interfaces now familiar on all types of access devices to ICT systems.

But not all techniques are of equal status. It is useful to think of techniques as lying along a dimension from stakeholder-centric at one-end to technical-centric at another. Technical-centric techniques are designed particularly for enabling technical staff to understand, document and communicate business analysis problems to other technical staff. Stakeholder-centric techniques tend to adopt sign-systems familiar to everyday organisational actors.

We shall use two related stakeholder-centric techniques as core media for visualisation within this book. One is the use of physical components placed upon a tabletop-to-prototype patterns of organisation. This we refer to as tabletop prototypes. The other is the production of a storyboard of events making up a pattern of organisation. This is what we refer to as the business pattern comic or the pattern comic for short. Both techniques have proven useful as a way of not only negotiating sense about some situation with stakeholders but also designing new forms of organisation.

Finally, by tools we primarily mean here available hardware, software, data and communication technology for engaging in some part of the process of business analysis. Tools are frequently used to support the application of techniques such as process or information modelling. Microsoft Visio, for instance, is a piece of software the author has used to produce all the illustrations in this book.

9   Conclusion

Business analysis and design work is no different from other forms of work in demanding certain ways of organising. Projects are restricted patterns of organisation that can be defined in a number of ways. First, in terms of their goals or objectives—the problem set for solution. Second, in terms of persons assigned to teams to undertake project activities—a mix of technical staff such as business analysts and various stakeholders for the problem situation at hand. Third, projects are defined in terms of activities, such as conception, analysis, design, construction, implementation and evaluation.

10   Theory

We have indicated that a project is a restricted form of activity system. The theory
behind that of an activity system is covered in more detail in Chap. 11 of my book
Significance. As mentioned, the idea of a stakeholder is relatively recent to the man-
agement literature (Mason and Mitroff 1981) and is used frequently in a very
ambiguous manner. Within this book we have pinned down this concept in terms of
the notion of a socio-technical system and particularly that of system change. A
stakeholder is any actor (more usually a group of similar actors) who has a 'stake'
in some system and hence will need to be involved in or consulted on any change to
such a system. Stakeholders, Worldviews and Problem Situations are also covered
in Chap. 11 of *Significance*.

11   Practice

Exercises in business analysis and design are organised as projects and must be
managed as such. There is a large literature on project management as well as a
range of methods, techniques and tools for this activity. For instance, PRINCE
(PRojects IN Controlled Environments) is a structured method for project manage-
ment, originally developed from a UK government-sponsored initiative in the 1970s
(see below) (Bentley 2009). PERT (Programme Evaluation Review Technique) was
developed in the late 1950s and is also known as the critical path technique. It is
frequently used as an aid to activity-based planning, in which activities are related
through precedence and the critical path is determined. Many automated tools such
as Microsoft Project are now available to aid project managers.

   The discussion of stakeholders within this chapter falls within the general area
of stakeholder analysis, which as a phrase broadly refers to the activity of identi-
fying stakeholders and mapping their likely influence on the trajectory of a busi-
ness analysis and design project. Sometimes the list of stakeholders is related to
factors such the level of interest in the project domain (low/high) and the level of
power (low/high) they have over facilitating or resisting change within the domain
in question.

   The idea of involving stakeholders within business analysis and business design
has a long history, particularly in the area of ICT systems design. During the 1970s
and 1980s the so-called participatory design movement was influential in the
Scandinavian countries of Norway, Sweden and Denmark. Strong trades unions in
these countries at the time backed by national legislation meant that employees
were able to become actively involved in decisions relating to the design and imple-
mentation of technical information systems. In the UK, a socio-technical tradition
promoted by people like Enid Mumford and Peter Checkland (1987) promoted
ways of improving the fit between technical and social systems and actively encour-
aged involvement of stakeholders in this process.

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Investigating Domains of Organisation

6

1   Introduction

In many ways, the work of the business analyst and business designer is similar to that of the anthropologist. The anthropologist tries to make sense of strange cultures or attempts to make strange her own culture. 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 her experience of this immersion in the field within detailed field notes.

In a similar manner the business analyst tries to make sense of existing domains of organisation while the business designer envisions future domains of organisation. Investigation within business analysis normally occurs in short periods of immersion within such domains, typically using some combination of investigation techniques. Investigation techniques such as interviews, observation, documentary analysis and workshops support the sense-making of the business analyst. Various forms of representation are then constructed to communicate common understanding between the business analyst/designer and various actors with a stake in the socio-technical system under consideration. Representations such as storyboards are used as an intermediate representation to communicate with business users and clients; more formal representations such as information models are used to communicate with other business analysts and technical actors, such as ICT system developers.

There are a number of established ways of making sense of both existing and envisaged patterns of action within some domain of organisation, which are illustrated in Fig. 6.1:

- Participation. Utilising knowledge gained as a participant in patterns of action.
- Conversation. Holding systematic conversations with participants in the pattern of action considered.
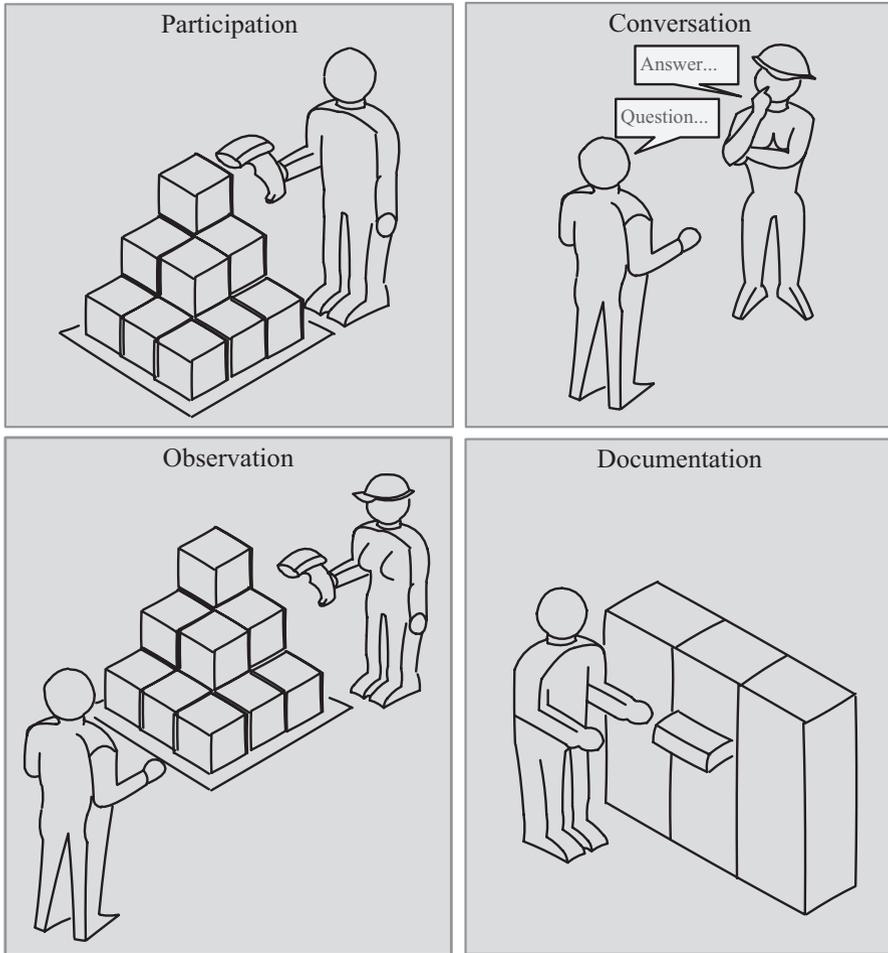
Fig. 6.1 Ways of making sense of patterns of action

- 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.

We consider each of these ways of investigating domains of organisation within this chapter. But first we consider the nature of domain investigation or business investigation.

2   **Business Investigation**

The term business analysis is actually something of a misnomer because, as we have seen in the previous chapter, business analysts not only analyse—they design, implement, evaluate and sometimes even construct. So, when we talk about business investigation, we actually mean a number of different ways of making sense of problem situations.

Builders and planners when talking about parcels of land for development frequently classify them as green sites or brown sites. Green sites are usually virgin fields on which no building development has taken place previously. Brown sites, in contrast, are sites that have previously been built upon. They may be segments of derelict land or land with an existing set of old buildings.

We can use this analogy to think about domains of organisation to be investigated. Usually business analysis is conducted in relation to 'brown' domains of organisation. In other words, the business analyst usually has to focus her work on a domain in which established patterns of action have to be taken into consideration. Occasionally, the business analyst will be given the brief to consider a 'green' domain. This is likely to be a new area embarked upon or wished to be embarked upon by some organisation.

For 'green' domains, analysis will involve analysing, designing, implementing and evaluating a new business model, designed to meet a particular and established business motivation, such as entering a new market or creating an online presence. Here the objective of business analysis is to investigate the range of requirements which define how these new patterns of action should work.

In contrast, for 'brown' domains of organisation, the existence of an existing business model means that business analysis as a project may do different things. For certain 'brown' domains we might be interested solely in documenting what goes on currently. This might be because we wish merely to build a 'map' which might be used for a number of purposes by different actors. For instance, it might help managers better manage this domain or it might make it easier to train new employees in existing ways of working.

The more usual reason that we might want to investigate and map a current domain is because there are some points of issue with current patterns of action. The aim of such business investigation may merely be to document systematically such issues for managerial inspection. However, usually a business analysis project will be expected not only to identify and document the source of such issues but to recommend ways of addressing the problems identified.

Some projects of business analysis will be expected to work up recommendations into a full-blown business motivation model (see Chap. 18), which expresses not only the reasons for change but features of the likely end-state desired. This motivation model will act as the starting point for a number of as-if designs for a new business model and may also help in the selection of a to-be business model, which will aim through implementation to change patterns of action.

We should also make clear that the objectives of an investigation associated with a business analysis project may differ in terms of whether the idea is merely to

improve aspects of an existing business model or to re-design a completely new business model for a domain. Although, as we shall see, business improvement is perceived to be the less risky option one should beware of shackling the vision of a business analysis project, particularly at the outset of such a project. In other words, the analyst may find in the course of the investigation that improvement will do little to address fundamental issues with existing patterns of action. It might be better, perhaps in the longer term, to propose an entirely new business model for the domain in question.

Finally, we should mention that business analysis may be required to conduct investigation of a 'developed' domain of organisation. In other words, some planned project of change has already been undertaken. Here, the idea is to evaluate the success or failure of such change to the domain of organisation (Exercise 6.1).

> **Exercise 6.1**
> Imagine you were a Spanish explorer who was trying to make sense of the life of the Inka. The Inka had no concept of money. So how did their economy work? What sort of things might this explorer do to attempt to understand how goods were distributed and consumed within the Inka empire and what made this system work for the Inka?

3   Business Analyst as Anthropologist

So how should we approach investigating 'green', 'brown' or 'developed' domains of organisation? One useful trick is to think of the similarities between the work of the business analyst and that of the anthropologist.

The aim of anthropology is often defined as *to make the strange familiar and the familiar strange* (Engelke 2017). During the period between the mid-eighteenth and the mid-twentieth century the discipline of anthropology emerged as the study of human culture. Anthropologists initially devoted their attention to the study of remote and so-called primitive cultures, as they were referred to at the time. In recent times many scholars have begun to frame these studies as attempts to make sense of such strange cultures by the major European powers of the day. In more recent times, anthropologists have turned their lens onto their own cultures. The aim here is to make strange the accepted culture such that insight can be generated.

This attempt to make things strange is sometimes referred to as sense-breaking. Sense-breaking is a standard anthropological technique which is particularly useful for thinking about the accepted or conventional in different ways. For instance, in Chap. 13 we particularly wish to decouple the concept of data structure from that of digital computing and communications technology. To do this we have to break sense not only with what data structures are but with what they do.

This emphasis on both sense-making and sense-breaking suggests a certain similarity between the work of the anthropologist and that of the business analyst. Both are thrown into situations which are strange for them. Their task is to make sense of such strangeness; also, to communicate how these situations 'work'—to impart to other

strangers to such situations what you might be expected to do to participate in the life of the domain in question. At least within the UK classical anthropology has frequently been portrayed as a tool of empire—a means for the British imperial administration to better understand the multifarious cultures under their control and in doing so to develop more effective ways of administrating the populace. In this utilitarian perspective of anthropology, we get closer to the idea of analysis in business analysis. Unlike the pure anthropologist who wishes merely to understand and explain how things work in particular cultures, the business analyst normally wants to improve patterns of action within domains considered. Hence, the main difference between business analyst and anthropologist is that the analyst must also think about what is problematic within situations and how such situations should and can be changed.

If the business analyst is an external role then the domain of organisation under consideration will be inherently strange. Such organisational settings need to be made sense of by the business analyst in much the same way that an anthropologist would investigate a remote and strange culture as far as she is concerned. If the business analyst is an internal role - in other words, employed by the organisation itself - then the organisation setting may be overly familiar to the business analyst. The analyst may 'have gone native' in the sense that he or she will accept conventions of action much as the normal participant would within the domain of organisation. In this case, efforts must be made to make the business domain sufficiently strange so that effective analysis can take place. Many of the ways of thinking described in this book are designed to enable the business analyst to maintain distance but also to be impartially engaged with a domain of investigation. Most of the techniques described also involve participation by business stakeholders and wherever possible involve acts of co-creation between the business designer and other business stakeholders. Making situations strange for stakeholders participating in a business analysis project is a particular challenge.

One good way to make the familiar strange is to consider similarities and differences between issues of organisation in other areas such as historical situations, other cultures or the behaviour of other species. This is a strategy we have much used within this book. Consider, for instance, the issue of business communication. In my book *Significance* I describe how honeybees communicate through forms of dance. Now imagine that business actors had to devise an efficient form of communication as a dance—in other words by simply moving the body in various ways. This is not so strange as it seems. Taxiing aircraft, for instance, are controlled by actors that effectively 'dance' their way through a communication. Such techniques for making the familiar strange are particularly good as devices for brainstorming in business analysis and design workshops.

4   Business Analysis as Discourse

One way to think of the investigation of domains of organisation is as a discourse between the business analyst/designer 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, of course, conversation. Conversation is a type of discourse in which the joint action of participants is purposive. However, conversation is typically not planned but emergent. No one person leads a conversation and the structure of conversation is continuously negotiated and coordinated by participants in the conversation.

In Chap. 10 we shall explain how information is an accomplishment achieved through acts of communication. A conversation is typically made up of a sequence of adjacent communicative acts (Clark 1996). In other words, one actor makes an utterance and another actor produces an utterance in response; this leads to a further pair of communicative acts and so on. Pairs of communicative acts within a conversation tend to follow conventional patterns in which a particular utterance generates a preferred response. Some typical patterns of adjacent communicative acts include:

- Question–answer ('How many production units do you have?' 'Eight.')
- Assertion–agreement ('There is clearly a problem with stock flow.' 'Yes, I think you are right.')
- Assertion–disagreement ('There is clearly a problem with production scheduling.' 'No, I think it has more to do with the way we manage stock.')
- Summons–response ('I'd like to talk to you about this issue on Tuesday.' 'Yes, that should be fine.')
- Thanks–acknowledgement ('Thank you for your contribution to this effort.' 'No problem, I enjoyed it.')
- Apology–acceptance ('I am sorry I raised this issue so abruptly.' 'Your apology is accepted.')

Most conversations are also 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 constitute either an understanding of how things currently are or an understanding of how stakeholders would like things to be.

Conversations between the business analyst/designer and stakeholders can be done on an individual or a group basis. When such conversations are typically led by the business analyst and are undertaken with specific individuals they are referred to as interviews—interviews are directed conversations. 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, collaborative meeting or design workshop.

5   Interviews

Interviews are not everyday conversations - they are systematic and directed conversations organised typically around pairs of questions and answers. Having said this, the degree of formality can differ between interviews. Informal or unstructured interviews are those in which questions are formulated by the analyst within the flow of the interview itself. Formal or structured interviews are those in which a structure or protocol is devised prior to the interview and used by the analyst to drive the flow of conversation. The consequence of this is that the actual questions asked within an unstructured interview will differ from one interview to the next. In contrast, a structured interview will deliberately involve asking the same questions of different actors.

Although, as we have mentioned, the process of business investigation in support of business analysis has some similarity with the systematic investigation of social settings there are considerable differences as well. Business analysts are likely to interview a much smaller number of people than a social investigator. The interests of the business analyst are also usually better served by the unstructured rather than the structured interview, if only because unstructured interviews are good at gaining deep domain knowledge from a single person whereas structured interviews are better at verifying relatively shallow knowledge held by a number of persons.

Generally, most business analysis interviews as systematic conversations follow an established pattern of action consisting of preparation, an opening section, the body of the interview, a closing section and documentation.

Preparation involves arranging a time and venue for the interview with the interviewee and usually forming a series of topic areas to be covered. One useful technique is to draw these topic areas out as a mind map. A mind map is a visualisation technique proposed and refined by the psychologist Tony Buzan (Buzan 2010). Essentially, it consists of a primary topic which forms the centre of the illustration. Sub-topics radiate from the central topic as linked and labelled lines. These lines in turn can branch as sub-sub-topics and so on. Not surprisingly mind maps are also known as spider diagrams. Figure 6.2 illustrates a simple mind map that can be used to guide an interview which seeks to develop common ground as to the shape of instrumental activity in some domain.

The English poet and novelist Rudyard Kipling once wrote a short poem outlining a powerful set of questions which can be used within any business analysis interview: 'I keep six honest serving men (They taught me all I knew); Their names are What and Why and When And How and Where and Who.'

Consider how such questions might be used to help make sense of patterns of activity in some domain of organisation:

• What do you do?
• Who does this activity?
• When is this activity performed?
• Where is this activity performed?
• Why is this activity undertaken?
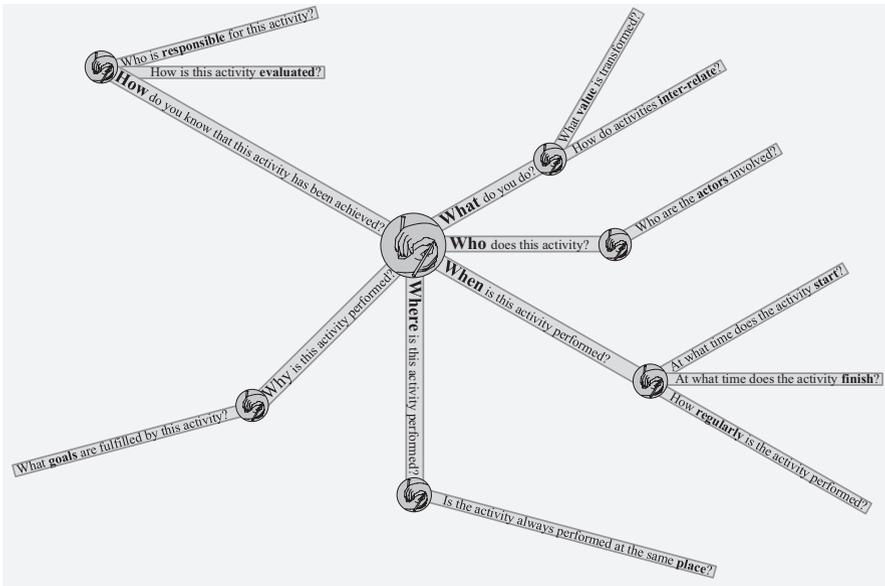• How do you know that this activity has been achieved?

Fig. 6.2 Aide memoire for a business analyst interview as a mind map

An interview normally begins with a period of dialogue between the business analyst and the interviewee in which the goal of the interview is established and the conduct of the interview agreed. As a crucial part of this the likely length of the interview is mentioned and agreement is reached as to whether the interviewee is happy with the interview being recorded in some manner—as an audio or video recording (Exercise 6.2).

> **Exercise 6.2**
> Imagine you were to conduct a series of interviews with elderly persons living independently within their own homes. The purpose of the interview is to establish which sorts of digital innovation will be most successful in this environment. Develop a mind map of possible topics and questions to guide the interview.

The main body of the interview takes the form of a structured conversation in which the business analyst frames a series of questions and the interviewee responds. Mind maps, as mentioned, can be used as an aide-memoire to both guide discussion and to take notes. But most interviewers if they have got any sense will not make an interview consist of a boring sequence of questions. It is better to intersperse questions and answers with other types of adjacent communicative act, such as the ones referred to in the previous section. For example, it is a good tactic frequently to make an assertion which describes your understanding of part of the common

ground developed in the previous sequence of utterances made in an interview ('So you are saying that to do this you do this …'). Agreement or disagreement to such an assertion will serve to validate aspects of this common ground for the business analyst. Also, thanking the interviewee on a regular basis within the body of the interview is particularly useful as a means to keep the flow of conversation going ('Many thanks for that—I think I'm now getting a clearer idea of the problem here …'). Apologising for being a dullard is also a good way to encourage people to open up in more detail on specific aspects of their work ('Sorry, I'm a bit slow on the uptake, does this mean that …').

At the end of the interview a period needs to be spent summarising key aspects of the discussion with the interviewee and agreeing any further interviews. As soon after the interview itself as possible any recording needs to be transcribed and the results written up. Barring this, interview notes taken during the interview need to be documented. It is good practice to send a written summary of either the transcript or the notes back to the interviewee wherever possible for verification and validation.

6   Focus Groups

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 to generating consensus views of something or some situation. For instance, a focus group might be used to gauge likely reaction to a major business change amongst employees. Syed (2019) argues that in choosing members for a focus group one should aim for as much diversity or heterogeneity as possible in relation to the makeup of the group and the issue being considered. For instance, in building design artefacts to help the elderly in their own homes the designer might be tempted only to select representatives of the elderly population who are living in their own homes currently. But a more informed picture of the design space might be gleaned from a focus group made up of not only the elderly living at home but also those in care or currently awaiting discharge from hospital. It might also be good to include representatives of carers, discharge nurses and relatives in the mix.

7   Meetings and 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.

Collaboration meetings are typically events scheduled within the life cycle of a business analysis project where representatives of stakeholder groups either are consulted on decisions made or participate in critical decisions that have to be made. Collaboration meetings are particularly good for making or agreeing decisions on specific issues. Meetings are typically not very good vehicles for arriving at collective outcomes, so meetings have to be designed with a clear rather than an open-ended purpose in mind. Hence, techniques such as MoSCoW prioritisation (Chap. 5) are frequently used in such settings to keep participants focused on the task at hand.

Within business analysis, 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.

Typically, a facilitated workshop will be composed of some 8–15 people fulfilling some of the following roles. Some of these roles may be filled by the same person:

- Facilitator. This is a person whose responsibility is to monitor the activities of the workshop, lead discussions, ensure that all participants are contributing fully, resolve conflicts and try to reach agreement wherever possible amongst participants. The facilitator role includes both pre- and post-workshop activity. He or she will be expected to prepare fully and to brief workshop participants. Following the workshop, the facilitator will be expected to document all the main outputs and distribute these to relevant persons.
- Scribes. These are persons tasked with carefully documenting everything relevant to the activities of the workshop itself. As a minimum, they will be recording all decisions taken.
- The Executive Sponsor. This is the person whose main responsibility is to make key business decisions and to resolve business conflicts.
- Stakeholder Representatives. These are people who represent a relevant area of the organisation in the workshop and who bring their knowledge and skills to the workshop. As mentioned in the previous chapter, such representatives should be persons who are empowered to make decisions on the part of the business and must be committed to the project.
- Domain Specialists. These are people who have wide knowledge and experience in the business area under consideration.
- Project Manager. This is the person who will take responsibility for implementing the agreed solution.
- Observers. These are persons who do not take an active part in a workshop but have an interest in the progress of the workshop.

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 white-board (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. This may mean that the workshop takes place in a hotel where all participants are provided board for the period of the workshop.

Just like any form of work, design workshops benefit from organisation. One way of doing this is for a screenplay to be developed for each day of the workshop. This will divide up each day into a series of time-periods and specify both the topic and the activities to be conducted in this time-period, as well as the person or persons to undertake each activity. Usually, an analysis workshop will be run according to a number of established 'ground rules' or conventions. 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'.

8   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. She can observe how things currently work and she can participate in the doing of things. She might also examine any documentation or data that is relevant and available to make sense of the situation.

One of the best ways to understand a set of socio-technical practices is to engage in such practices yourself—this is what is meant by participation. There is nothing like practically attempting to 'walk in someone else's shoes' for appreciating what is actually involved in doing some aspect of work. The key problem with participation as an investigative technique is that it is likely to take time. Whereas an interview or a piece of observation can take an hour or so, an act of participation normally involves days or possibly even weeks of immersion in some aspect of activity. Nevertheless, the key benefit of participation is that some in-depth sense can be made of some pattern of activity. The analyst is not only likely to learn how things are done but also to experience the everyday problems that actors have with their routine action.

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 to manage the observation of work is through shadowing, that is, following a particular worker around and observing all the tasks performed by this worker in the activity system in question. Another way of managing observation for business analysis systematically is to walk-through a pattern of action with the people doing the job. Ideally, this should be done a number of times with different workgroups to tease out any differences in practices across business units (Exercise 6.3).

> **Exercise 6.3**
> What would observation of the elderly using some digital device such as a personal alarm tell you about this digital innovation?

9   Dealing with Artefacts

Most of the investigation techniques discussed in previous sections involve the business analyst engaging with a domain through its human actors. However, we shall argue in Chap. 13 that it is useful to think of artefacts as acting, at least in a limited sense. Therefore, it is particularly important that the business analyst engages with such artefacts to help make sense of either current or envisaged domains. Typically, artefacts such as documents or records are particularly useful things to examine to find out how organisation works in some current domain. When the analyst wants to encourage creativity in thinking about how things might be, she may engage in building artefacts with stakeholders. This is often referred to as prototyping.

We shall argue in Chap. 13 that the data utilised within some domain of organisation helps constitute institutional facts about this domain. Such data comes in many different forms. For instance, documents are a valuable resource in most organisations. Such documents may consist of paper forms used in work, reports generated from ICT systems or design documents of various forms. Documents are particularly important, for understanding the structure of data used in the support of work performance (Exercise 6.4).

> **Exercise 6.4**
> What sort of records would be useful to help you understand the needs of an elderly person living independently?

Records, as we shall see, are data structures that help maintain collective memory. Hence, sampling the records used in support of some domain of action and analysing such records is particularly important for understanding what actors within the domain feel it is important to remember about. Records also act as key resources for communication between multiple actors, sometimes remote in time and space.

Records are typically built for a particular defined purpose and are important to understand for the way in which they establish purpose and performance in some domain of organisation. In recent times business data has become even more significant than in the past. The amount of business data represented in organisational ICT systems of various types has grown astronomically. Various technological approaches are now available to analyse large datasets which suggest patterns of action worthy of further investigation. Collectively, this approach has become known as 'big data'. Technologies such as data warehousing, data mining and data analytics are being used by business analysts to determine hidden patterns—patterns which will probably need to be explored and detailed further using other methods of investigation such as observation, workshops and interviews.

Finally, we should mention that the business analyst is not only interested in analysing artefacts, but may be interested in building particular types of artefact known as prototypes. The use of the word prototype tends to suggest the tentative nature of this artefact. It is an early, unfinished model of something. The rationale behind the use of prototyping runs as follows. Frequently to gain some idea of what is required in terms of some new business model it is better to build something and get a reaction rather than investigating using techniques such as interviews or observation. Prototypes may be low-technology mock-ups such as models drawn on flipcharts or the tabletop prototypes proposed in this book. They may also consist of early realisations of ICT systems or the like.

10   Triangulation

In trigonometry and geometry, triangulation is the process of determining the location of a point by measuring angles to it from known points at either end of a fixed baseline. The point can then be fixed as the third point of a triangle with one known side and two known angles. This idea is critical to much measurement in land surveying. It also underlies the way in which any point upon the Earth's surface can be positioned in relation to the 24 satellites making up the global positioning system or GPS.

Social researchers also talk of the importance of triangulating methods of investigation of the same domain. It is important to recognise that the use of any one investigation technique will provide only a partial picture of the domain being investigated. Frequently, for instance, what people describe in interviews only partly reveals how they go about their everyday work. In this case we might use one or more further techniques such as observation to check that what people say they do, they actually do in practice. The principle here is that the use of multiple approaches to investigation is likely to verify or validate each other.

11   Business Visualisation

Many of the approaches proposed within business analysis for investigating business domains utilise some form of visualisation. In other words, rather than trying to understand and capture what is going on or what people would like to happen in

words, business analysts tend to use pictures of various forms. Visualisation is not only used to build a collective record of some experience; it can also be used to facilitate creative thinking or to improve the analysis of some problem. Business visualisations have a number of important properties which make their use within focus groups, workshops and other forms of group setting particularly useful:

- Visualisations tend to be more engaging than written text.
- Visuals are easily created and amended.
- Generally, more can be represented on one visual than a page of writing.
- Visuals are by their very nature highly visible—this helps encourage group working.

For such reasons, within this text we shall focus on a number of techniques for visualising patterns of organisation.

12   Physical Prototyping

Many design professions such as architects not only use visualisation; they build physical models of their design artefacts. The key advantage for the architect of such models is that they can test the 'shape' of the design and use it to communicate with their clients about key design decisions and assumptions that have been made. In showing their prototypes to clients and users, they open up dialogue and can thus get immediate feedback on whether they are meeting their brief or not.

In a similar manner, many business and technical designers now build physical prototypes to help with the design of strategy or customer interaction. For instance, Roos and Bart (1999) have used LEGO bricks as a means of getting strategists to engage in what they refer to as *serious play*. This allows the strategist to explore, in an unconstrained way, not only the space that strategy must take place within but also to express some desires for future change.

In further chapters we describe a technique for developing physical prototypes of socio-technical organisation. We have found such prototypes an effective way of focusing design workshops not only upon parameters of the current problem situation but also expressing various possibilities for the use of technology. They are particularly good at showing how the use of certain technology changes patterns of activity, communication and data articulation.

13   Conclusion

The purpose of investigation is to input into the process of analysis—of making sense of some domain of organisation. A business analyst making sense of some domain of organisation engages in similar practices to the anthropologist. Both analyst and anthropologist attempt to understand strange domains of action or to make strange familiar domains of action. However, unlike the anthropologist the business analyst is concerned not only with how things are but how things might or should be.

An anthropologist normally seeks to do two things—to understand the patterns of action making up some culture or sub-culture and represent such patterns usually in terms of the written word. A business analyst normally seeks to understand a much narrower and existing domain of organisation. She also seeks to represent the patterns of action comprising this domain using not only the written word but also various forms of visualisation. Also, the business analyst does not stop at this point. The business analyst then seeks to understand motivations for changing such organisation as well as designing new forms of organisation.

Within this chapter we have considered a number of established ways of making sense of both existing and envisaged patterns of action within some domain of organisation. Anthropology is clearly a discipline within the broader endeavour of social science. In line with the similarities between the work of the business analyst and that of the anthropologist it is not surprising to find the business analyst adopting many of the investigatory techniques of the social sciences to attempt to make sense of some domain of organisation.

The business analyst may also gain understanding through participating in certain patterns of action. More usually, the business analyst will hold systematic conversations (interviews) with participants in the pattern of action considered. Sometimes it is useful to observe actors taking action, particularly as a check upon what actors tell the business analyst. Finally, it is important for the business analyst to hold a discourse with any relevant artefacts from the domain being considered, such as documents or other forms of data.

14 Theory

I first compared business analysis (then called systems analysis) to anthropological investigation some time ago (Beynon-Davies 1990). The idea of applying the notion of sense-making to understanding the issue of organisation is due to Karl Weick (Weick 1995). Sense-making is the process by which people give meaning to experience. This is an elaboration of the idea that investigation in many of the social sciences benefits from the ability of humans to take the place of other humans. In other words, it exploits our ability to interpret the patterns of action taken by other human actors. In Chap. 5 of *Significance* sense-making (Beynon-Davies 2011) is unpacked in terms of the related issues of psyche, communication and control.

15 Practice

Most of the approaches for business investigation described in this chapter are familiar from the wider realm of social science research. However, these investigatory techniques normally have to be adapted to the exigencies of business analysis projects. This is because, unlike projects of social science research, business analysis projects are normally much shorter in duration, directed at understanding much more focused issues and typically constrained by organisational demands such as deadlines and resource constraints than pure exercises in social scientific investigation.

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Engaging with Problem Situations

7

1   Introduction

The late novelist Ursula Le Guin described in a quartet of fantasy novels (Le Guin 1993) the world of Earthsea in which magic is a reality. Wizards perform magic through the use of special words, which allow them to manipulate things in the world. But our use of words is not entirely remote from the wizard's use of words in Earthsea. This is because words are signs and signs always have two faces. Our use of words as signs allows us to describe and reflect upon reality. But when we use words we also construct major aspects of the reality we are describing. This means that we all engage in sign-magic on a daily basis. This is particularly true for the setting of problems. When you ask someone 'what's the problem?' you inevitably open up a discourse about possible futures in which signs will be used not only to describe but also to construct possible realities.

Hence, to begin to design you first must establish what you wish to design. This means establishing or setting the problem to be engaged with. Problem setting involves exploring the problem space or problem situation and discovering its features. It also involves setting the boundaries around the problem—what you shall consider within design and what you shall not. However, problems of organisation are rarely straightforward. Problem situations within domains of organisation exist for would-be improvers of the situation. But accounts of what the problem actually is with the current situation may vary depending upon the system stakeholder you speak to. Within this chapter we explore several techniques for engaging with the complexity of problem situations within domains of organisation and establishing the problem to be set. These include brainstorming, affinity mapping, stakeholder analysis, rich pictures and MoSCoW prioritisation.

2   Problem Setting

Business analysis and design is normally undertaken in relation to some perceived problem or problems with some domain of organisation held by certain persons with a stake in this domain. At one end, business analysis involves problem setting—establishing what domain is being considered, what the scope of consideration is and what the precise nature of the problem to be addressed is. At the other end, business design involves problem solving—expressing and implementing a system of action which will remove or alleviate the problem identified within the domain of organisation considered.

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' and 'wicked' rather than tractable.

Most domains of organisation considered within business analysis and design are a mix of 'soft', human systems and 'hard', technology systems. In the previous chapter, we referred to this mix or 'mess' as a domain of socio-technical organisation (Exercise 7.1).

> **Exercise 7.1**
> What is the difference between a fridge and a freezer? Well mechanically a fridge is pretty much the same as a freezer. The difference lies in what a fridge is used for as compared to what a freezer is used for. A fridge keeps things cool while a freezer freezes things.
>
> So basically, the same technical system here is used to do two different things in terms of activity. Can you think of any other technical systems which although similar in the 'hard' sense perform different functions in the 'soft' sense?

Technical problems tend, by their very nature to be relatively tractable. In terms of a system of technology we can usually identify quite precisely what a problem constitutes and in terms of some definition of this problem identify suitable solutions. It is for such reasons that technical problems are sometimes described as being 'hard' problems. We might argue that in this area of analysis, technical problem setting is relatively uncontentious whereas technical problem solving is the activity to which most effort is devoted.

At the opposite end of the scale lie institutional and environmental problems. Problems in this area are frequently difficult to identify, if only because different people will have different ideas about what the problems are and might even define what appears to be the same problem in different ways. It is for such reasons that these problems are sometimes described as being 'soft' or 'wicked' problems. Such soft problems tend to demand much more effort in problem setting rather than problem solving.

Given that a domain of socio-technical organisation will be a mix of such 'hard' and 'soft' situations and issues, where do we or should we start? A good place to

begin is with establishing the domain to be considered by business analysis and setting the problem to be considered in terms of this domain. To help in this task of framing the domain of investigation, the related concepts of stakeholder and worldview are useful.

Organisations are normally established for a purpose: usually to produce value of some form (see Chap. 8). 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 must involve engaging with stakeholders and their viewpoints.

3 Systems of Complexity

The biologist Conrad Hal Waddington in his classic book *Tools for Thought* (Waddington 1977) argued that 'we need nowadays to think not just about simple processes but about complex systems'. Following on from the discussion in the previous section it should be apparent that inherent in the idea of a domain of socio-technical organisation is this notion of complexity (Exercise 7.2).

Exercise 7.2

Systems theorists propose the concept of variety as a way of measuring the complexity of some system. Variety is the number of possible states that a given system can be in. Try to calculate the likely variety of the following simple system:

We have a collection of human actors, each of which we represent as a node labelled A-F. 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 communicate with actor B and actor B can communicate with actor A; each is a separate 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 amongst 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.

But complexity comes in different forms. The American mathematician Warren Weaver suggested in a landmark paper in the 1930s (Weaver 1948) that there were three broad categories of complexity which help define three broad types of problems, as well as the approaches taken to make sense of them. The first might be called simple systems in which there are a small number of variables to consider. Examples here include the rotation of the planets and the causal relationship between an electric current and its voltage and resistance. The behaviour of such simple systems can usually be made sense of by deriving laws which describe, usually in the form of a mathematical equation, the regularities of cause and effect. The second category involves systems of disorganised complexity, in which there are billions of variables to consider. Examples here include the behaviour of molecules in a gas or patterns of heredity in a gene pool. Such systems can only be made sense of in statistical terms as well as in terms of probability theory. But there is a third class of system lying between Weaver's simple system and systems of disorganised complexity. Such a class of systems Weaver referred to as systems of organised complexity. Such systems have a moderate number of variables, but the complexity of the system derives from the inter-relationship between the variables. It is this type of system which helps frame the idea of a domain of socio-technical organisation.

4   Problem Situations and Stakeholders

Therefore, in situations of socio-technical organisation, the notion of a problem is rarely straightforward. Peter Checkland prefers the term problem situation rather than problem because problem situations exist for 'would-be improvers'—people who feel that the current situation 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 inter-related problems while the systems theorist Russell Ackoff (1967) referred to complex problem situations as 'messes'.

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 inter-subjective agreement between stakeholder groups (stakeholders, for short). Mason and Mitroff (1981) 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.

5 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 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.

Consider a manufacturing enterprise as a system of action. A customer might see it as a system to meet his or her demand for a designated range of products. 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 manufacture goods 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.

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's 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 systems 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 sub-systems such as a log handling and storage sub-system, a finished goods and warehousing sub-system, a marketing sub-system and a financial control sub-system. They might be interested principally in the way each sub-system communicates its needs to other sub-systems, 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. Different stakeholders will have different ideas as to what the purpose of a university is. Students might define the purpose of a university as being to educate students. Academics might define a university as having the purpose to conduct research and develop new knowledge. Administrators might define its purpose as being the provision

of given services in return for income. This difference in perspective will lead to different issues that might be used to define the problem situation.

So, to establish or engage with organisational problems you must generate lists of stakeholders, issues and worldviews. You also must try to represent these elements in some form of overall description of the problem situation.

6   Issues and Requirements

In the design of technical systems such as ICT systems, issues are frequently cast as requirements. A *requirement* is any desired feature of an ICT system. It is sometimes thought that these are unproblematic, in the sense that it is not that difficult to find out from the stakeholder community what they want. However, requirements can vary depending on the stakeholder group. They are not objective in the sense that they will be the same for everyone; they are relative to a stakeholder's perspective or worldview. Different stakeholders' requirements might conflict.

A distinction between the functional and non-functional requirements of some ICT system is frequently made. Functional requirements are expected features of an ICT system. Non-functional requirements are constraints set on the ICT systems development project. The set of functional and non-functional requirements establishes the scope of the ICT system.

7   Brainstorming and Affinity Mapping

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. Later in the design process brainstorming can also be used to generate ideas for the resolution of problems—solutions. The invention of this group creativity technique is credited to advertising executive Alex F Osborn who was frustrated with his employees' inability to develop ideas creatively. Brainstorming works with four major conventions:

- *Go for quantity*. The reason for this is that the greater number of issues or ideas generated the more likely it is that a radical and effective solution to some problem will be generated.
- *Withhold criticism*. The focus in brainstorming is in the generations of issues or ideas. Participants in the process must suspend judgement and not seek to evaluate any ideas or issues. This is to encourage participants to generate unconventional issues or ideas.
- *Welcome wild ideas*. To try to break current conventional ways of thinking, wild ideas are encouraged. This is to encourage participants in the brainstorming session to suspend their assumptions and look at things from different perspectives.

- *Combine and improve ideas*. This relates brainstorming to the idea of finding associations or affinities between issues or ideas and combining them into larger clusters or classes.

One way of practically running a brainstorming session is to work with post-its and whiteboards. I have also run such sessions using the tabletop prototyping technique, which we describe later. 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.

8   Scoping and MoSCoW Prioritisation

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. This involves scoping what will be considered within the design process and what will not. Sometimes this will involve setting a boundary around what part of the system or pattern will be considered. Frequently it will involve clustering issues into those that will be considered and those that will not.

One more refined 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. Must haves are issues that are critical and hence must be considered within design. Should haves are not critical but are issues that if resolved will directly benefit the business. Could haves are issues that will not directly benefit the organisation but would be nice to resolve. Finally, won't haves are issues that the organisation would like to have, but probably will not have. These are issues where the benefits of resolution are currently unclear.

In thinking about such prioritisation it is useful to visualise each type of product as a liquid of different density. Must haves are the 'densest' type of issue and hence can be regarded as sinking to the bottom of the container. Should haves are the next densest and so on. At the top of the container we have the least dense 'liquid'—the would-like-to haves or the could haves. As the design work progresses, other requirements or issues may be identified or some of the issues may take longer to resolve than thought. Thus, the would-like-to haves and the could haves need to get displaced by the more critical must haves and should haves.

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.

9   Stakeholder Mapping

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 design activity in these terms (Exercise 7.3).

> **Exercise 7.3**
> Consider a domain of organisation such a local authority as a problem situa-
> tion. Identify likely stakeholders for this system.

10   Rich Pictures

To help bring together the elements of some problem-setting exercise, the technique
of rich pictures is sometimes useful. A rich picture is a free-form visualisation of
some problem situation. The problem situation is conceived as a set of different
stakeholders, with differing concerns and issues that help define their worldview of
the problem situation (Checkland 1987). Rich pictures, as visualisations, are delib-
erately loose or informal. There is no standard notation or method for constructing
rich pictures: it is up to the analyst or modeller. Instead, in drawing a rich picture the
business analyst attempts to capture the essence of some domain of organisation
with which some stakeholders perceive a problem to exist. A rich picture is particu-
larly useful as a means of establishing the boundary of the system to be considered
and as such helps to set the defined problem in its proper systems context.

   The author has found the following 'recipe' for producing rich pictures useful in
practice. First, think of a blank canvas upon which you are going to delimit the
context for the domain of organisation in question. Next, think of an appropriate
name with which to label the central problem to be considered. Place this name,
along with some icon, which illustrates the key essence of this problem, at the centre
of the canvas.

   Next think of the stakeholder groups that are likely to impact upon the problem
or issue identified. Typically to help do this we might utilise certain signs to enable
us to think about the different types of stakeholder that might be interested in the
problem, are affected by the problem or have influence over a solution to such a
problem. This typology of stakeholders is sometimes referred to as the stakeholder
wheel. Stakeholder types on this wheel include clients, customers, partners, suppli-
ers, regulators, employees, managers, owners and competitors (Fig. 7.1).
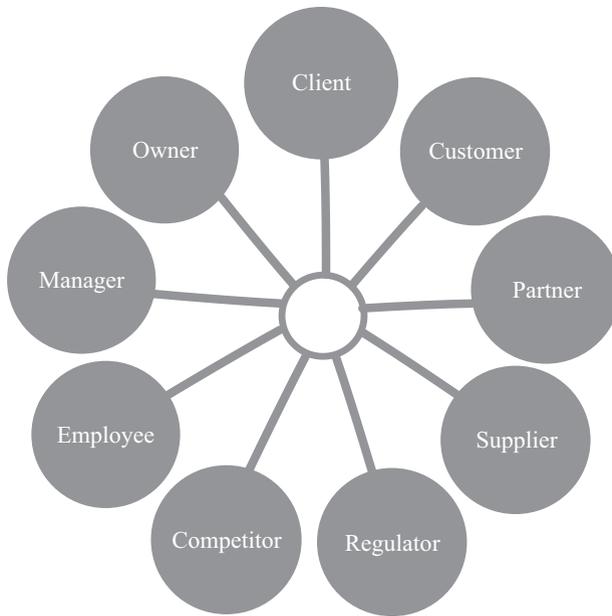
Fig. 7.1 The stakeholder wheel

Different stakeholder groups might be users of the system in question, such as managers and employees. Other stakeholder groups might utilise the results from some system, such as clients or customers. Yet other stakeholder groups might constrain the workings of some system, such as regulators or partners. For each such stakeholder group place an icon and an informative label which denotes the group upon the rich picture.

Now try to develop a short statement which suitably represents the worldview of each stakeholder group in terms of the problem situation. Place the statement in a speech bubble next to the stakeholder icon. Relate the stakeholder and worldview to the problem situation icon or to other stakeholders using arrows. Label such arrows with an appropriate meaning for each relationship, such as supports, rejects, investigates and so on.

In many situations it is important to know where agreement or disagreement lies among the worldviews of different stakeholders. Use some icons upon the canvas, such as the smiley face or the sad face, to indicate such approval or disapproval. In certain cases, there may be outright conflict between the worldviews of certain stakeholders. This can be represented by using an icon such as crossed swords. Finally, it may be important to know who has responsibility for scrutinising aspects of the problem situation—in other words, monitoring or evaluating another stakeholder's activity. This can be represented using something like an eye symbol upon the rich picture. Some of these representative icons are illustrated in Fig. 7.2.
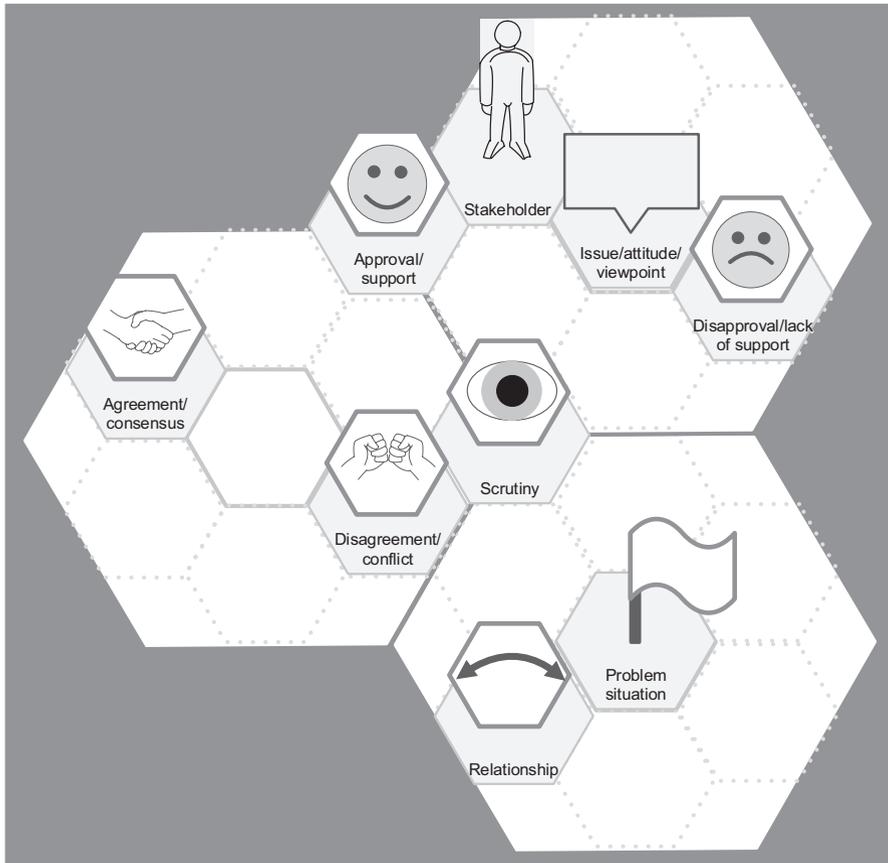
Fig. 7.2 Components of a rich picture

To summarise, 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.

Within design workshops we have found it useful to produce rich pictures as tabletop prototypes. Such prototypes enable icons to be freely mounted on bases and quickly positioned on the design landscape. Consider Fig. 7.3 as an example of a rich picture produced as a tabletop prototype. This describes a domain of organisation known as Perpetual Inventory Checking which was proving a problem
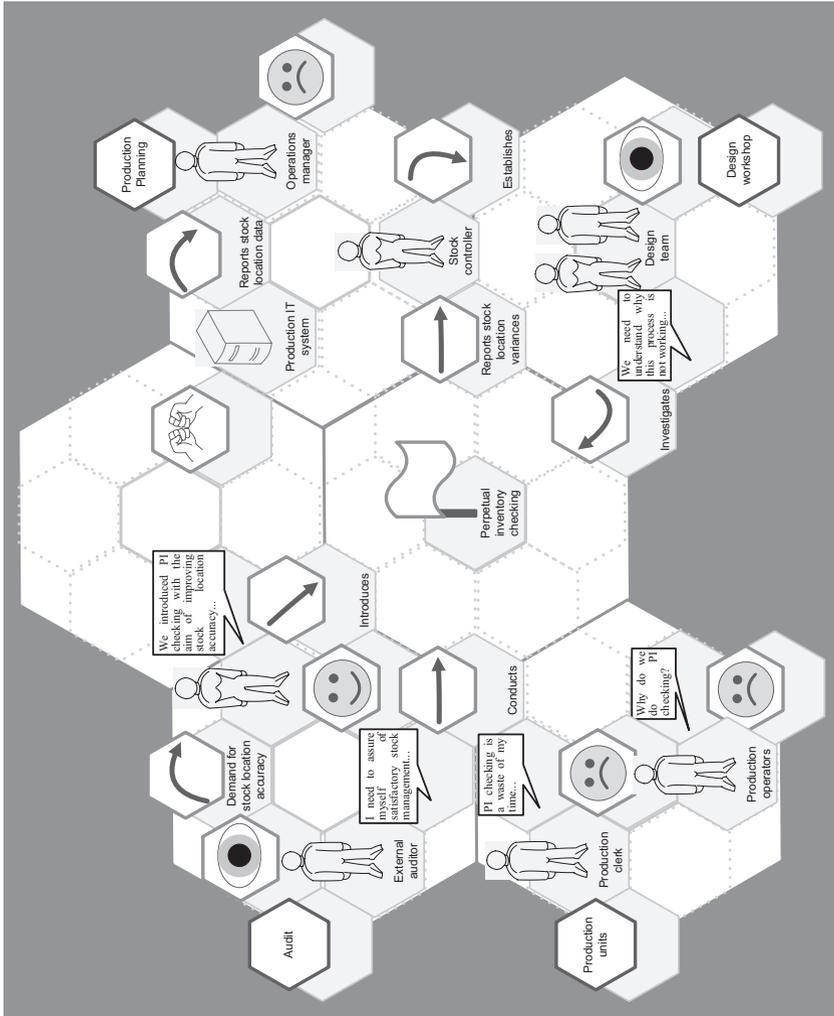
Fig. 7.3 A rich picture of a problem situation

situation for different stakeholder groups within a manufacturing organisation known as the Royal Mint. Fundamentally, this system was introduced into production by finance managers to improve stock accuracy at production locations. The activities prescribed for such checking were undertaken by production clerks at production units, but these persons did not understand the reasons behind this system of activity. After some period of undertaking these checks other managers such as the operations manager were puzzled that the stock reported by such checking did not exactly match that reported by the production IT system. So, the problem was set: some business analysis was needed to work out why this stock location inaccuracy was occurring. To solve this problem a design workshop was initiated and briefed with scrutinising the problem and suggesting improvements to this domain of organisation.

11   A Grand Challenge

In Chap. 3 we considered the grand challenge of providing effective care for the elderly in the face of an increase in the elderly population in countries like the UK. Suppose you want to understand the problem situation of bed-blocking in much more detail. You might start by building an affinity map of some of the key issues involved in this problem situation. In Fig. 7.4 the issues are expressed as states of the system of organisation under consideration. Within this domain issues that are felt to impact each other are placed close together on the affinity map. For example, the number of elderly patients waiting discharge from hospital is likely to be related to several issues such as the availability of places in care homes.

We can be more specific in our modelling of impacts by using some ideas from an area known as system dynamics. This will involve us adding arrows to the affinity map to indicate which issue or state of the system affects which other issue or state. Hence, we might clearly think that the number of elderly persons living alone in their own homes has an impact on the number of accidents experienced by such persons. But impact normally can occur in one of two ways. An increase in the state of one system issue may increase the state of some other part of the system. Conversely an increase in one state may contribute to a decrease in some other state.

We can add a plus sign to the arrow to indicate that an increase in one issue is likely to cause a further increase in the linked issue. For example, it is likely that the larger the number of elderly persons living alone in their own homes will mean more accidents suffered by the elderly. A minus sign, in contrast, indicates that an increase in one issue will lead to a decrease in the linked issue. Hence, the greater provision of support services for the elderly is likely to decrease the number of patients awaiting discharge from hospital because such support will enable them to return to independent living (Fig. 7.5).

An affinity map such as this is a useful basis for building a rich picture of some problem situation. Upon this rich picture we can add mannequins to represent
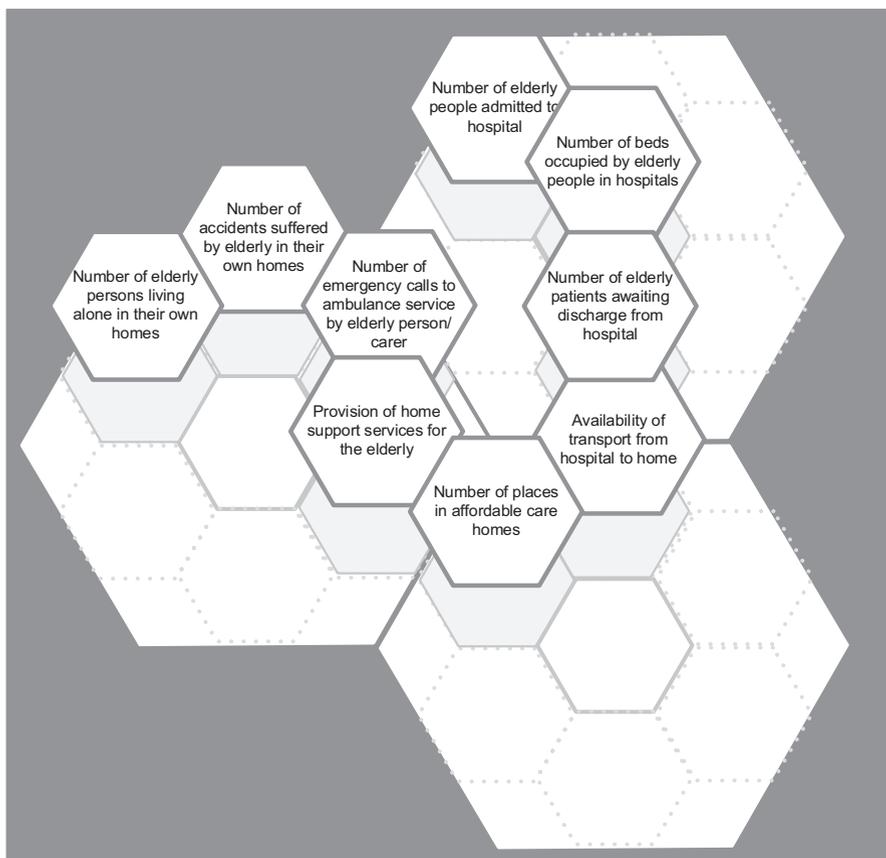
Fig. 7.4 Issues in elderly care

stakeholders and speech bubbles to provide a vignette of the stakeholder's view-point on particular issues, as in Fig. 7.6. Within this tabletop prototype we have also added some additional environmental issues such as lack of public sector funding that impact upon certain issues within the rich picture.

12   Conclusion

Organisational problems are best set as problem situations. Problem situations exist for would-be improvers. But the ways in which problems become situated rely on the worldviews of different stakeholders. A problem situation can be conceived of as a set of issues or concerns making up the worldviews of stakeholder groups. Such issues can be mapped through brainstorming and prioritised in terms of the MoSCoW framework. Stakeholders can be mapped in terms of groups that influence a problem and its solution. Their worldviews can be expressed as positions
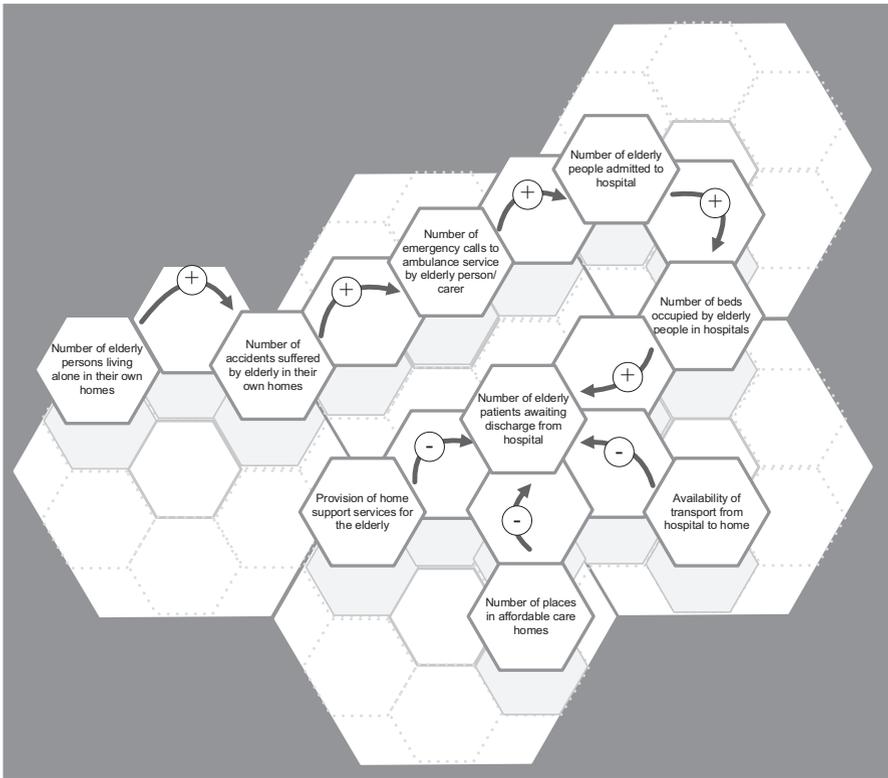
Fig. 7.5 An affinity map

Exercise 7.4

Conduct a problem-setting exercise for some other grand challenge that you know will affect your country in the next couple of decades. For instance, we know that the use of fossil fuels is continuing to damage our planet. How might we reduce consumption of fossil fuels by the introduction of electric cars, trains and trucks? What consequences arise for national energy infrastructure from this change?

Try to think systemically about this problem situation by conducting a brainstorming exercise in which you identify issues, their affinity and perhaps how they might be inter-related. Then see if you can develop a detailed rich picture which enables you to document as much of the important context for this grand challenge as you can.

Fig. 7.6 A rich picture for elderly care

they take in relation to issues within the problem situation. Each of these elements can then be expressed as a rich picture of the problem situation (Exercise 7.4).

13   Theory

The distinction between issues, problems and requirements is often a difficult one to make. As we have indicated in this chapter generally issues are useful as a means for setting the context for some exercise in business analysis and design. The important point is that issues should not be seen as separate but very much inter-related in a system. The designer can then use a mapping of key issues with their inter-dependencies to decide at which point to lever change. This is a critical concept within system dynamics—an approach to systems thinking first developed by Jay Forrester (Meadows 2008). After further analysis, this lever point can then become a defined problem and a set of requirements generated for how we might like the future state of the system to look.

14   Practice

The idea of rich pictures dates back to the first documented version of Soft Systems Methodology (SSM) in 1975 (Checkland 1987) where he described the rich picture in the following terms: 'the end point of this stage in the analysis should be a picture of the problem situation, one as rich as can be assembled in the time available.' Lewis (Lewis 1992) documents some of the genesis of this notion and also some of the confusion arising from the term 'rich picture': the association of the term 'rich picture' with an actual diagram; the idea that rich picture building is a required part of SSM; the notion that there is an established way of producing the content of a rich picture diagram. Rich pictures were not referred to by early practitioners of SSM but the term was gradually introduced by practitioners to denote an appreciation of some problem situation. Lewis feels it important to distinguish a rich picture, which constitutes some abstract understanding of a problem situation, from a rich-picture diagram, which illustrates or visualises aspects of such understanding. The notion of a rich picture relies upon the idea within SSM that different 'would-be improvers' of some problem situation will have different worldviews not only about what the 'problem' constitutes but also about the valid ways of resolving the problem through purposeful action. A rich picture diagram is a way of documenting some developing consensus amongst users of SSM about what the 'problem' constitutes. However, a rich picture might exist as an appreciative system (Vickers 1965) without any realisation in a rich picture diagram or diagrams. As a consequence, rich picture diagramming is not inherently part of SSM work. There is no inherent requirement that rich picture building must be done as part of an exercise of SSM. Rich picture diagramming is only one technique that can be applied within SSM. There are also no rules about how to draw a rich picture: each rich picture diagram should deliberately be unique and reflect the meaning of those creating it.

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Making Sense of Business Activity

8

1   Introduction

Within a classic of the silent movie era, *Modern Times*, Charlie Chaplin satirises the instrumental activity of the modern factory system. Within this system humans are portrayed as cogs in a mighty 'machine'. Unfortunately, Chaplin's vision is not too far from the truth as far as many modern work situations are concerned. The activity of many actors in modern work settings is pressured, monitored and rule driven. People seem to be working at the behest of an almighty 'machine'. But does it have to be this way? Ask yourself the question: is this the way you would like to work? or perhaps more importantly how you would like your children to work? One would hope that there are perhaps better ways of designing activity to meet both human and technological needs.

So, note, when undertaking any business analysis and design you cannot avoid questions of *what is better*. When a business designer designs a new business model for some domain, he or she will think of what is best usually in terms of measures of performance, such as efficiency. But beware. An efficient business model may not be an ethical or even an effective business model. Also, a business model designed to fulfil some short-term efficiency goal may have some long-term, nasty and unintended side-effects. For instance, designing a restrictive, highly regulated and highly monitored set of work practices may degrade staff loyalty, increase staff sickness and turnover and eventually raise a number of hidden costs for the organisation.

In this chapter we look at what people do or should do to organise. We shall look at how actors within organisations coordinate their activities in the pursuit of collective goals. We shall show how goals relate to the issue of value and then unpack the notion of performance and relate it to goals and their measurement. Finally, we shall consider how we can design patterns of coordinated activity to achieve goals.

Human activity is normally directed at some goal and does not occur in isolation. Instrumental activity is normally undertaken in response to other actors and their activities. When the activities of two or more actors are directed towards a common

goal then issues of coordination come into play. If multiple actors pursue a common goal, they have to *organise* their joint actions. This extra layer of organisation we refer to as *coordination*. Such coordinated action typically relies on convention, which provides the motor for the regularity or patterning of activity. When it is possible to set a coherent boundary around such patterning then we speak of an activity system.

To remind ourselves, we take a system to be a patterning of some phenomena. Systems display order or organisation. We take a patterning of something to be a sign of organisation. Within business analysis and design, we look to observe such patterns within domains of socio-technical organisation. We also attempt to model such patterns, as well as innovating new patterns of action. It is convenient to think of three levels of patterns that need to be identified in any consideration of organisation: patterns of coordination (activity), patterns of communication (information) and patterns of articulation (data). We also need to understand how such patterns relate or entangle to build systems of organisation. In this chapter we shall focus upon patterns and systems of instrumental activity directed at the transformation of value (performance). In later chapters we shall focus upon patterns and systems of communication, then upon patterns and systems of articulation.

2   Coordination

This chapter considers the first layer or aspect of socio-technical organisation which we refer to as coordination. This stresses the need for the designer to be interested not only in individual performance but in coordinated performance between people as well as between people, artefacts and machines.

Let us consider a rather commonplace but also 'strange' example to illustrate some of the themes which lie within the realm of coordination. The act of walking is an accomplishment—an activity that we all take for granted every day. We only become aware of the difficulties underlying this accomplishment when aspects of this activity breakdown. For instance, when we trip up or accidentally collide with a fellow walker.

All human walking is based upon a common and cyclical pattern referred to as the double pendulum—but the activity of walking is far more than the physical act of locomotion. Perambulation, or the act of walking through some space, is a complex, coordinated activity reliant upon internal and external communication.

As an individual accomplishment perambulation involves an actor in navigating through some 'space'. Such a space is typically occupied by other moving persons—so reading *signs* of others' bodily movement and inferring the likely trajectory of other actors is critical to successful navigation. Perambulation is thus not just an individual activity it is also a social activity. When walking through certain spaces we frequently inter-act with other actors, also perambulating.

Studies of the way in which large numbers of actors walk through huge public spaces reveal that patterns of order emerge spontaneously from the interactions of

many individual perambulators. Clear 'lanes' begin to develop in such moving crowds—people coordinate their collective behaviour to avoid collision. They perambulate as if in unison to form an organised milling crowd (Exercise 8.1).

> **Exercise 8.1**
> How do such patterns of perambulation emerge in human crowds? Can you think of what patterns of individual action cause the production of patterns of collective action—the 'walking in lanes' pattern?
>
> Other animals produce patterns of collective action from simple individual behaviour. Think of swarms. How do swarms of thrushes or of mackerel behave? How do such swarms emerge from the individual behaviours of thrushes and mackerel?

3   Purpose and Value

So, what is organisation for? The answer to this question must relate to questions of purpose and value: what are we attempting to achieve; what value do we derive from certain activity? But purpose without action is fruitless and frustrating. So, of course, is action without value.

One key advantage of a system's view of organisation is that it allows us to directly engage with the question of what is organisation for? Any system is teleological—it exists to fulfil some purpose or purposes. The purpose of some system is typically expressed as a goal or goals that the system is directed at achieving. For technical systems the goal or purpose of the system is relatively clear-cut. It is for this reason, as we have seen, that they are referred to as hard systems. For instance, the purpose or goal of a thermostat is clearly to regulate room temperature.

Systems of human activity are different in the sense that the goal or purpose of such systems may be much less clear-cut. The goal of a human activity system frequently will depend upon who you ask. This is why human activity systems are sometimes referred to as soft systems. For example, the purpose or goal of a university will differ depending upon who you ask. 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 socio-technical action is the first step in designing any system of organisation. Any organisation must be concerned with what steps (activities) we take to achieve some purpose or satisfy some goals. As we have seen, purpose is frequently expressed in terms of the notion of value, at least as far as human organisation is concerned. In such terms, organisation is a 'mechanism' or system for achieving or creating some value. But definitions of value depend upon the perspective taken by particular actors. For example, what is the value of walking? The answer to this question clearly depends on *why* you are walking:

- Getting from point A to point B
- Keeping fit
- For enjoyment—experiencing the outdoors, countryside or cityscape
- Saving money on transportation

The goal of most systems of action relates to the issue 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 (1954) 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 Chap. 2, is an arbitrary concept: it depends on what is considered of worth by some community of people (Fig. 8.1).

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 the with 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.

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 (1985) thinks of organisations as value chains and believes that competition amongst business organisations is all about the attempt to deliver better value to customers. Lean thinking focuses upon
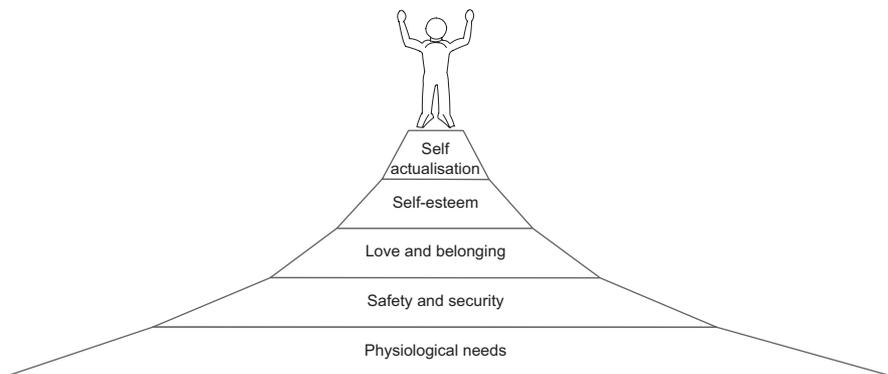

Fig. 8.1   The needs hierarchy

improving manufacturing by designing what it refers to as the value-stream to eliminate 'waste'—non value-adding activities. Alex Osterwalder (Osterwalder et al. 2014) conceives of strategy-making and digital innovation in terms of developing the value-proposition of some business.

The idea of the organisation as a value chain is similar to an idea from lean thinking known as the value-stream. The value-stream is a sequence of activities required to design, produce and provide a specific good or service to a customer. The objective of lean thinking is to identify within this value-stream those activities which add value and eliminate those activities which generate waste in terms of measures such as the time and effort to do things.

According to the idea of the value chain and value-stream then, an institution such as a business organisation can be seen as consisting of a series of interdependent chains made up of related activity systems that deliver value. But organisations, as we have seen are open systems. This means that they 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. Hence, people speak of an organisation's supply chain, customer chain and partnership chain as clear conduits for the flow of value within an organisation's wider value-network.

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.

4   Coordination Problems

The mathematical biologist Robert Axelrod believes that cooperation or collaboration is a selective strategy adopted by many organisms to improve the survival of such organisms (Axelrod 2006). Cooperation is achieved through coordination of activity. 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 inter-related 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 driving along a road network as a system of activity. The common goal of actors within this system is to travel between their point of departure and their destination using this road network safely—in other words, without colliding with fellow actors (other drivers and vehicles) using this network. This means that actors

driving the road network experience coordination problems. Such coordination problems are resolved through adopting one or more conventions of driving, which in a country such as the UK, are documented in the highway code.

Consider one coordination problem experienced in this activity system 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. Most other countries of the world adopt the convention of driving on the right and giving way to traffic on the left. This demonstrates that conventions by their nature are arbitrary. They are nor fixed, but rely merely on precedent. 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 situations (Exercise 8.2).

Exercise 8.2
In Sweden in the 1960s they switched over from driving on the left to driving on the right. How difficult do you think this was to establish? What do you think the Swedish authorities did to try to establish this new coordination convention?

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5   Equifinality and Design

Design is possible in relation to the design artefact of systems of organising because of the property of equifinality. Systems or patterns of organising are open systems and all open systems display *equifinality*, which 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. Another way of putting this is that we can implement different conventions of action to achieve the same outcome, of creating value.

The equifinality of business activity was recognised quite early on. In the early twentieth century Frederick Taylor (1911) proposed that management should closely study the way in which business activity is performed, with the aim of re-designing activity to better achieve established goals. This implicitly assumes that established goals can be met by doing work in many different ways, but that certain ways may be better than others. Take the simple activity of shovelling raw material such as iron ore, which was important to ensuring the effective flow of this material within iron foundries at the time. The transformation of value in this case is the movement of some volume of raw material from one place to another. Taylor studied this instrumental activity (activity directed towards achieving some goal) in some detail and then prototyped a number of different ways of shovelling raw material. From this analysis he implemented a number of design changes, such as training workers in the use of different shovels for different material and introducing regular rest breaks for workers. These changes collectively improved the performance of this activity.

6   Performance and Performance Measurement

Evident in this case of the design of shovelling is the link between activity, goals and performance. To engage in design of any system of action we first need to establish the goal or goals of this system. We then need to establish what we mean by the performance of the system. Finally, we need some way of measuring the performance of any designed system against declared goals.

In terms of coordinated 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). It is no accident that the English verb *to perform* and the noun *performance* have a common root. There is a clear relationship between performing some business activity and measuring the performance of such activity.

The activity of driving an emergency ambulance to an incident involves the transformation of moving paramedics and specialist medical equipment to the location of some medical emergency. Clearly, we can measure the performance of this activity in several different ways. In practice, such activity is typically measured in terms of response time—the period of time elapsed between an ambulance being dispatched to an incident and arriving at the location of an incident. Since delivering medical treatment quickly at point of incident is a key goal for this activity system, response time is best seen as a measure of the efficacy of this system—how well it is doing what it is designed to do.

Or, take the activity of galvanising steel product. The transformation here involves coating steel products such as steel lintels with a zinc coating. We might want to measure the performance of this activity, perhaps in terms of the productivity of this activity. To do this we compare the output from the activity with the input into the activity. Perhaps as output we might calculate the throughput in terms of how many items of steel product are produced on average per working shift. We then calculate the amount of resources such as people, equipment and of course zinc we need on average for each working shift. A ratio of resource to throughput will give us an efficiency measure—a measure of the productivity of galvanising.

Or, take the example of a major supermarket chain that decides to introduce an online grocery arm. Clearly, the effectiveness of this new way of doing business for the company needs to be measured. One possible way of doing this is to compare online sales of its foodstuffs with offline sales in its conventional supermarket stores. This might establish the level to which online grocery (the subsystem) contributes to overall sales of the supermarket chain (the supersystem).

It should be apparent from all these examples that measurement is best seen as a form of communication—a means of informing certain actors of the state of certain aspects of some system. Hence, if we wish to measure something, we must first choose certain signs to stand for things in which we are interested. We then use these signs, typically in some aggregate way, in the evaluation of the worth of some system or pattern of activity (Exercise 8.3).

Exercise 8.3

Why do we use an arbitrary number of 60 seconds to the minute? Why is the measurement of time so important to coordinated action? Why is temperature so important to safe performance within the workplace? How does the Fahrenheit scale differ from the Centigrade scale? How is productivity typically measured? Why is productivity typically measured within the work-place—what is the goal of productivity measurement?

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. Likewise, we measure temperature using a mutually agreed sign-system such as the centigrade scale, which is calibrated in terms of two major natural signs: the freezing point of water and the boiling point of water. The standardised measurement of time is a precondition for measures of response-time, whereas the standard measurement of temperature is critical to manufacturing processes such as galvanisation.

This shows how the development of sign-systems helps us measure business activity such as productivity, sales, procurement and so on. 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.

7   Control

We know that something is systemic if it is ordered or organised: if we see evidence of patterning. Hence, a common pattern of activities is evident in situations such as the Goronwy Galvanising or the medical emergency response examples. These patterns consist of routines through which organisational actors perform work. But such order of patterning must be sustained and this is achieved through some form of control. In other words, if we observe a common pattern across situations then we know something is organised and most likely there is evidence of control.

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 and 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 amongst groups of actors.

Hence, control can be conceived both as a process of regulation and as 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 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 (Exercise 8.4).

> **Exercise 8.4**
> Reinforce your understanding of the link between 'to perform' and performance? How do you know you are doing what you should be doing?
> Give me an example of a way of doing something and how you would measure the performance of this activity.

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.

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 Fig. 8.2 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.
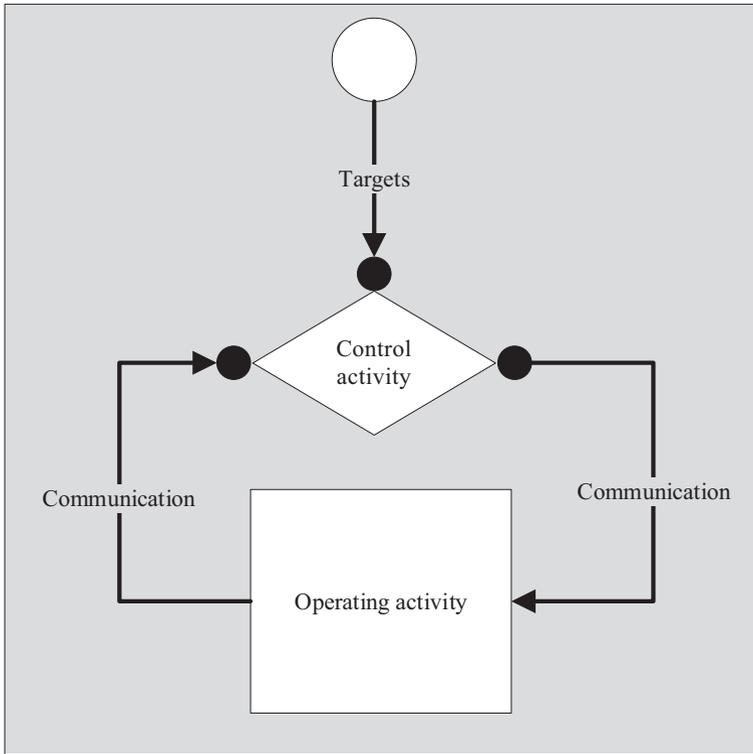
Fig. 8.2 The system of control

The loop of communication and control evident in the tabletop prototype illustrated in Fig. 8.3 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.
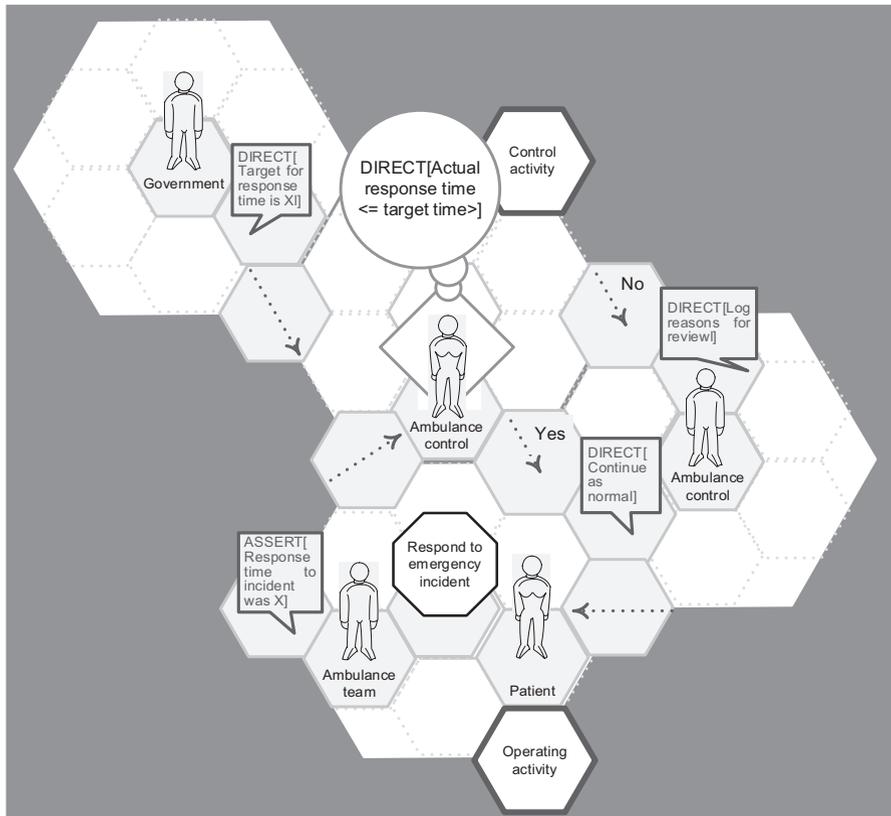
Fig. 8.3 Control in practice

8   Performance Measurement

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 mis-aligned 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 in an attempt 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 the 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.

9   Patterns of Activity

Whenever we analyse or design an activity system we must tell a story or provide a narrative of its working. In formal terms (Abell 2004), any narrative or story can be seen to be made up of a number of standard elements:

- A finite set of actors or characters. Actors may be individual or collective. They may be humans or institutions, artefacts or even 'machines'.
- A finite set of descriptive states relevant to some 'world', such as a domain of socio-technical organisation.
- A weak order in time expressed on the set of states. This defines the chronology of states—what happens first, second, third and so on.
- A binary causal relation between some pairs of states. The relations will run from earlier states to later states in the chronology. These ordered pairs can be considered events within the narrative.
- A finite set of actions that transform some elements of the states of the world. The actions transform earlier to later states in the chronology of the narrative.
- A mapping of the set of actions onto the set of actors. This will show which actor(s) performs which action.

Informally, this means that to tell a story of an activity system we need ways of describing actors taking action in a defined chronology of events, sometimes also in different spatial locations (Exercise 8.5).

> **Exercise 8.5**
>
> Consider a thought experiment. Numerous books and films have the mythical zombie as a central character of threat and horror. One recent film has zombies taking over the World. But consider if this is possible—is there not an inherent contradiction within the plot of such films?
>
> Assume that zombies exist and that the defining feature that makes zombies different from human beings is that although they act, they have no consciousness of acting. Consider why these differences make it extremely unlikely that zombies would be able to effectively cooperate and collaborate to take over the World.

10   Phrasing Activity

The management scientist William Edwards Deming once said that 'if you can't describe what you are doing as a process, you don't know what you are doing'. There is a clear synergy between the idea of activity patterns (and more generally that of an activity system) and other ideas familiar within the business and ICT literature. We have already mentioned that there is a resemblance between the idea of an activity pattern and that of an organisational routine. Activity patterns also bear a resemblance to business processes (Hammer 1990). The approach of soft systems utilises the idea of a human activity system (Checkland 1987). As we shall see there are also inherent similarities between the themes underlying activity systems and those found within the philosophy of lean systems or lean production (Holweg 2007).

To prove the point, let us examine one of these ideas in more detail: that of an organisational routine. Within the literature of Organisation Science, an organisational routine is considered as a pattern of interdependent actions undertaken by multiple actors. Such routines have two sides to them because they adhere to the idea of structuration discussed in Chap. 4. Routines in principle constitute resources for actors that enable and constrain the performance of routines in practice. Routines in practice constitute actual performance that create and recreate routines in principle. Within the USC case, for instance, clerks utilise the routine of booking customers upon course presentations as a way of directing their own action. They use the idea of this routine as a resource to guide what they should do in taking actual bookings. But their actual accomplishment of making specific bookings in a certain way recreates this routine. The act of booking clerks acting in a patterned way reinforces the idea of this particular routine within University Short Courses (USC).

Within this book we use the idea of an activity system as an attempt to generalise the issue of coordination, which all of the approaches mentioned above implicitly focus upon, and in doing so we try to build a more integrative account of this issue. In calling something an activity system we are trying to think of how do, or how should, actors cooperate and coordinate their activities to realise collective goals. In our terms, any process is better described as a pattern of coordinated activity. Some of the key goals of business analysis are to analyse, describe and possibly re-design such patterns of activity.

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. Organisation is a continual accomplishment in the face of disorder. Organisation is an island of negentropy—patterned order—in a sea of entropy and requires the use of energy through work. In relation to human systems, work can best be thought of in terms of patterns or systems of activity that create value. But the creation of value is not normally achieved through individual, but through collective action. Actors coordinate their work within such systems in the achievement of collective goals.

Work typically involves three forms of transformation: production, distribution and consumption of value. For example, the following statements all consist of a description of activities involving the production, distribution or consumption of goods:

- Manufacturing a table
- Growing foodstuffs
- Transporting passengers
- Retailing goods
- Delivering parcels
- Purchasing food
- Hiring a car

Or consider a range of activities more appropriate to services:

- Cutting hair
- Paying benefits
- Educating children
- Caring for the elderly
- Collecting waste
- Providing healthcare
- Managing funds
- Issuing insurance policies

Note that the phrase we use to describe an instrumental activity typically begins with some verb which indicates a certain transformation of something, such as manufacturing, paying, collecting and managing. The second part of each phrase consists of a name which denotes the value transformed such as goods, food, waste and benefits.

11   Roles

We tend to bundle actors and the acts they undertake into organisational *roles*. By doing so we are inherently making the analogy between organisational life and drama. There is a perspective in Sociology which is referred to as the dramaturgical perspective. This perspective adopts the stance familiar in this quote from the play

As You Like It by William Shakespeare: '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 therefore a package of expectations as to the actions appropriate in particular settings. My role as lecturer is subtly different from my role as consultant and very different from my role as husband or father or grandfather. Roles are resources for actors. Much like organisational routines they help guide decisions about what action to take—what to do, how to communicate and what to record. Therefore, we make the argument that a role is a convenient device to define as a 'package' of conventional action as illustrated in Fig. 8.4. Such packages are 'assigned' to particular actors acting in particular settings.

Within business settings many expectations will be formalised in representations such as job specifications. However, many expectations will be semi-formal or informal: no-one has written down what is expected; people learn how to 'perform' a particular role over time in interaction with other business actors. Roles, as we shall see, form a critical part of the business models we shall build.

Within forms of interaction and product design the idea of defining *personas* has become popular. A persona can be seen as a type of role defined by the designer to encapsulate the way in which a group of persons is likely to interact with an ICT system or react to a product. Personas are often considered characters in a story and have attitudes, goals and concerns which help define their motivations for taking particular actions in relation to artefacts.

The designer when she specifies roles, personas or job specifications in the models she builds is attempting to draw upon the human capacity for empathy. Empathy is typically described as the capacity or ability of some actor to recognise and, to some extent, share the 'mind' of some other actor. This is often phrased as being able to 'walk in another's shoes'.

Fig. 8.4   Roles
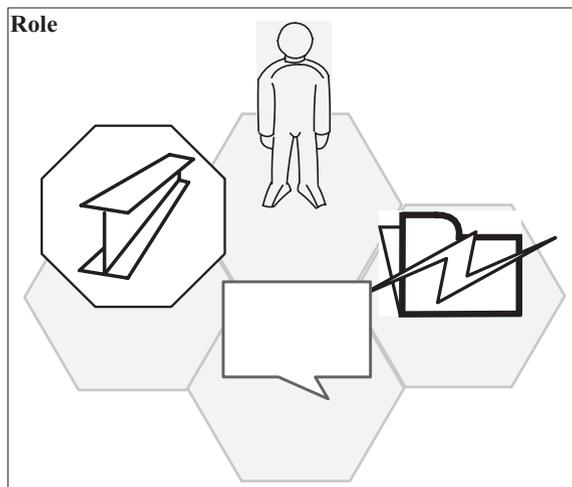
Empathy is often discussed in terms the sharing of feelings, which is much evident in work on non-verbal sign-systems such as human facial expression. Human facial expressions signal to others a person's emotional state, which is then in some sense shared by other actors—they empathise with the person. What is interesting is that DeWaal documents convincing evidence that empathy as an accomplishment is common amongst the great apes (DeWaal 2010)—thus lending support to an earlier hypothesis by Charles Darwin.

But empathy, of course, involves not only the sharing of feelings but also a range of aspects making up the human psyche or 'mind'. So, designers will attempt to empathise with not only a user's feelings about certain interactions with an artefact but their reasons for doing so in terms of background and motivation. This is why persona definitions frequently include details of education, lifestyle, interests, values, goals, needs, limitations, desires and attitudes.

12   Tabletop Prototyping an Activity System

Let us consider a very simple case of an activity system. 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 amongst 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 do get it on time and of a requisite quality.

In this simple example we have all the component elements making up an activity system. 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, and records need to be made—but these are topics for further chapters.

Consider 'Meals on Wheels' solely as a system of activity. If we analyse what this domain of organisation does, we may unpack a high-level sequence of activities undertaken by nominated actors. Within Fig. 8.5 we indicate what a first-pass table-top prototype of this domain might look like. Note, start and stop connectors are used to indicate the boundary of this system. An individual hexagon placed upon the design landscape is used to indicate a nominated activity and the relevant actor(s) are placed within the hexagon as mannequins. The mannequins are labelled with names for the likely roles that actors play within the sequence of activity which is indicate with dotted arrows placed between hexagons.

A model such as this is useful not only because it includes a rough idea of activities and their coordination, but also because it also gives us an idea of likely roles being played within this pattern of organisation. Clearly two roles critical to this pattern are elderly person and volunteer. To add more detail to the analysis and to help in re-designing this pattern, a useful exercise is to build a persona for the typical elderly person who signs up for the service and the typical volunteer who gives of their time to helping the elderly in this manner (Exercise 8.6).

> **Exercise 8.6**
> The illustration of a tabletop prototype in Fig. 8.5 is clearly a simple first attempt at analysis. Try thinking about some additional activities that would need to be added to this pattern.

13   Conclusion

The Greek philosopher Plato in one of his dialogues had his mentor Socrates saying that 'the life which is unexamined is not worth living'. The same might be said of domains of organisation—the domain which is left unexamined is probably not worth having. Business analysis is the continuous endeavour devoted to the critical examination of ways of organising. Business design is the complementary endeavour of creating future ways of organising.

One way of examining ways of organising is in terms of the purpose of such organisation. In such terms organisations can be seen to be value-creating systems. So, there are a number of questions we can ask of organisation in any domain. We begin with the question of *what do you* or *should you do?* This question suggests the issue of coordination which we have introduced in this chapter.
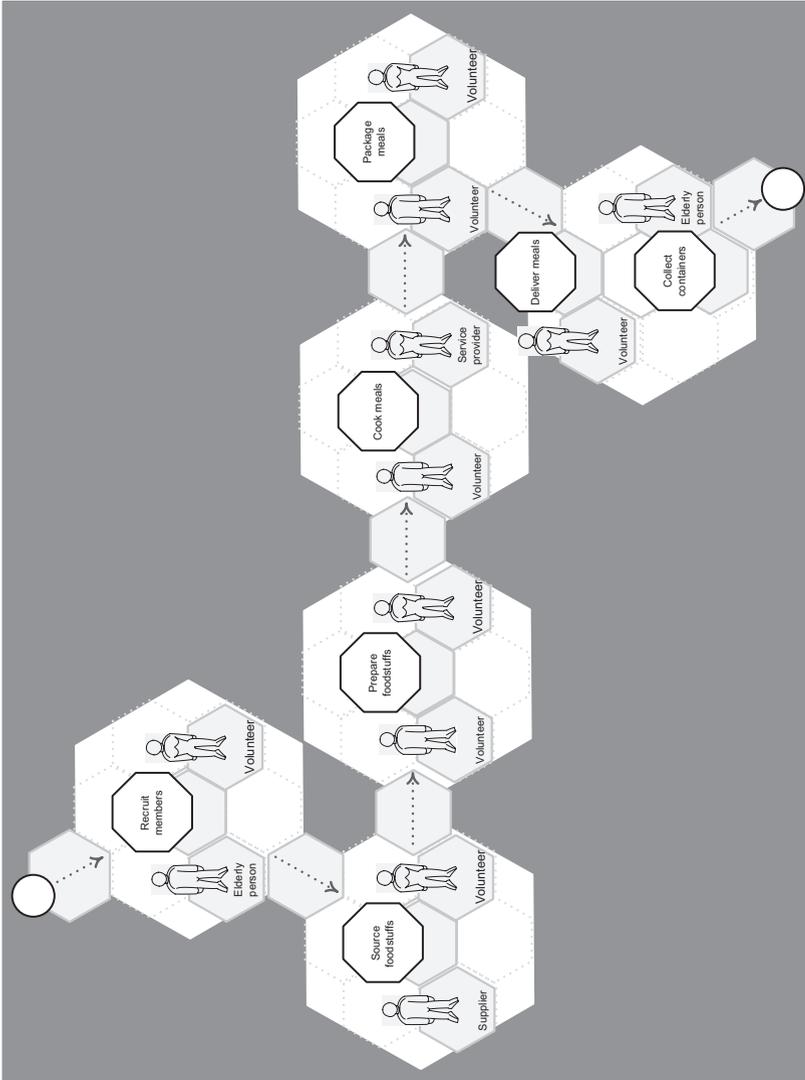
Fig. 8.5 Meals on Wheels as an activity system

14   Theory

The sign we utilise to stand for coordinated activity suggests *handedness*—our species ability to use our opposable thumb to grasp and use tools. This is clearly a crucial feature of a human's ability to perform—to take instrumental action or to transform the physical world. Coordination stands for the 'work' of people, machines and artefacts in collective inter-action and as such lies within the realm of an activity system. Instrumental activity as a domain of concern is considered in Chap. 10 of my book *Significance*.

The idea of value is particularly relevant to the work of Michael Porter who, as we have seen, describes a number of primary and secondary activities which he sees as making up the value chain of organisations. The idea of the value-stream is similar in nature and much used within lean thinking to conceive of the way in which activities within production either add value to the stream of work or contribute waste. The value-network expands upon the idea of value-creating activities to consider how they critically affect the external environment of the organisation. These ideas are discussed in more detail in my book *Business Information Systems* (Beynon-Davies 2020).

15   Practice

The idea of an activity pattern can be seen as an abstraction of the notion of a business process. Mapping instrumental activity is core to conducting process analysis and process design. Standard notations are available such as the Business Process Modelling Notation (BPMN) for drawing and specifying the workings of business processes (Holt 2010). Other less formal approaches include the conceptual models of soft systems method (Checkland and Scholes 1990) and the ideas embedded in value-stream mapping.

Business Process Modelling Notation (BPMN), which was developed by the Business Process Management Initiative and is now maintained by the Object Management Group. Its aim is to provide a standard notation that is readily understandable by a variety of business stakeholders, including business analysts who create and refine business processes, technical developers responsible for implementing the ICT systems they need, and business managers who manage and control them. Some of the key constructs from this notation are illustrated in Fig. 8.6. In the next chapter we shall provide a couple of examples of modelling using BPMN and indicate how activity patterns are positioned in relation to process models.

Actor	Events or actors in the external environment are represented as circles on in the process model. These act as triggers for given processes and serve as the start or end-point of a process, or as an anchor for some an intermediate result within a process.
Process	A process, activity or task defines a coherent piece of work, and is represented by a labelled box.
Decision	Decisions or decision points represent key control points in a process, and are also used to fork, join or merge different flows in a process. Decision points are represented by labelled diamonds.
Flow	It is sometimes important to include the flow of physical items such as raw materials or finished goods on a process model. For this purpose a broad, labelled arrow is used.
→Flow→	Two types of message flow in support of activities can be represented on a process model. A labelled solid but narrow arrow with a solid arrow-head is used to indicate the direction of data flow.
Flow	It is sometimes useful to distinguish between non-physical flow of data and the physical flow of paper documentation on a process model. For this purpose, document symbols are placed on the arrow.
Annotation	Annotations serve to provide additional information in the description of some process, sequence, decision or data flow, and are attached by a line to the appropriate modelling construct.
·······▸	A sequence arrow represents the precedence of activities performed within some process, and are indicated by dashed or dotted lines with open arrow-heads.

Fig. 8.6 Constructs from BPMN

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Models of Activity

9

1 Introduction

The sociologist Norbert Elias (Elias 1978) published a fascinating and accessible academic textbook book some time ago titled, *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 of individual actors. Instead, society is a system consisting of the multitude of individual actors accomplishing relationships through their actions. Such actors through their relationships and actions produce and re-produce patterns (Elias referred to them as figurations), which in turn serve to constitute society. In such terms, what we know of as society emerges from this complex and adaptive system of action.

Within Chap. 4 we established that human organisation relies on the patterning of conventional action. Actors perform expected actions and in doing so constitute (produce and reproduce) organisation. This chapter considers a number of ways of modelling such conventions of action. Modelling, as we have mentioned in Chap. 3 is critical to activities of both analysis and design. Building models is important not only for understanding problem situations but also for exploring problem solutions. We focus on ways of visualising patterns of coordinated activity in this chapter. In further chapters we consider how to model patterns of communication (Chap. 11) and patterns of articulation (Chap. 14).

2 Visualising Patterns of Activity

To get a grip on the efficacy of patterns of organisation (*are we doing things right*) we build models of either what we are doing currently (as-is) or what we should be doing in the future (as-if). Models of either type are useful in several ways:

- We can use them to simplify the complexity of some domain, representing the important things of interest for the purpose of communication between groups of designers but also between designers and system stakeholders.
- Models can hence be used as tools for building mutual understanding not only within a community of design but also amongst some community of actors.
- Models are therefore useful tools to think through, negotiate and plan new forms of organisation.

Within this book we use two central techniques to model patterns of organisation—building tabletop prototypes and producing pattern comics. These two techniques, as we shall see, are complementary forms of visualisation. We introduced tabletop prototyping in Chap. 3, while in the current chapter we focus on the related technique of pattern comics. The term comic derives from the Greek *komikos* which means pertaining to comedy. Comics for most of their history have been used as an entertainment genre: as a way of telling a story to the public. They are still very popular and have even achieved the status of a literary genre, through comic novels such as *300* or *V for vendetta*. During the 1930s, Walt Disney started to use comics for the purposes of designing animations. These types of comic are generally known as storyboards and the process of producing them within design as *storyboarding*. More recently the idea of storyboarding has been used widely within software design, particularly website and interface design. These types of comic are referred to as design comics.

There are several reasons why comics are appropriate as a design technique. First, a comic consists of a sequential arrangement of both pictures and words to narrate a story. A comic is therefore both a visual and a textual form of representation. Comics are a unique hybrid that exploit in a freeform way the strengths of both images and text as media for portraying a coherent storyline. Second, comics are well known and well-read as popular genre. Because of such familiarity, as intermediate representations, comics appear to be readily accepted and understood by non-technical actors. Third, this genre is particularly well-suited for expressing the ways in which actors take action. They are also good at expressing transformation resulting from actions. Fourth and finally, comics utilise well-established conventions for expressing events as 'movement' of action through time and space. Therefore, they offer a particularly useful way of expressing the dynamics of organisation.

Because of our focus within this book on designing domains of socio-technical organisation, we prefer to refer to design comics as business pattern comics or pattern comics for short. This is because we shall use them not only for the purposes of designing patterns but also for the purposes of analysing patterns of organisation. There may even be a place for using such representations as aids to implementing business patterns.

To use a pattern comic to tell the story of some activity system we need ways of describing actors taking action within a defined chronology of events. Our pattern comics offer a way of visualising all these component elements of a story or

narrative. A typical comic is made up of a series of panels, with each panel consisting of one or more cells. The finite set of descriptive states for the domain of organisation in question is visualised as a finite collection of comic cells, each cell typically describing one state of action within the overall business pattern.

The chronology of states within some pattern is expressed in one of two ways. The sequencing of cells normally follows some convention of presentation such as a left to right and top to bottom arrangement across the page. When such a convention is broken, dotted arrows are used to establish the chronology of the narrative. Therefore, each cell is generally used to represent a snapshot of action (event) within an overall plot and a linked series of such cells is used to narrate the storyline. Human actors are represented by stickpersons or named mannequins within comic cells. Machine actors such as ICT systems or artefacts such as data structures are represented by appropriate icons. Actions are represented within a comic cell by a directed arc in which the actor enacting the appropriate action is placed at the foot of the arrow. Such action-arrows are also annotated to indicate not only the type of action undertaken but also the transformation resulting from a particular action. Hence, each comic cell expresses the action responsible for transforming earlier to later states in terms of the business pattern.

When actors are represented, speech bubbles (to indicate external dialogue) and thought bubbles (to indicate internal dialogue) are attached to pictured characters—particularly within patterns of communicative action, as we shall see. Captions are also attached in a more free-form way to cells and are used to convey additional message content over and above that conveyed by visualisation. These elements are illustrated in Fig. 9.1.

We emphasise the use of comics not only for design but for analysis more generally. Whether for analysis or design we put central emphasis on using three levels of comic for representing patterns of organisation. We draw one or more comic panels for each of these three levels of socio-technical organisation. Alternatively, the three levels of organisation can be included in one integrated comic spread over several panels. We shall see examples of each type of comic throughout the remaining chapters of the book.

There are a number of reasons for using comics in this manner. Comics are highly visual, and we know that 'a picture paints a thousand words'. We deliberately use only a few constructs within a pattern comic to help us think differently about organisation. Just like tabletop prototypes, comics are deliberately freeform in nature—you can add to the core constructs of comics with ease. Most people, with little prior training, find it reasonably straightforward to 'read' a comic. We use comics to focus upon patterns of action by actors. In other words, we put actors and action at the centre of our representations of organisation. Finally, such comics can be used not only to document common understanding about what people do or think they do, but also to document ways of improving some domain of organisation.
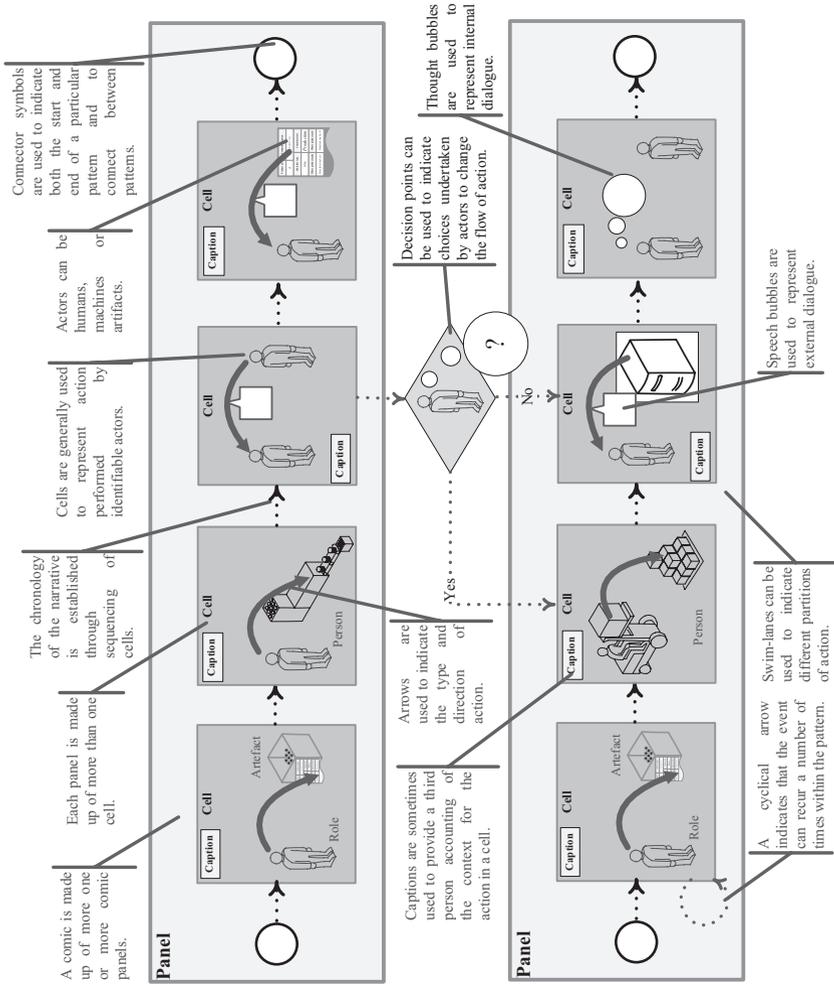
Fig. 9.1 Elements of a pattern comic

3   Drawing Anxiety

Our use of the term *visualisation* should not be taken to refer to an internal exercise in imagining something. Instead, we use the term visualisation to denote the process of portraying something in visual form. Visualisation, as we have mentioned, is commonplace within design activity but is now proposed more widely as important within business activity (Brand and Koene 2017; Brand 2018). However, it is interesting that although we live in a highly visual age, many people have what might be referred to as *drawing anxiety*—they rarely express ideas visually but prefer to communicate through text or speech.

As young children we thrive on drawing things—we use the act of drawing to explore our understandings of the world. However, by the time we enter secondary education this way of expressing ourselves appears to be knocked out of us. What is worse: certain anxieties are introduced into our attempts at visualisation. These anxieties get expressed through statements such as 'I can't draw' or 'I am rubbish at doing pictures'.

The visuals you see within this book have been produced using a software tool. However, within acts of business analysis I would encourage you in the first instance to always use pen and paper or pen and whiteboard or flipchart. To help overcome your visualisation anxiety, draw things quickly and roughly. Do not worry about the aesthetic merit of your visualisation; concentrate on making sense quickly with figures. Use stickmen, boxes and bubbles rather than finely drawn icons. Most importantly, do not be afraid of wiping things out or throwing things away and starting again.

4   Comics of Activity Patterns

In terms of activity patterns and systems, the basic cell of our comic is a representation of one instrumental activity. But you can use comic cells to draw such activities in two ways. You can use a comic cell as a representation of an actual activity performed by an actual defined actor, perhaps observed in doing something (Chap. 6), such as, *Joe Bloggs galvanised ten racks of lintels in the first hour of shift 4* or *Jane Bloggs took ten bookings for five courses yesterday*. In contrast, you can also use a comic cell to represent a class of similar performances, such as, a *production worker galvanises products* or a *bookings clerk takes bookings*. In this latter sense, a given cell within a comic is an abstraction from a range of actual activities performed by particular people within the domain in question. Terms such as *production worker* or *bookings clerk* represent roles undertaking or enacting designated activities.

It is important to note, that we include both human and non-human actors in our cells. Humans and machines inter-relate to form patterns of value transformation. ICT systems of various forms play important roles in contemporary patterns of organising.

As mentioned, throughout this book we take examples from several distinct domains of organisation. Four key domains are used to consider ways in which business

significance such as through activity patterns is accomplished. You will find written descriptions of each of these cases at the back of this book. A number of other cases are also included at various points in the text to encourage further investigation.

Figure 9.2 illustrates one act of instrumental activity from each case domain as a pattern comic cell. Take one of the examples in Fig. 9.2, which is a cell representing an activity from the emergency ambulance service case. Here, *a paramedic delivers emergency healthcare to a patient*. Paramedic and patient are identifiers for two key roles in this domain. An arrow is drawn from the paramedic to the patient to indicate that the paramedic performs a certain action upon a certain patient. The arrow is annotated with a description of the transformation of value making up this action. Within this annotation, *Administer* is the transformation and *emergency healthcare* is the value delivered.

Figure 9.2 also illustrates how each instrumental activity might be represented as a cell upon a tabletop prototype. Hence, it is relatively easy to take the pattern details from a tabletop prototype of an activity pattern and translate them into a pattern comic. This means that a tabletop prototype can be used to explore issues and different ways of organising that help resolve issues identified in the early stages of design work. When a degree of stability has been reached within design then the pattern can be produced as a comic for easier portability and as a record of design decisions.

5   Activity Systems

The English Tudor poet John Donne once published a poem which begins: 'No man is an island, entire of itself; every man is a piece of the continent, a part of the maine.' To remind ourselves, instrumental activity involves actors taking roles and transforming value in some way. But no activity is an 'island' in and of itself. Activities take place in patterns and we think of an activity pattern as an inter-related sequence of coordinated activities undertaken by different actors. Certain activities rely on preceding activities and such activities in turn may be the antecedents of other activities. Hence, to understand and represent an activity pattern we have to think of a chronology (a timeline) of performance.

Each cell of the tabletop prototype in Fig. 9.3 is an act of instrumental activity. The dotted arrows between cells indicate precedence or sequence—this activity leads to this activity which leads to this activity and so on. We also add two symbols to indicate the start of the pattern and the end of the pattern. These so-called connector symbols indicate that a given pattern of activity is likely to link to other patterns of activity to form some system within the domain of socio-technical organisation considered. A dotted arrow emerging from a circle indicates the start of a pattern or an entry point from some other pattern. A dotted arrow ending in a circle indicates the endpoint of a pattern or an exit into some other pattern.

Hence, the use of connectors is one way of managing the representation of the complexity of socio-technical organisation. A larger pattern can be broken down into smaller elements which are explored separately. Each pattern can then be connected back together using connector symbols.
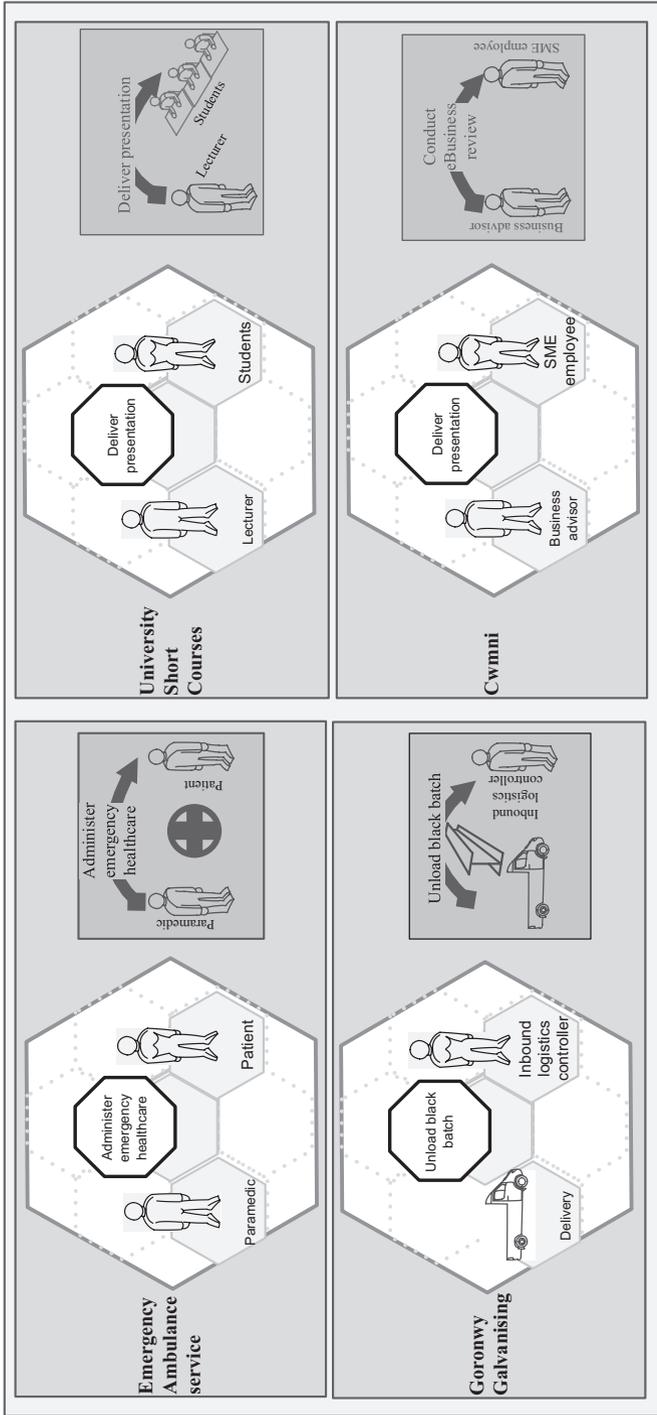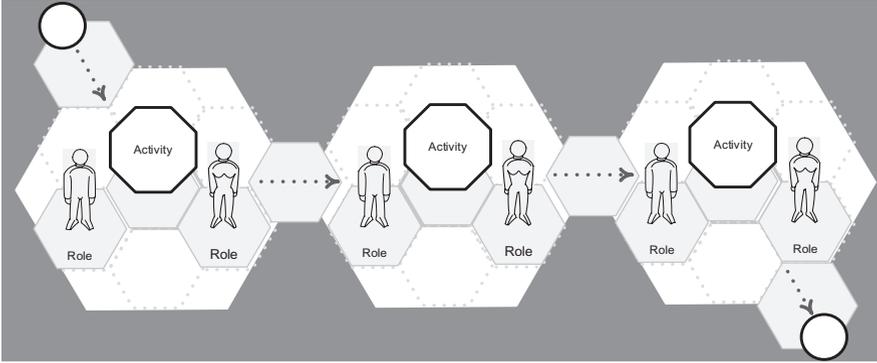
Fig. 9.2 Examples of domain activities

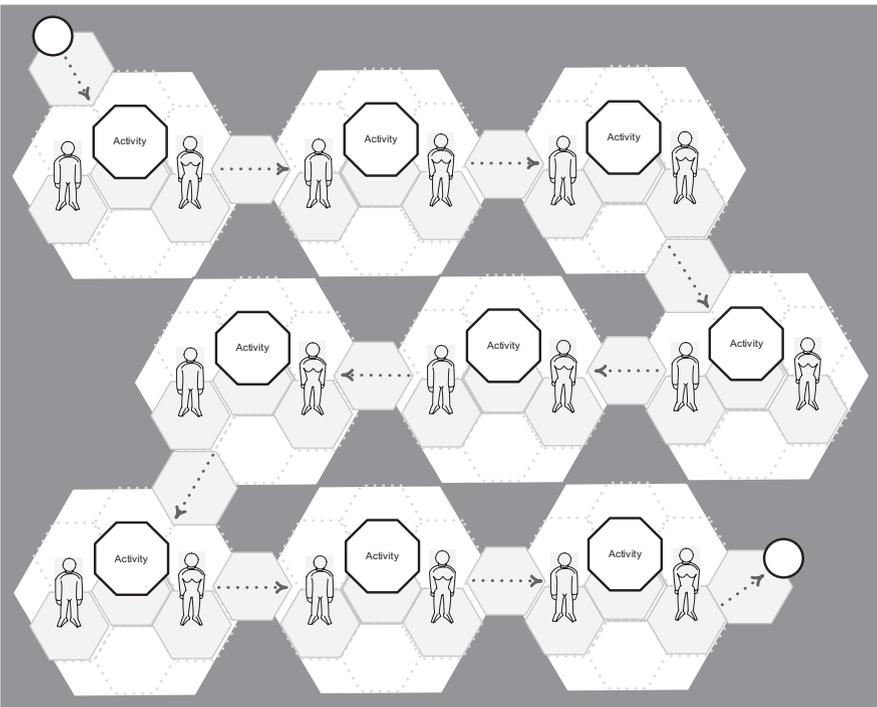**Fig. 9.3** Elements of an activity pattern

Fig. 9.4 Elements of an activity system

What makes a pattern and what a system clearly depends on the point of view of the modeller. This is an inherent part of scoping the problem to be considered, discussed in Chap. 6. Generally, we use the term activity system to refer to some coherent collection of patterns of activity. In other words, a system represents a further level of abstraction, as illustrated in the tabletop prototype in Fig. 9.4, which contains several inter-related patterns.

6   How to Build an Inka Rope Bridge

To help ground the notion of an activity pattern or system, let us consider how the creation of value was dependent upon the organisation of collective performance in a different culture and at a different time.

To administer the empire, we described in Chap. 8 the Inkas created a network of thousands of kilometres of purpose-built roads and rope bridges. This network straddled the Andes, stretching across modern-day Peru and Ecuador, and reached the coast, as well as extending into modern Colombia, Bolivia, Argentina and Chile. Most of the roads were stone-lined and in places extremely narrow, allowing only foot travel and transport using llamas. Also, the roads could not be used by everyone. Only those on official business, the imperial runners and the emperor and his armies were permitted to use this transport network.

By some estimates, at least 200 suspension bridges spanned river gorges within this network. The Inka suspension bridges achieved clear spans of at least 150 feet longer than any European masonry bridges at the time of their construction. The Inkas used natural fibres found within local vegetation to build these bridges. This meant that major parts of these structures needed to be replaced every year by local villagers as part of their (mita) public service or obligation to the Inka state. In some instances, local peasants had the sole task of maintaining and repairing these bridges so that the Inka highways or road systems could continue to function. With the coordination of the actions of as many as 200 people these bridges could be replaced in their entirety in a matter of two days.

We can consider the problem, purpose or goal of how to make an Inka rope bridge as an activity pattern or perhaps activity system. Whether you regard it as a pattern or a system depends on your level of analysis. In other words, if your focus is merely upon bridge-building this would be an activity system for you. If you have a larger focus, perhaps looking at the wider Inka transport network, then this would be an activity pattern. This demonstrates the idea of using system hierarchy to handle complexity as discussed in Chap. 4.

As mentioned above, Inka villages needed to repeat this pattern of activity every year. Nowadays, this activity is preserved in only a few places in the high Andes. We can consider a pattern of activity as a 'recipe'—almost like a list of instructions on how to perform within some domain of activity (we shall refer to these as lists of directives in Chap. 10).

The pattern of activity for making an Inka rope bridge might be considered as the following sequence of activities:

1. Collect dried coya grass.
2. Twist the grass into 50-yard lengths of a two-ply rope—a quota for a particular individual.
3. Deliver the rope to the site of construction.
4. Tie rope together in 150-yard strands.

5. Place 24 strands together and twist to form a cable.
6. Do step 5 six times.
7. Toss a rope across the gorge.
8. Attach a cable to the rope and pull across the gorge.
9. Attach a cable to stone anchor points on each side of the gorge and tighten cable.
10. Do steps 7, 8 and 9 six times—four cables will form the walkway and two cables will form the handrails of the bridge.
11. Tie vertical ropes between the walkway and the handrail and tie foot cables together with horizontal ropes.

Alternatively, we could express this pattern visually as a comic or storyboard, as in Fig. 9.5. Note, that we have indicated in this comic not only the precedence of activities but what roles are involved in each activity. For example, young women typically collect the grass and hand it over to the older women who engage in the construction of rope lengths.

7   Pattern-making

A question frequently asked is, how do you start drawing up a storyboard of some activity pattern or system, such as the one in Fig. 9.4? The answer is that there is no one best way to visualise a model of some activity pattern or system. Personally, I work in a freeform manner. I will first normally draw up a collection of independent activities on the basis of some planned investigation, as discussed in Chap. 6. Then I will think about the precedence of such activities—what activity comes before another. This may cause me to re-work my representation of activities—perhaps creating new activities and sequences.

One more methodical approach is taken from soft systems work (Checkland 1999). It recommends thinking about the central transformation of some domain of activity, which is normally related to the overall goal of this pattern or system. This typically involves asking yourself the question—what is the central value transformed by this pattern or system? Such a central transformation might be evident from a rich picture drawn to make sense of the domain in question (see Chap. 7).

Having identified the central transformation, you are encouraged to think about activities that must be performed first in order to achieve this goal. Finally, you are encouraged to think about activities that are triggered by the central transformation.

Take the example of the emergency ambulance service. We might define the purpose or goal of this activity system as *to provide emergency healthcare at the point of incident*. This is the central transformation of the system.
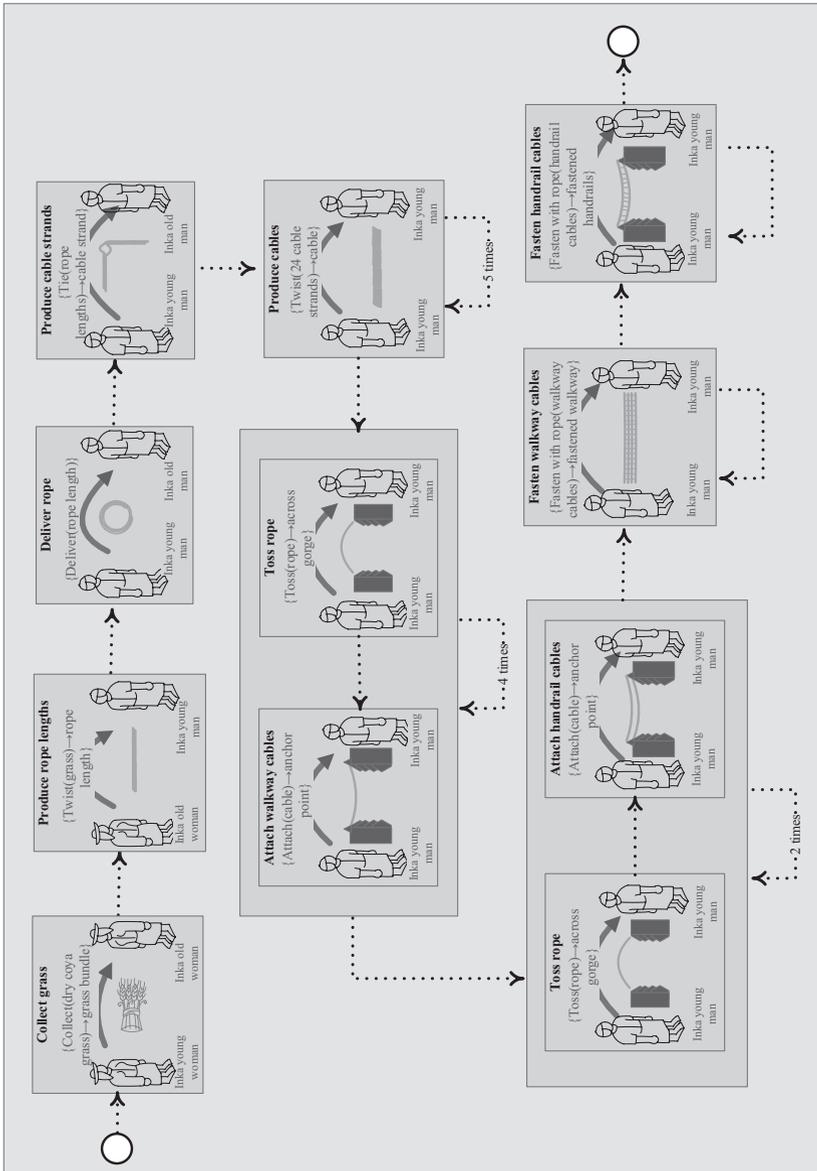
Fig. 9.5 A pattern of activity for building a rope bridge

But to provide emergency healthcare resources such as paramedics, ambulance drivers, control room staff and ambulances are needed, as well as the equipment they carry. These resources also need to be deployed at specific geographical locations to ensure that resources can get to incidents quickly (Exercise 9.1).

> **Exercise 9.1**
> Consider one central transformation such as:
>
> • Collecting household waste
> • Transporting non-emergency patients to hospital
> • Manufacturing bespoke furniture
>
> Just like managers you can probably draw upon some implicit patterns to make a first stab at drawing a high-level activity pattern for each domain (such as that in Fig. 9.5). For instance, you might adapt the pattern in Fig. 9.5 to the purposes of describing what goes on in transporting non-emergency rather than emergency patients to hospital. To go further, of course, with each of these cases you will need to conduct some business investigation.

Once emergency healthcare has been provided, patients need to be transported to the most appropriate general hospital. The resource then needs to return to the pool and be placed on standby again. Hence, the high-level activity pattern which constitutes emergency healthcare can be represented as a sequence of coordinated acts as illustrated in Fig. 9.6 (Exercise 9.2).

> **Exercise 9.2**
> At the time of writing, there are currently 22 such local authorities in Wales—a region of the UK. Do they all do planning, waste management in the same way? If not, should they do it the same way and why?

Note, that when you start thinking about activity patterns you are always asking the question: *how do I ensure that people perform appropriately*? This is a question of performance and control. Activity is typically monitored in terms of some defined levels of performance. If variation occurs between actual and intended performance, then corrective action needs to be taken. As we shall see, these issues of performance and how to control performance stray into the domain of information systems—the topics of Chaps. 10 and 11.
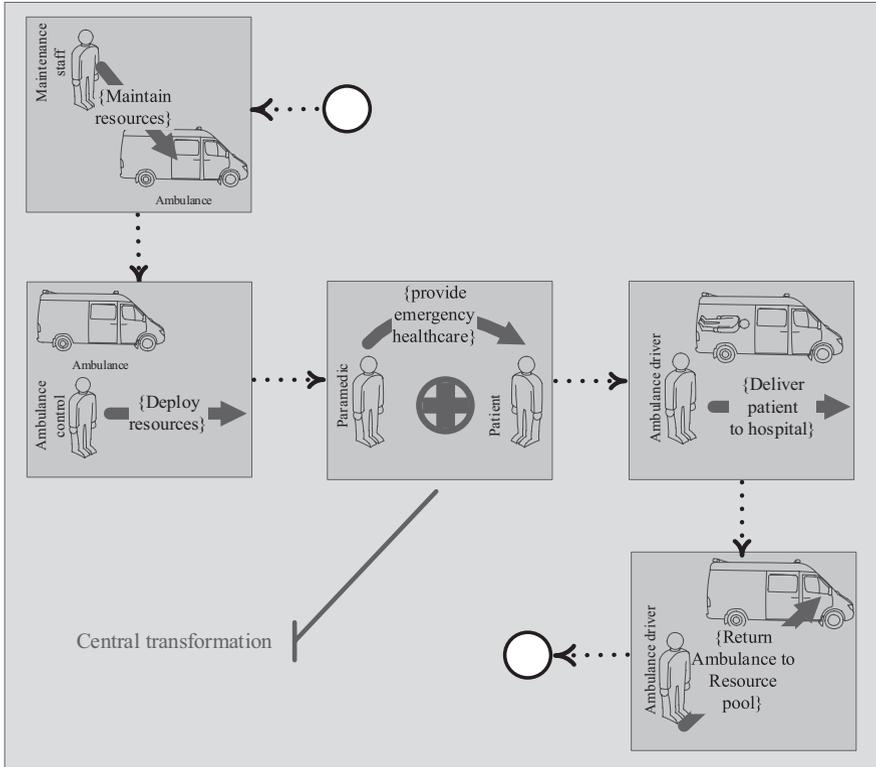
Fig. 9.6 Activity pattern of emergency healthcare

8   Patterns and Templates

The idea of pattern is central to many disciplines. For instance, the American architect Christopher Alexander (Alexander 1964) proposed that architectural design is based on a number of archetypal patterns which encapsulate fundamental principles of building design. This idea has had much influence within other disciplines such as software engineering where design patterns are proposed as general solutions to programming problems (Hay 1996).

The idea of an activity pattern suggests that we can observe common ways of doing things across different domains of organisation. In this sense it has a resonance with the idea of best practice and process benchmarking (Stapenhurst 2009), familiar in the business literature. A benchmark was originally a mark cut in a wall or pillar of some building and was used as a reference point to take measurements. In business terms a benchmark now typically refers to some organisation or process which is regarded as in some way exemplary. In such a sense, benchmarking refers to the idea of comparing a pattern of activity within one's own domain of organisation with that in the best practice organisation and perhaps also adopting some of the practices of the best practice domain.

For instance, does the idea of a local authority as a form of organisation suggest a core set of activity patterns? This begs a further question: should one local authority organise the provision of services in a similar manner to another local authority? And yet a further question: how do we know that one pattern of doing things is better than another way of doing things?

The ancient Greek playwright Aristophanes once said that 'men of sense often learn from their enemies. It is from their foes, not their friends, that cities learn the lesson of building high walls and ships of war.' The very idea of patterns also suggests their use as lessons of reuse. In other words, it becomes possible to consider some existing activity pattern, which we see as in some way good, as a template for the design of performance in other domains of organisation. Therefore, the idea of pattern suggests we might use a particular pattern to encapsulate some idea of appropriate performance—sometimes called good or best practice. We might even use this approach to benchmark, that is, to measure in some way actual performance against some expressed ideal performance in such a pattern.

For example, the way in which coffee is sold in a coffee shop may be documented as a pattern and compared with how fast food is sold in some other outlet. This might enable us to abstract a general pattern for fast food retail. Such a pattern might suggest ways in which selling other forms of fast food should potentially operate. Or consider teaching on an undergraduate or postgraduate module at a university—certain elements of this activity pattern might be considered exemplary and promoted by quality assurance mechanisms across the university sector. Finally, consider the pattern of handling patient appointments. There are elements of this pattern which are relevant to a number of different healthcare domains such as general practice, dental surgeries and even outpatient clinics.

9   Bridging Patterns

But one should not assume that business patterns just occur within the domain of one institution. Many business patterns that deliver value to some stakeholder group involve actions that cross institutional boundaries—they bridge across the space between organisations. In other words, the business pattern occurs within the value-network between organisations, rather than within the value-chain of some particular organisation.

Take the simple event of two people deciding to engage in a civil marriage. This decision actually sets off a whole train of actions, many of which are performed by different public sector agencies. First, the two people have to apply to some civil registry to get married. This normally involves verification of details supplied by the applying persons and usually checking of identity and citizenship requirements using documentation such as passports and birth certificates. Assuming this verification completes satisfactorily then a marriage ceremony is booked and conducted. However, after the marriage certificate is issued a whole series of other agencies will need to be informed of the change to each person's marital status and other possible changes to personal details such as change of residence and surname (Exercise 9.3).

> **Exercise 9.3**
> Jot down some public sector agencies that might need to be informed following the death of an elderly parent.

Frequently, the examination of bridging patterns is a good place to look for breakdowns in modern life. Take the following example. The simple activity of using an automobile to transport oneself from point A to point B is, of course, commonplace practice for individuals but relies upon a complex, entangled system of significant accomplishment.

Automobiles are clearly produced by automobile manufacturers. As new vehicles they are then normally sold through established automobile dealerships to buyers. Automobiles are, of course, purchased for the purpose of driving and as such pass into the ownership of particular persons; but they can only be driven by people who have passed the appropriate driving test. They also need to be parked at various locations in the process of making journeys. At some point in its life an automobile may be subject to some incident: it may be in a crash, be stolen in its entirety or have its number plates or hub caps stolen. Eventually, the automobile will reach the end of its usefulness and will need to be scrapped and recycled.

Now consider a scenario based upon one described by Par Agerfalk and Owen Eriksson (Agerfalk and Eriksson 2011). The scenario begins with Lars having his number plates stolen from his blue Toyota Auris, which he duly reported to the police. He then proceeded to order another set of the same number plates from a registered plate supplier, and when they arrived, placed them back on his car.

A week or so later, Lars received a notification from the police that a burnt-out car had been found with his stolen number plates and that this car was now being scrapped. Then Lars received 13 parking tickets for his car through the postal service. He was puzzled: during the period in which these offences occurred because his car had been mainly parked outside his house. It became apparent after contacting the police and parking authorities that the parking tickets were actually incurred by the car with his stolen number plates. Later still, Lars received notification from his car insurance company that that his car insurance policy was now void because they had been informed that his car had been scrapped. This was odd because Lars could clearly see his car parked on his drive (Exercise 9.4)!

> **Exercise 9.4**
> Using any background knowledge, you might have about the activities of owning and using an automobile try to identify other things that can go wrong.

This breakdown is explained by the fact that the activity pattern of using an automobile is actually supported by both an information pattern and a data pattern that bridges between many institutional authorities such as the police, insurance companies, local authorities and driver and vehicle registration. It is to the notion of information patterns or patterns of communicative action that we turn next.

10   Conclusion

To remind ourselves, instrumental activities involve actors performing roles—transforming value in some way. An activity pattern is an inter-related sequence of activities. Certain activities rely on preceding activities and such activities in turn may be antecedents of other activities (Exercise 9.5).

> **Exercise 9.5**
> You are lying in a hospital bed. You are cared for by nurses, doctors, pharmacists… How do these care workers coordinate your care? In other words, how do they ensure that they are performing together? Jot down some methods of coordination they might employ.

One methodical approach to constructing an activity pattern is to think about the central transformation of some aspect of performance, normally related to the overall goal of this pattern or system. Then you are encouraged to think about activities that must be performed first in order to achieve this goal. Finally, you must think about activities that are triggered by the central transformation.

The idea of a pattern suggests that we can observe common ways of doing things across different organisations. The very idea of patterns also suggests their reuse, perhaps as templates for establishing or benchmarking best practice.

11   Theory

The sign we use to stand for an activity system suggests a set of inter-linked hands. This is meant to illustrate the essence of an activity system—the mutual coupling or binding together of the activities of multiple actors. Each actor within an activity system must coordinate his performance with that of his fellow actors in order to achieve collective goals. Activity systems are considered in Chap. 11 of my book *Significance*.

12   Practice

Representing a domain of performance as a comic or upon a tabletop prototype is a bit like process modelling. Process modelling typically uses visual notation for the following constructs, amongst others: process, sequence, information flow, document flow, material flow, information stores and decision points. A sample process model for the case of civil marriage discussed in this chapter is illustrated in Fig. 9.7. As such, a process model tends to contain within it the three layers we tend to model separately such as instrumental activity, communication and data-handling.
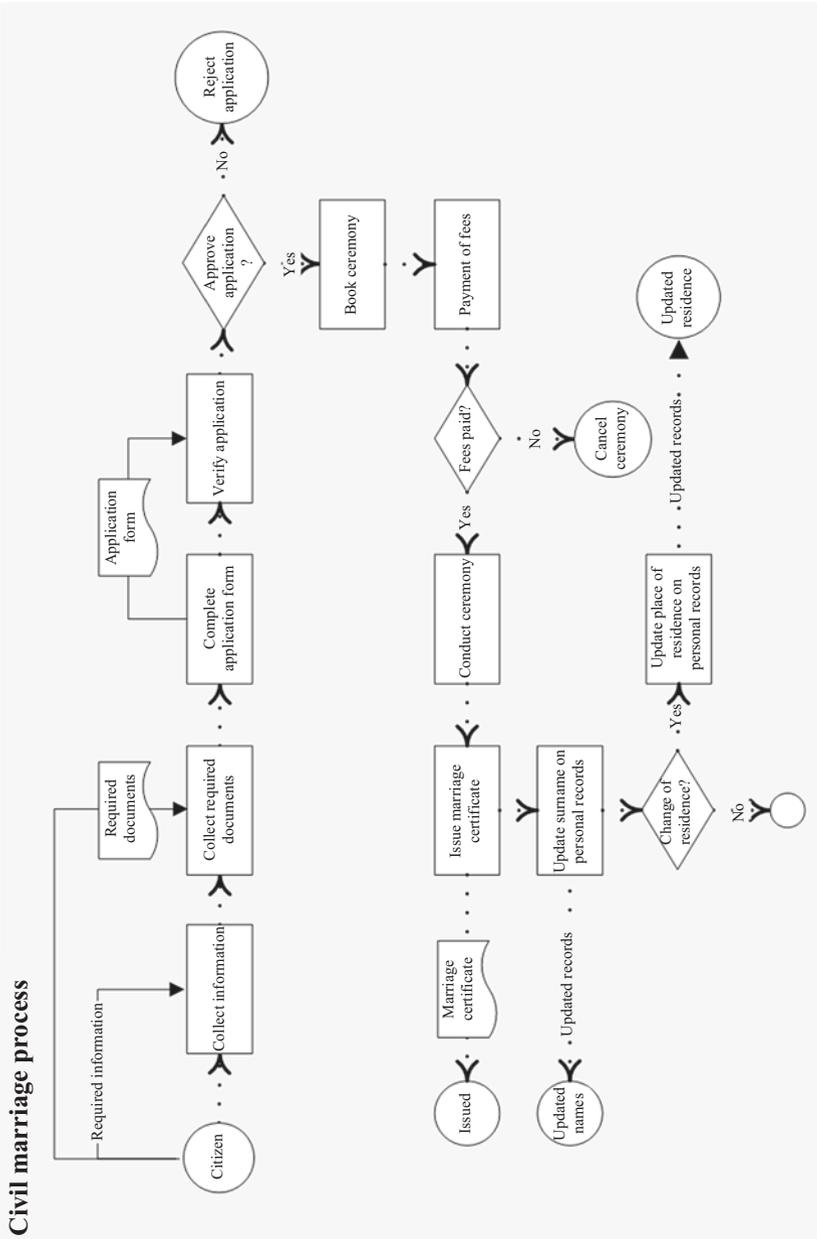
Fig. 9.7 Process model for civil marriage

A process model is typically supported with a range of ancillary techniques such as sequence diagrams, state-transition diagrams and scenarios. A sequence diagram shows how the 'objects' relevant to some domain collaborate in some time sequence. A state-transition diagram visualises a system as a series of states connected together by various transition paths. A scenario is typically a written description of the sequence of actions making up a particular event. See the compendium at the book of the back of the book for more detail on these specific techniques (Exercise 9.6).

Exercise 9.6

Assume you have at least 8 people Split the people into four groups. Give each group one instruction card. Set the chairs in the starting position. Give only two verbal instructions: 1. that they must not alter the orientation of the chair in any way; 2. that the goal must be achieved in no more than five minutes.

The lesson of the game is that this is a coordination problem. To solve the coordination problem, they have to take joint action. To take joint action they must communicate.

| Group 1: you may move a chair in a straight line but only towards wall A. Your goal is to place chairs in the position indicated. | Group 2: you may move a chair in a straight line but only towards wall B. Your goal is to place chairs in the position indicated. | Group 3: you may move a chair in a straight line but only towards wall C. Your goal is to place chairs in the position indicated. | Group 3: you may move a chair in a straight line but only towards wall D. Your goal is to place chairs in the position indicated. |

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Making Sense of Business Information

10

1 Introduction

During the nineteenth century increasing industrialisation stimulated the routinisation of performance in work settings. This further stimulated innovations in the standardised measurement of time and space. For effective coordination, instrumental activities need to be referenced in time and space to what we referred to in an earlier chapter as a common ontology. Such referencing demands effective ways of signifying events in time and points in space. Hence, during the rise of industrialisation the invention of accurate clocks for the signification of time and the invention of accurate maps for the signification of space assumed critical importance.

Take just the notion of time and its importance to scaffolding the activity of institutions. As we have mentioned, the representation of time in terms of seconds, minutes, hours, days, months and years is clearly an arbitrary set of signs. In other words, it is an invented (cultural) and hence an entirely arbitrary sign-system. We collectively accept that midday is signed as 12 am and midnight as 12 pm.

The signification of time in terms of such units serves to aid collaborative action in the sense of providing a common reference point for persons in coordinating their joint activity. The measurement and standardisation of time using accurate clocks and the calibration of such clocks in terms of standards such as Greenwich Mean Time was critical to establishing both the concept of time itself and the accurate measurement of other related concepts such as longitude (Sobel 1996). The accurate measurement of time consequently aided the development of naval exploration, merchant shipping and subsequent world trade. Therefore, time is a critical information concept in the sense that it is important to the scheduling of human action, has developed a standardised syntax for expressing the meaning of the passage of time and stimulated the development of a range of technologies for its measurement.

Consider one particularly interesting example of the relationship of time within acts of communication and its performative consequences. Until the advent of the railways in the early nineteenth century, towns and cities throughout Great Britain

kept their own time based upon the rising and the setting of the sun. Travellers across Britain would re-calibrate their timepieces as they moved east to west across the country. This meant that the time at Plymouth in the west was twenty minutes earlier than the time kept in London in the east. When travel by stagecoach between these two cities took twenty-two hours this had little effect on the activity systems of industry and trade. However, with the rise of the railway network and the speedy travel which it afforded, the need for a common measure of time became essential. First suggested by the Great Western Railway, Greenwich Mean Time or London Time was eventually adopted across the railway network by the mid-1850s. However, it was not until 1880 that Greenwich Mean Time became established in British law as the standard for measuring time across all parts of the country.

This base ontology of time encouraged further innovation such as the invention of the railway timetable: a significant artefact that contributed to the control of performance enacted by multitudes of actors such as passengers, station guards, train drivers and number takers in the British railway network (Wolmar 2007). Early railway companies produced their own timetables for this purpose. However, in 1839 George Bradshaw introduced a single timetable for all the railways in the British rail network. In 1842 this timetable was published monthly, and each issue had over 1000 pages. The publication ran for over 1500 editions, the last appearing in May 1961.

In this chapter we examine the nature of information and argue that information is accomplished in instrumental (goal-directed) communication. Information, as we shall see, is the set of differences that some encounter with data makes to some actor and is accomplished both in terms of the intent and in terms of the content of communication.

2   Communication

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
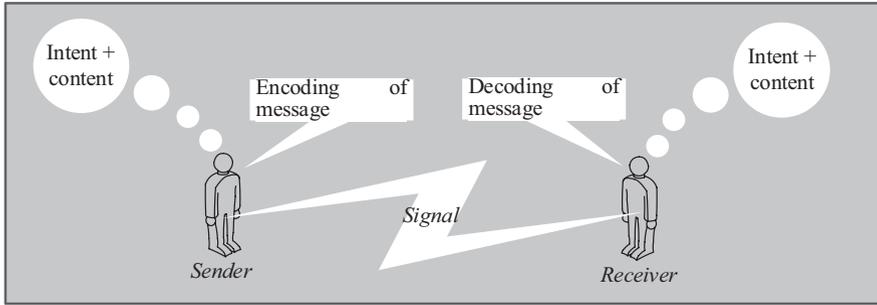
Fig. 10.1 A simple model of communication

decision is made then it makes a difference to actor B in the sense that their future action will depend on this accomplishment. Perhaps they will later meet at an agreed place at 1-o'-clock.

So, if information emerges in the accomplishment of certain forms of communication, what is communication?

Consider a simple model of communication as illustrated in Fig. 10.1. 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.

3   Communicative Acts

For our purposes, communication can be thought of as a series of communicative acts taking place between one actor and another. A communicative act involves a sending actor creating some message and transmitting the message to some receiving actor.

But any message has two aspects, which we refer to as intent and content. The intent of a message establishes what an actor (normally the sender of the message) is trying to achieve through the communication. In other words, the intent of a message is the purpose of the message. In contrast, the content of a message consists of the things identified and described by the symbols making up the message.

A communicative act from the domain of Goronwy Galvanising is illustrated in the tabletop cell in Fig. 10.2. Two critical roles within this domain are an inbound logistics controller and an inbound logistics operator. Many communicative acts are enacted by these actors within the daily business of their work. One such communicative act is illustrated here as a speech bubble. The inbound logistics controller is the sender of a message and the inbound logistics operator the receiver of this message. The elements within the square brackets consists of the content of this

Fig. 10.2 A
communicative act
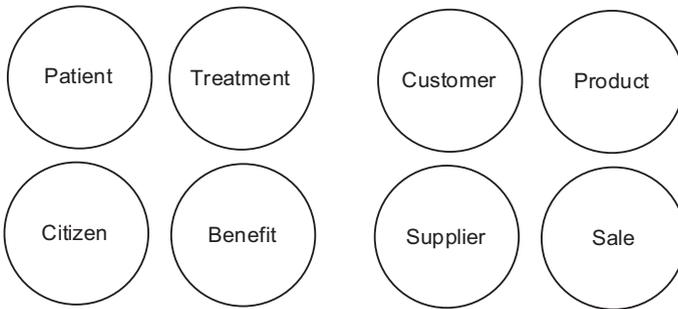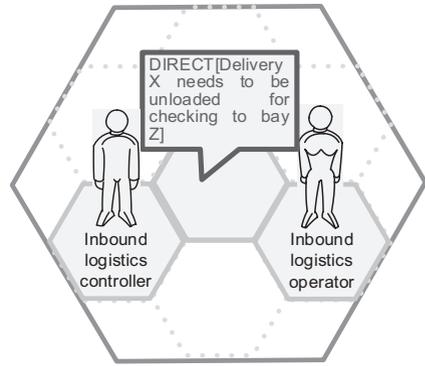
Fig. 10.3 Some example business signs

message—the things identified or described—in this case a delivery and where it is to be placed. The keyword DIRECT refers to the intent or purpose of the message. Here, the inbound logistics controller is directing that the inbound logistics operator do something indicated by the message itself—namely, ensure that a delivery is checked after being moved to a manufacturing bay.

We have indicated previously that actors within domains of organisation communicate about things of interest to them through signs used within the content of a message. As mentioned in Chap. 2 anything used to communicate something to somebody is a sign. Within domains of organisation, signs are used to refer to 'things' of importance to actors. They are also used to describe such things of importance. In Fig. 10.3 customer, product, supplier and sale are important signs for private sector organisations, whereas 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.

As a reminder. according to Charles Sanders Peirce (1931), a sign is some thing which stands to somebody for some other thing. The differences made within some substance we called a symbol and such differences are what data are made of. But

for any consistent set of differences to be considered signs then the symbol has to stand for something else to somebody (some actor).

Certain signs, such as human emotive facial expressions, are non-arbitrary, meaning that they do not rely on convention. The smiling human face is generally understood by everybody world-wide to stand for the fact that someone making this expression is happy. But most signs we use within domains of organisation are arbitrary, meaning that the relationship between the symbol and what it refers to (referent) is based purely on convention.

The arbitrary nature of most signs means that the same symbol can stand for different things to different actors in different domains of organisation. Take the symbol 434 as illustrated in Fig. 10.4. Within USC, the symbol 434 is used to stand for the number of students having attended presentations of courses in the last month to the presentation manager. In the case of Goronwy Galvanising in contrast, 434 is not a quantity but an identifier—it refers to a particular type of steel lintel to be galvanised by a production operator.

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
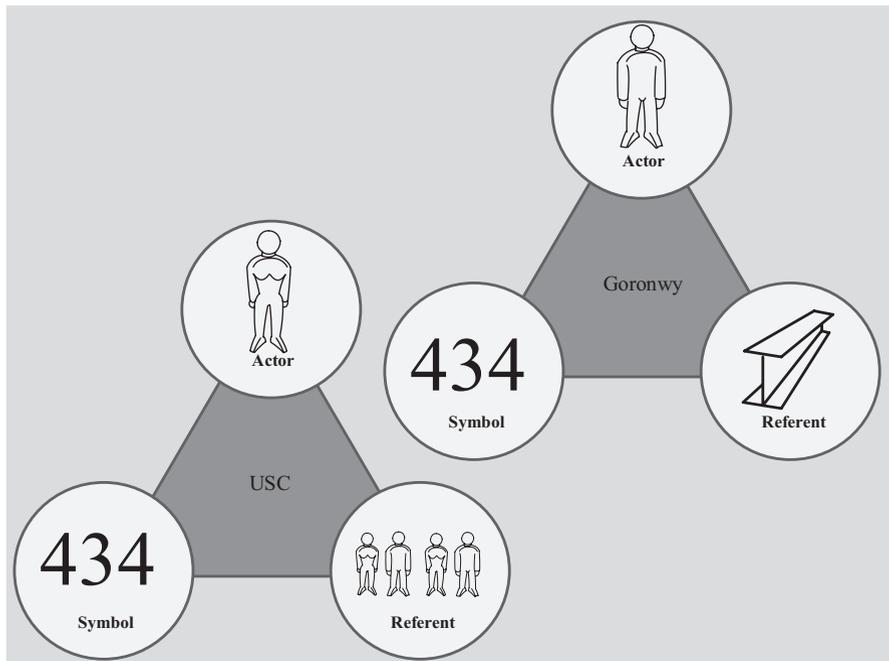
Fig. 10.4 Two signs: different contexts

Fig. 10.5 A barcode
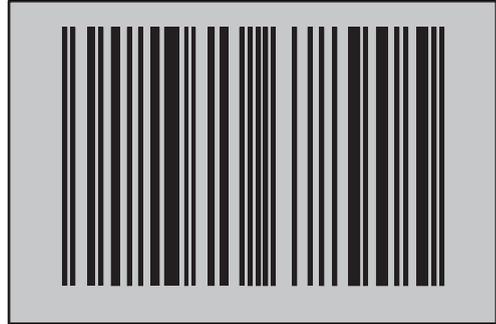
Fig. 10.5, which is of course a barcode. The differences made in this symbol are actually the sequence of different widths between the vertical lines. Most humans cannot make the connection between this sequence of differences and what it refers to. But a barcode scanner attached to some ICT system can. This combination of technology can accomplish information such as the product code and manufacturer code it refers to.

The important point here is that the meaning of a symbol can be accomplished in different ways depending upon the actor and/or the domain in which it is used. 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 typically uniquely identify an admitted patient—the barcode stands for a particular person.

4   Identifying and Describing Things

In the previous section we intimated that symbols tend 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, a patient's age or the satisfaction rating of a particular course.

Whereas intent defines the purpose of a particular communicative act, content refers to the message being conveyed within the communicative act. More specifically it identifies and describes the things of interest to actors within the domain in question.

Such things of interest are clearly expressed through what we referred to as signs in an earlier chapter. Such signs denote things of interest because actors within the business domain need to know about such things to perform properly. ICT people like to refer to such signs as *information classes*—because a given class serves to *classify* a number of instances of things of interest.

Hence, when we call an actual person with whom we interact a *customer* we are classifying that person. According to the cognitive scientist Eleanor Rosch we are

using the term customer as a category (Rosch 1973). We use such categories to help us make differences or similarities between things. Hence, stating that Paul and Gill are both customers we draw a similarity. Stating that Paul is a male while Gill is a female we make a difference.

Such classification is useful because categories not only allow us to organise our perception of the world but help us to determine what we do or should do in the world. This is why the Computer Scientist/Sociologist Lucy Suchman (Suchman 1994) claims that 'categories have politics'.

Suchman when she made this statement was particularly concerned with the way in which the categories we use to classify things reflect power structures in society. Given that the signs we use to chunk up the world are critical to our discourse then our discourse is necessarily likely to reflect our politics—relationships and positions of power.

For example, was Che Guevara a terrorist? Using this particular sign (terrorist) to stand for this person and classifying him in this way probably depends upon what end of the political spectrum you are from. If your political attitudes lean towards the Right (another example of classification) then this statement would probably accord with your views. In contrast, if you are at the opposite end of the political spectrum (the Left) you would probably prefer to classify him as something like a freedom fighter.

More widely we might say that the signs we use influence what we do. Consider the simple sign of patient. What do we mean when we use this sign to stand for a particular person? How we define its meaning will help determine how we act with or for the person classified with this term. Hence, is this patient an in-patient or is she an out-patient? Is this patient a mental patient or a patient of intensive care? Is this patient suffering from a chronic or acute medical condition? Our definition of this category of things will help determine what activity we take in relation to this person—particularly what healthcare we provide to this person.

So unpacking the component elements of messages conveyed in communicative acts allows us to build up a picture of the things of interest to some domain of organisation. This picture or map or model allows us to detail what the organisation is communicating about and hence what it needs to know about to perform effectively.

Consider one communicative act from the emergency ambulance service case illustrated as a comic cell in Fig. 10.7—ASSERT[*A medical emergency has taken place at location X on person Y*]. As we shall see, in terms of intent, this is an assertive. An actor, or more precisely the role of caller, is asserting to another actor/role (in this case the call-taker) that some medical emergency has taken place.

What categories or classes is this type of message engaging with? Or to phrase it another way, what does the call-taker need to know from this message? There are actually two important information classes within this message: incident and patient. The call-taker needs to know where the incident is and what time it took place. The call-taker also needs to know something of the medical state of the patient. As a consequence we are naturally linking a given information class *patient* to another information class *incident*.

So all messages contained within a given communicative act can be seen to be made up of various information classes and the relationships between such classes. There are approaches which take such classes and draw them up as an information model. An information system model specifies the logic of communicative action in some business domain. An information model, in contrast, specifies the information classes appropriate to some domain and how they are related together. The information model takes a static or structural viewpoint on the domain of organisation; the information system model takes a dynamic or systems viewpoint on the same domain (Exercise 10.1).

> **Exercise 10.1**
>
> Many retail operations now employ loyalty schemes implemented through a loyalty card. In what way is handing over a loyalty card and having it swiped a communicative act? What type of communicative act would you say this is and why? What are the likely components of the message being transmitted—the things of interest? Why are these things interesting for the retail operation?

We can add to an information model appropriate properties or attributes of information classes such as incidentLocation or patientName. We can also document which classes are related to which other classes and how they relate. For example, we might say that an incident, always by definition in terms of this domain of organisation, relates to one and only one patient.

The particular details of this approach are covered in more detail in Chap. 12. Within this chapter we merely use this as a means of highlighting how an analysis of communication is critical to an analysis of performance, because what people communicate about normally reflects what people have done, what people are doing currently or what they wish to do in the future. A sample information model for the emergency ambulance case is presented in Fig. 10.6. We shall unpack what these signs mean in Chap. 12.
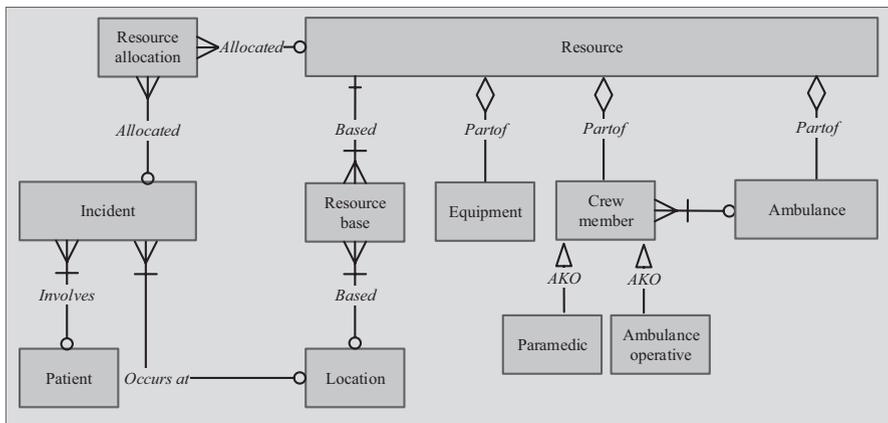
Fig. 10.6 An example information model

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 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 is likely to generate a different re-action by people.

This helps explain how signs such as barcodes don't 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 he had been classified as a visitor.

5   Intent of Communication

Within this book we are interested in business communication that gets things done. In other words, we are interested in communication that helps people, machines and other artefacts coordinate activity. The American philosopher John Searle (1970) calls such instrumental communication *speech acts*. However, we shall refer to them as communicative acts, because much communication within domains of organisation is conducted via a range of different media, such as the creation of electronic records and the transmission of electronic documents, electronic mail, and so on [Note].

> **Note** Much communication is not directly informative and is sometimes referred to as phatic. Phatic communication is often called 'small talk', because it is communication merely for the sake of communication. Can you think of any examples of such phatic communication? How much of organisational life do you think is taken up with phatic communication rather than informative communication?

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. Or, if a presentation manager at USC instructs a booking clerk to prepare a presentation schedule for a certain course, then both expect that this activity will be undertaken.

Searle maintains that there are five major ways in which people influence other people through communication—assertives, directives, commissives, declaratives and expressives (see Fig. 10.7).
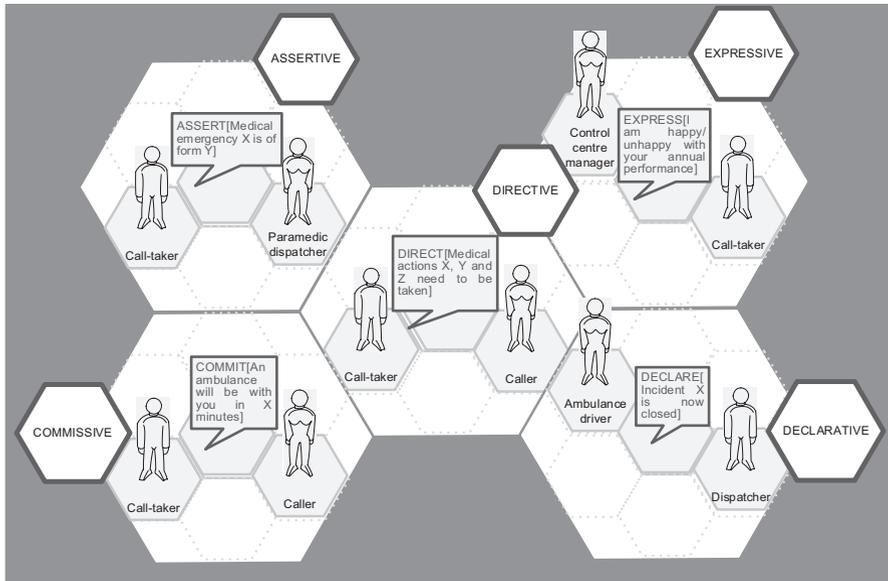
Fig. 10.7   Forms of communicative act

- *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.

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]. The content of 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 fork-lift truck driver, to move an indicated product to a designated production location.

6   Assertives

Assertives are communicative acts that explain how things are in a particular part of the domain being communicated about, such as reports of business activity (Fig. 10.8). Such acts express the truth (justified belief) of the expressed proposition or content of a message on the part of the sender of the message. For instance, within various business organisations different assertives will be made on a regular basis using verbs such as report, confirm, deny and so on. Hence, all of the examples below constitute assertives (Exercise 10.2):

- An employee may report on business activity to a manager.
- A document may confirm that certain action has been taken.
- A wall-chart might indicate the current sales position.
- A business article may say that such and such is the latest business trend.
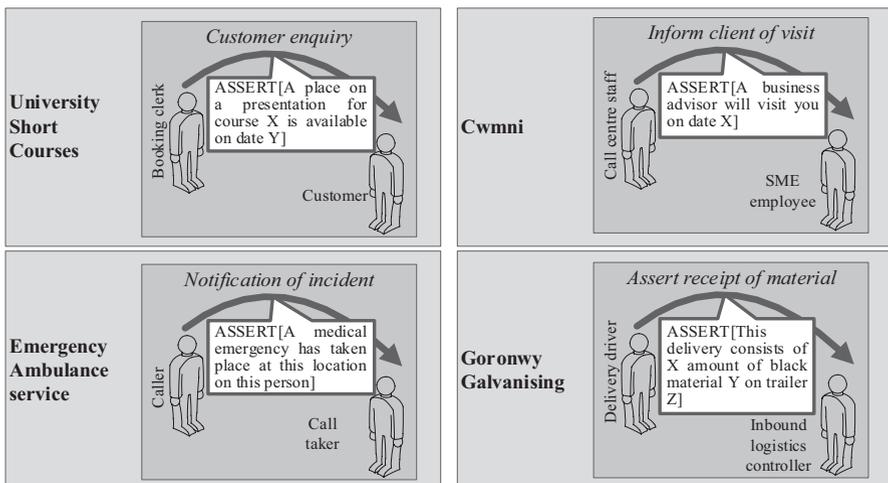
Fig. 10.8 Assertives

- A person might send an email denying his or her participation in a particular affair.
- A poster might announce that a certain person is standing for a particular organisational position.
- A piece of consultancy work predicts the demise of a particular product-line.
- A diary may tell of the activities of a particular worker.
- A to-do list will remind someone of something she needs to do.
- A document will attest ownership of some item.
- A note will certify that some product is authentic.
- Two business statements may contradict each other.
- In conversation an employee might refute an employee's understanding of the situation.
- An employee might contest his dismissal.
- An employee might accuse some other actor of plagiarism.
- A person might denounce an organisation's use of child labour in the supply chain.
- An organisation might proclaim its mission statement.
- A person might confess or admit that they were present when something happened.
- A salesman may boast that he is the best in the company.
- A sales manager may brag about the performance of the sales division.

Figure 10.8 illustrates one assertive as a comic cell from each of our four case organisations:

- At USC a booking clerk will assert that places are available or not on given presentations within a presentation schedule.
- At the emergency ambulance service, a caller will assert that a medical emergency has taken place.
- Within the business advice operation Cwmni, a call centre operative will assert that a particular business advisor will visit an SME on a given date.
- Within the manufacturing operation, Goronwy Galvanising, a delivery driver will assert that an amount of certain steel products is on his lorry.

> **Exercise 10.2**
> Take an organisation record such as a patient record. What does it assert about the patient? Or what about a student record? Who is asserting what when a patient or student record is created?

7   Directives

Directives are communicative acts that express how one actor would like another actor to behave. They represent the senders' attempt to get the receiver of a message to perform or take an action. Within business organisations directives are evident in the use of certain verbs such as request, suggest, summon, recommend and prohibit (Exercise 10.3). For example, in different organisational domains each of the statements below represents a directive:

- A person's presence will be requested at a particular business meeting.
- A management consultant may advise against an organisation moving into a new market.
- A manager may ask his secretary to arrange a particular appointment.
- An organisation may invite tenders for the supply of certain raw materials.
- A business analysis report recommends change in organisation.
- A business plan suggests a course of action.
- Some underling may question the decision of his line-manager.
- A company may issue a profit warning.
- An organisation may notify its customers of changes to their service agreements.
- Employees may be summoned to attend health and safety training.
- Workers may feel compelled by their union to take strike action.
- A charity may solicit our help financially.
- Shareholders may demand that the managing director resign in the wake of poor performance.
- A contract will enjoin us to work a specified number of hours per week.
- A confidentiality agreement may forbid us from whistleblowing on bad practices.
- Certain behaviours may be banned in the workplace.
- A passport authorises me to travel between different nation-states.
- A customer may beg for preferential treatment of her case.
- An employee may make a supplication for a period of unpaid absence.
- The managing director will implore his workforce to work harder to meet targets.
- A valued employee may be beseeched to stay in his job.
- A supplier may make an entreaty to consider them in terms of some tender.

Figure 10.9 illustrates four directives as cells of a pattern comic from our case studies:
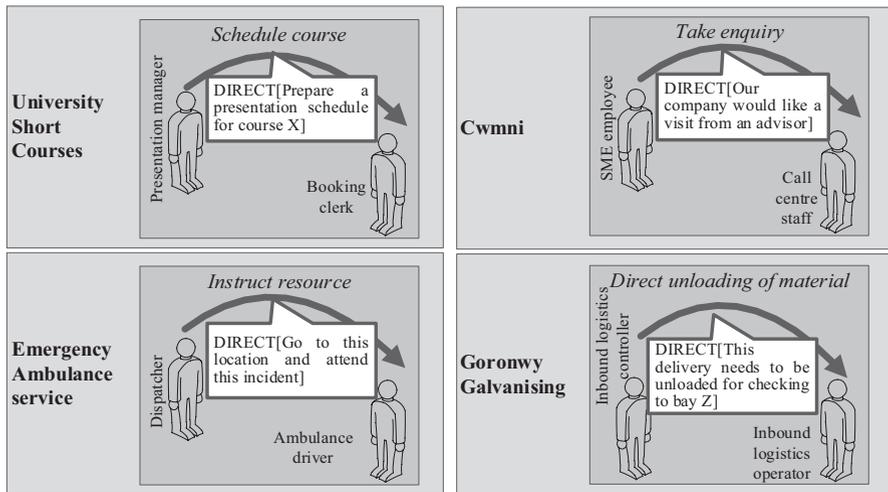
Fig. 10.9 Directives

- Within USC a presentation manager might direct a booking clerk to prepare a schedule for a particular course.
- Within the emergency ambulance service, a dispatcher might direct an ambulance driver to attend a particular emergency incident.
- At Cwmni an SME employee might request a member of the call centre to send them a business advisor to visit.
- At Goronwy Galvanising an inbound logistics controller might advise an operative that a particular delivery of steel product needs to be unloaded.

> **Exercise 10.3**
> In what different ways might a directive be issued within a business? Are directives only issued by managers? How do we know that directives will be performed or have been performed?

We should not assume that we are thinking merely of human to human communication when thinking of communicative acts. Directives are particularly important in relation to the interaction between humans and ICT systems. The software within such ICT systems is effectively a series of instructions—directives expressed by the programmer. The human-machine interface is also taken up with many directives. For instance, moving a mouse to an icon on the screen and clicking upon it effectively issues a directive to the software running the graphical user interface to do something.

8   Commissives

Commissives are communicative acts that express how I as an actor intend to behave. Such communicative acts commit a speaker or sender to some future course of action. They are communicative acts that represent a speaker's intention to perform an action at some time in the future (Exercise 10.4). For instance, within business, promises, guarantees, acceptances and refusals are all examples of commissives. Hence, for example:

- A signature on a payment document commits a person to payment.
- A promissory note will promise that a sum of money will be paid.
- A guarantee document guarantees some action in the case of some problem.
- A voucher will vouch that an actor will be reimbursed in monetary terms.
- An agreement will ensure that joint actions will be taken between participating actors.
- A letter or email may threaten someone with disclosure.
- A person may swear they will never do something again.
- Some actor may take an oath to conduct herself in an appropriate manner.
- An individual may accept the offer of some service.
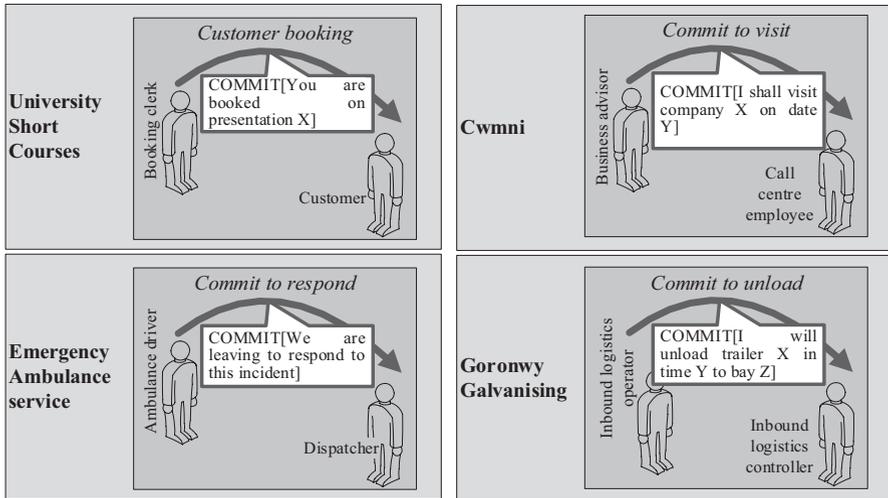- A manager may consent to an employee's request to change his workload.

Fig. 10.10 Commissives

- An employee may refuse to give up some project.
- A person may bet on something happening.

In Fig. 10.10 we have some visual examples of commissives as exercised within our four central case studies.

- At USC a booking clerk might confirm that a particular customer is booked on a given presentation of a course.
- Within the emergency ambulance service an ambulance driver might promise to respond to an incident.
- At Cwmni a business advisor might commit to visiting a particular company.
- Within Goronwy an inbound logistics operator might commit to unloading a trailer.

> **Exercise 10.4**
> Many commitments in organisations are implicit and never recorded. But think of situations where the explicit recording that a person will do something is important. How often do you issue a directive but do not get a commissive in return?

Most plans, including business plans, are effectively made up of a complex series of commitments. A to-be business model can be considered in this vein as a narrative about what people promise to make happen in terms of business change.

9   Declaratives

An old English nursery rhyme has the words: *sticks and stones may break my bones, but words will never hurt me*! Unfortunately, this is not always true because words frequently can be used to change things for the worse for people. For example, a judge may use words such as—*I sentence you to …*—or your boss may utter the words—*You are fired…* (Exercise 10.5).

These are both examples of declarative acts. Declaratives are communicative acts that make things be. A declarative changes the state of some business domain through the communication itself (Fig. 10.11). For example:

- A governor may declare a state of emergency.
- A letter may constitute my dismissal from a university.
- A judge might revoke a particular legislative decision.
- A manager may approve a piece of work.
- A contract may authorise a person's appointment.
- A company might sanction some business practice.
- A piece of contractual law might ratify accepted practice.
- An edict might legalise a merger between two companies.
- A particular document might condemn a person's actions.
- The sentence imposed upon some company might be commuted because of mitigating circumstances.
- A person's behaviour may be pardoned.
- A person's association with a project might be reprieved.
- A person might be absolved of a company's debts.
- A discussion of corporate policy might be postponed.
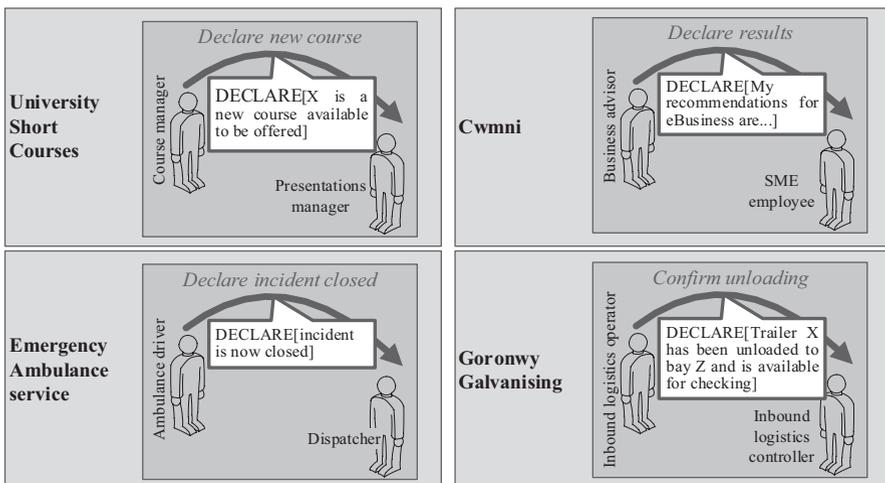
Fig. 10.11 Declaratives

- A session might be adjourned.
- The legislation constraining business practice might be repealed.
- A person's signature might endorse a particular action proposed.
- Joe renounced his position in relation to a particular business project.
- Kim resigned from her position of chairman.
- A person may relinquish his access to certain materials.
- A managing director might abdicate his role in favour of a younger successor.
- A new product-line might be opened.
- An old product-line might be closed.
- A person may retract his statement.
- A person may nominate some other person to take over.
- A person may be awarded with a business medal.

Within business settings declaratives are particularly used to represent or declare that some state of performance important to the domain in question has been achieved—such as in the case of

- USC, that a new course is to be offered;
- the emergency ambulance service, that a given emergency incident is closed;
- Cwmni, that the business advice for a particular company is declared to consist of …;
- Goronwy, that a particular batch has been galvanised.

> **Exercise 10.5**
> John Searle believes that the whole of what we call social reality is based upon an implicit and accepted background of declaratives such as that *this note I have in my hand stands for an amount of money which may be used to purchase goods and services*. In what way is a person's job or role reliant on declaratives such as this?

10 Expressives

As we shall see, people frequently motivate others through their expressions. Expressives are communicative acts that represent the speakers' psychological state, feelings or emotions towards some proposition or state of affairs (Exercise 10.6). For example:

- A person might be complimented on their appearance.
- A manager may criticise the performance of an employee in a job appraisal.
- A person may be praised for their performance.
- A person might be thanked for their contribution.
- A call centre operative might apologise to a customer for company performance.
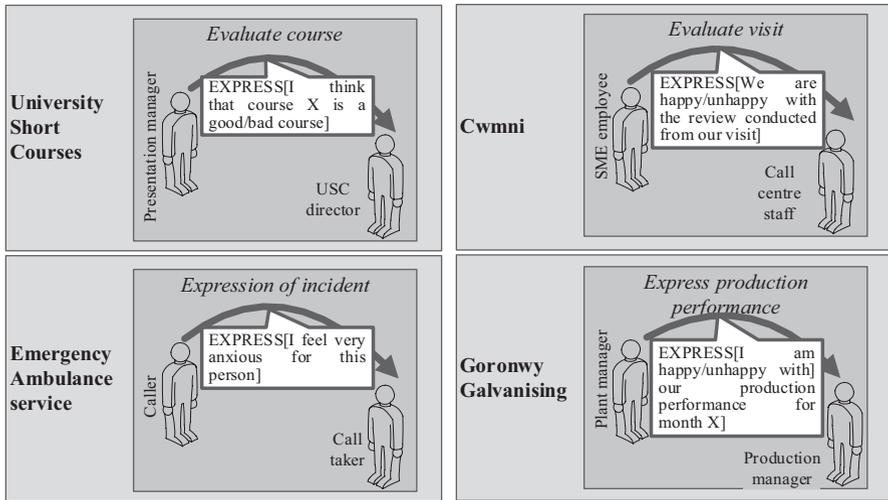
Fig. 10.12 Expressives

- A customer might be congratulated on receiving a discount.
- A customer might complain about poor service.
- Condolences may be offered to an employee on their dismissal.

Figure 10.12 illustrates some expressives of relevance to our four cases as pattern comic cells.

- In the case of USC, the presentation manager might express that a course is good or bad in her view.
- In the case of an emergency incident, a caller normally imparts the level of feeling about the seriousness of the incident.
- In the case of Cwmni, a company may express its satisfaction with the advice provided.
- In the case of Goronwy, the production controller might comment about the level of satisfaction with production levels.

Expressives are an important part—as we have seen in the case of facial expression—of the affective (emotional) dimension of communication. Emotion or affect is particularly important in sustaining motivation within organisations (it is no accident that the terms emotive and motivation in English have the same Latin root—*motere*). It is also equally important in stating dissatisfaction or satisfaction with some current state of affairs—and hence is a motive force for organisational change (Chap. 18). Evaluation by actors of performance within organisations frequently contains an affective component (Chap. 18) such as in a manager expressing satisfaction with the results of some business analysis project.

Exercise 10.6
Expressing one's emotions within business settings is frequently seen as negative. Think of some particular situations where such expression might be positive, particularly in sustaining employee motivation.

11   Conclusion

This chapter has considered the use of communication for the coordination of activity. Whenever a group of people need to perform joint activity in the attempt to realise a common goal, we have a coordination problem (Chap. 8). Coordination problems are normally solved in one of two ways: either by using conventions of activity, or by using conventions of communication (information) (Exercise 10.7).

Exercise 10.7
What is emotional intelligence? How important is emotional intelligence to business? How do you normally communicate how you feel within work? In what form do expressives express? Think of some examples where communication of affect (emotion) degrades performance. Think of some counter examples where the communication of affect improves performance.

Communication is a process in which a sender codes a message as a signal which is transmitted to a receiver who decodes the message. Communication is achieved through acts of communication. Acts in which information is accomplished are therefore communicative acts, which involve the transmission and receipt of messages. A communicative act is some aspect of performance designed by one actor, the sender of some message, to influence the performance of some other actor, the receiver of some message.

In any organisational activity, business actors normally communicate in five major ways and these ways amount to five major forms of communicative act. Assertives are statements of belief about some domain made by particular actors. Directives are statements that represent the senders' attempt to get the receiver of a message to perform or take an action. Commissives are communicative acts that commit the sender to some future course of action. Declaratives are communicative acts that aim to change aspects of or the state of some business domain through the communication itself. Expressives are communicative acts that represent something of the internal state of the speaker (Exercise 10.8).

Exercise 10.8
Consider your own typical working day. How much percentage time is actually spent doing things? How much percentage time is spent communicating about things and the process of doing things with others?

Studies like this have been done in various work settings. In healthcare, for instance, doctors and nurses appear to spend as much as 40% of time communicating (particularly making records for communication). In the current climate in which medical litigation is rife, such levels of recording might even have increased. Doctors and nurses can now be disciplined for poor record-keeping.

12　Theory

The sign used to stand for information is based upon a speech bubble familiar in comics and of course now online communication. A symbol, such as this speech bubble, points in two directions. On the one hand, it points to the physical world and relates to signals travelling within the ambient environment—in this case, sound waves travelling through air. On the other hand, a symbol points to the social world: it relates to effects such as individual and social action—such as the building of rope bridges, the planting of crops and the galvanising of steel. Interposing between these two is the realm of psyche: the domain of understanding—of being informed. Information is centred in this latter pattern of organisation and is concerned with both the content and the intent of signs used within the message conveyed in a communicative act. The nature of information is considered in Chap. 8 of my book *Significance* [Note].

Note The speech bubble as a symbol has a long and varied history. For instance, the ancient Maya produced folding books (the formal term is a codex) many elements of which looked very similar to the idea of modern comics. In these representations illustrations of human characters frequently have what looks like mist emanating from their mouths, as in Fig. 10.9. This depiction is known as the Mayan speech glyph and it is meant to signify that some communication is occurring when represented upon a codex. However, the speech glyph, as a sign, was used to stand for not only communication through speech, but also the process of someone being informed by another (learning from or gaining knowledge from another).

13   Practice

Business analysis in considering information tends to restrict itself to forms of information modelling, sometimes called conceptual modelling. Class diagrams are generally used to specify such information models. We consider this technique in Chap. 12 but expand its use to consider the structure of business communication. By such means we relate an information model to an information pattern.

Customer journey mapping can be seen to have a certain overlap with modelling patterns of communication. A customer journey map is a timeline of key *touch-points*, in which a touchpoint is a moment of interaction between the organisation and its customer. So, a touchpoint might involve face-to-face communication in a physical shop, chat via an online website or perhaps a mobile phone call. Although the term customer is used, normally the designer would consider key types of customer and develop personas of such types (Chap. 8). Sometimes the satisfaction of each persona with a touchpoint will also be modelled.

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Making Sense of Information Systems

11

1   Introduction

During the summers of the late 1930s the Royal Air Force's Fighter Command prototyped an information system known as the *Warning Network* (Beynon-Davies 2009). This information system played a critical role in the Battle of Britain against the German Luftwaffe in 1940. Since control of the skies was an essential precondition of a successful sea-borne invasion, this victory contributed, in part, to the decision of German High Command to abandon the planned invasion of Britain and turn its attention eastwards towards the Soviet Union. This, in turn, created space for the invasion of continental Europe by the Allies in 1944.

For many years both business people and technologists have conflated the term information system with IT system or ICT system. In this chapter we start to make a clearer distinction between these two terms. As cases such as the warning network demonstrate, information systems have been in existence for thousands of years because they are essential for effective coordination of human activity. Depending on your definition of the term, ICT has been in existence since the 1940s, but data systems of which ICT systems are its most sophisticated incarnation have also been around for thousands of years.

Within the last chapter we established the nature of information within acts of communication. Information is not stuff but an accomplishment of actors in such acts of instrumental communication. To make sense of information we therefore must unpack both the intent and the content of communication—what communication is trying to achieve and what things are being identified and described. We also must know something of the actors involved in the communication.

But communicative acts do not occur in isolation—they form patterns that support coordination. Such patterns we refer to as information patterns or more generally as information systems. But the actors in modern information systems are not just humans. Contemporary information systems consist of humans, ICT systems and artefacts communicating in support of coordination.

2   Communication and Coordination

The set of communicative acts discussed in Chap. 10 amount to ways of communicating for action. In a discipline known as cybernetics, communication is always coupled with control (Wiener 1948). In terms of actors within domains of organisation this enables us to make a distinction between internal and external communication and its influence upon the control of action.

Internal communication is thought, particularly conscious thought. We think, at least consciously, using signs. Such thought or thinking is particularly used to decide between alternative courses of action by individual actors. External communication involves the articulation of data structures between two or more actors. Clearly external communication is directed at communicating content and intent to one or more actors and as such is important for group decision making.

Therefore, communicating for action is critically important because it is the catalyst for decision making, which in turn facilitates coordination. Consider the decision illustrated in Fig. 11.1. Here, a car-hire operative holds a face-to-face dialogue with a customer. As part of this dialogue the customer asserts her personal details to the operative. Such assertions allow the operative to determine whether the customer is a loyalty member of the car-hire firm. It further allows the operative to select between two alternative ways of costing the hire of the car for the customer.

Note, how we have represented a decision on this comic pattern using a diamond shape familiar from flowcharting or process modelling. However, we differ from these modelling techniques in explicitly representing within the diamond itself who or what is making the decision. We also detail what the decision relates to in a thought bubble attached to the decision point. Such decisions, represented as a question in this manner, essentially amount to internal directives to the individual, or to the machine.

A decision then can be regarded as a form of internal communication, almost like a directive to oneself. An actor asks of him, her or itself, what should I do next? The decision is the response to this internal message following the accomplishment of information. In the tabletop prototype illustrated in Fig. 11.2 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 a data structure within the 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.

It should be evident from these examples that decision points, such as the one represented in Figs. 11.1 and 11.2, effectively serve to control the flow of action. The output from a decision is normally one or more communicative acts which
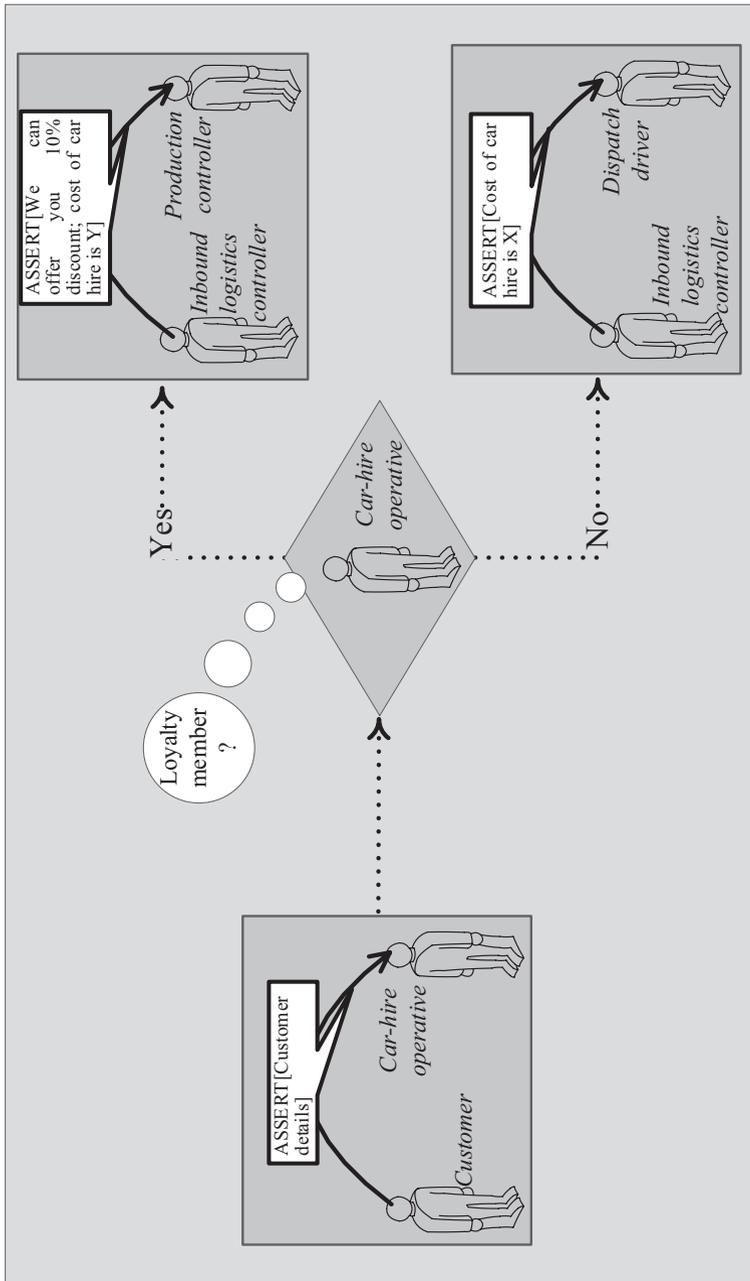
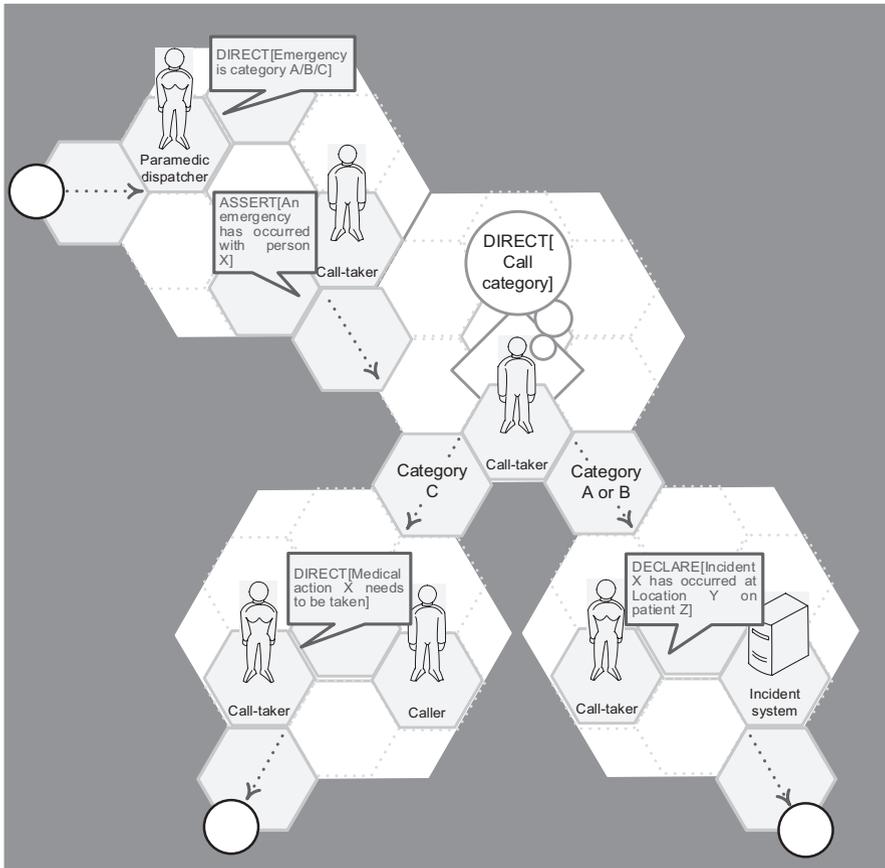**Fig. 11.1**   Decision making represented on a pattern comic

Fig. 11.2 Decision making represented on a tabletop prototype

attempt to control the behaviour of other actors. Directives and commissives are particularly important to the control and coordination of activity—people ask other people to do things and people either agree or disagree to do what is asked. For example, in Goronwy Galvanising an inbound logistics controller might request an inbound logistics operative to unload a particular delivery. The controller would expect the operative to confirm that they will do the unloading.

But decision making is of course not solely an individual activity. Decision making within domains of organisation typically involves collective activity. Such collective decision making relies upon a wider range of communicative acts such as assertives and expressives. Actors need to assert a position in relation to some decision or express how they feel about something. The negotiation of collective intention from individual intention is a critical part of what we mean by coordination.

This ability to form collective decisions is not unique to our species. Many other social animals spend time and effort in formulating group decisions. Honeybees, for instance, have been studied not only in their ability to direct other bees to food

sources but also in the ways they arrive at collective decisions about the positioning of a new hive. Effectively, once a year, scout bees returning to the hive 'vote' on their preferred nesting site by asserting a position through a dance similar to the famous waggle dance. Eventually, a critical mass of bees is seen to 'vote' for the same position and a collective decision is then taken to leave the current hive and establish the new hive at the chosen location (Exercise 11.1).

> **Exercise 11.1**
> Can you think of an example of human collective decision making that works in a similar manner to the honeybee example?

You can see the inherent linkages between communication, control, decision making and activity in the case of breakdowns of organisation. For instance, within hospital situations in the UK the set of symbols DOA can, as a piece of data, help to inform action in different ways. Within general hospital admission this string of characters it typically taken to mean 'Date of Admission'. However, within the emergency department it is normally used to signify 'Death on Arrival'. In one scenario, a worker trained in the use of emergency admission has been transferred to a general admissions role. In one of her first cases she was rung up by a wife concerned about her husband who had been admitted to a general hospital ward for a knee operation. Seeing DOA on his admissions form she told the wife that she was sorry but her husband had passed away!!!

3   Analysing Communication

When you come to try to build information patterns you may find a certain interpretive flexibility in classifying a particular communication as a type of communicative act. In other words, one person's assertive may be another person's directive. Some advice to help in such sense-making is given below:

- Try to focus on the main goal or intent of the communication. Ask yourself the question: who is communicating to whom and for what major purpose?
- It must be recognised that the same communication can be used with different intent by different actors. Hence, ask yourself the question: what is the significant intention of the actor making the communicative act?
- Any one communication may contain within it a number of different forms of communicative act. For instance, in any one communicative situation the sender may be using a number of different data channels to communicate different things at the same time. Hence, I might say something as an assertion but express how I feel about the assertion using a facial expression. Try only to document what you think is the most important type of communicative act for coordination of activity. In this case it is probably an assertion.

Another thing to beware of is assuming that when you attempt to analyse communication within some domain that you are looking for instances of humans speaking to other humans. Human speech is only one of the forms of communication that are used on a day-to-day basis within a domain of organisation. When someone sends an email or tweet or even a paper memo to some other person they are also communicating. In other words, the same message (in terms of its meaning) can be sent using many different forms, media or channels of communication. This topic concerning the form of communication is what data is fundamentally about and is considered in Chaps. 12 and 13 (Exercise 11.2).

Exercise 11.2
Think about two different ways of managing the flow of traffic at road intersections—traffic lights and roundabouts. What communication is occurring in both these situations and how do they differ? Who or what is communicating in these situations? How are the intentions of actors communicated?

Roundabouts have been found in studies to be generally more effective at managing traffic flow than traffic light systems. Think about why this should be the case in terms of what we know about communication.

4   Conversations for Action

So, communicative acts don't 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*. We refer to them either as communicative patterns or as patterns of information (Exercise 11.3).

Exercise 11.3
Electronic mail or email is clearly an important medium for person-to-person communication within the modern organisation. But why do people turn email into a one-to-many medium through the use of CC and BCC? CC stands for *Carbon Copy* and BCC for *Blind Carbon Copy*—anyone remember what a carbon copy was? So, what is the difference between CC and BCC? The answer is that when someone uses CC then the persons being copied see the address of both the sender and the other person being CC'd, while when using BCC the address in the BCC line is not shown to others receiving the email.

Think of directives ('Do this…') and CC-ing in one's superiors into an email—why do people add such a cc line? What assumptions are being made by the senders of such emails? Is email a good medium for seeking commitments ('I promise to…')? Is email a good medium for expressing ('I'm not very happy with this…') one's feelings?

Consider the emergency ambulance case as an information pattern or system as illustrated in Fig. 11.3. The domain is first described in written narrative. To make connections between this narrative and the cells of the pattern comic easier, the life cycle of an emergency incident is narrated as a series of numbered paragraphs below.

1. The life cycle begins when telephone operators take an emergency call. The caller's area code or closest mobile phone cell is identified from the call, which is then routed to the ambulance control centre.
2. At the control centre a call-taker matches the call number with a physical address using a computerised map (or gazetteer) of the area covered by the service. The call-taker asks a pre-established series of questions of the caller(s), prompted by a set of rules embedded in the incident system.
3. Most ambulance services in the UK now institute a process of 'triage' to enable prioritisation of response to incidents. Calls are classified as category A (life-threatening), category B (serious but not life-threatening) or category C (does not require emergency response). On this basis, further decisions are made about the dispatch of resources to such incidents, taking account of two national targets set for response-times to category A and B calls. Within the UK, ambulance services are required to reach 75% of category A calls within 8 minutes and 95% of category B calls within 19 minutes (DOH, 2005). For category C calls, patients are referred to other healthcare providers or transferred to a paramedic who will offer medical advice.
4. Assuming a call is categorised as either A or B, an emergency incident is declared and the location entered in an incident management system by the call-taker. A dispatcher will start to listen in to the call at this point.
5. The task of the dispatcher is to assess the most appropriate resource to send to the incident using a screen indicating a plan designed to maximise the efficient use of resources (known as the system status management or SSM plan), a screen listing the status of all resources and a screen which plots the current location of such resources against a computerised map. The SSM plan is an attempt to dynamically deploy resources around the area covered by an ambulance service according to demand patterns established for day and time, geographical area and clinical urgency.
6. Using this technology and her knowledge of the local area the dispatcher selects and assigns a resource to the emergency incident. The dispatcher uses a radio message to inform the crew about the location of the incident (including a map grid reference) and reported details of the patient's condition.
7. While the dispatcher is conducting this task the call-taker will be giving pre-arrival advice to the caller. In certain extreme cases the call-taker will remain in continuous communication with the caller until the ambulance arrives at incident.
8. Following receipt of an incident alert from the control room, and once mobile, a member of ambulance crew presses a button on their communication set to indicate departure. Crews are guided by satellite navigation to the incident location, supplemented with radio communication from the control room.
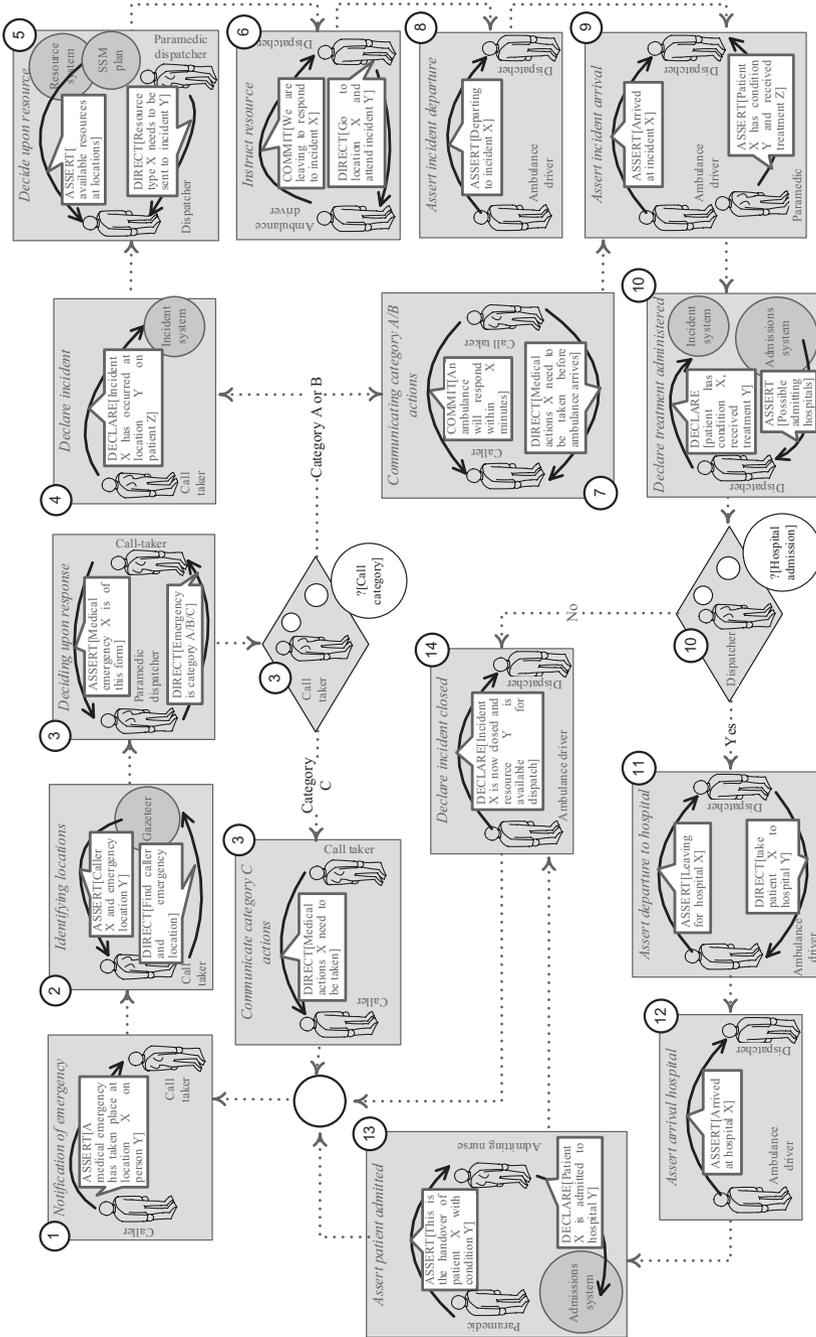
Fig. 11.3 Emergency response as a system of communication

9. Upon arrival, a member of crew presses an arrive button on the communication set. A paramedic then administers any immediate treatment required at the scene and communicates the medical condition of the patient back to ambulance control.

10. The dispatcher will enter details of the patient condition and the treatment administered into the incident system. If the patient condition is sufficiently serious, the dispatcher will request of a general patient admissions system to suggest possible hospitals to admit the patient based upon the patient condition, the location of the incident and the location of hospitals. If the patient condition is deemed non-serious then the ambulance resource makes itself available for further allocation.

11. In the case of further treatment being required, the dispatcher will select an admitting hospital and communicate the patient condition and likely time of arrival to the emergency department of this hospital. The admitting hospital is indicated to the ambulance crew by the dispatcher. When the patient is deemed ready she is moved into the ambulance and prepared for departure. A crew member then presses a leave scene button.

12. Upon arrival at the general hospital, an at hospital button is pressed.

13. As soon as a cubicle is available in the emergency department, the patient is admitted.

14. Finally, the crew presses a clear button which declares that they are available to be allocated as a resource again.

There are many examples of communicative acts evident in the domain of emergency response. For instance, dispatchers are regularly instructing an ambulance driver to 'go to this location and attend this emergency incident'. Sometimes this act will involve a radio message. Most often, it will involve an electronic message transmitted to an ambulance resource, received on some dashboard display and read by the ambulance driver. Or consider another example in which ambulance drivers are expected to assert to dispatchers when they have 'arrived at the allocated incident'. This communicative act will consist merely of selecting an option on the ambulance's dashboard display, which transmits a signal back to the incident ICT system, which in turn updates the display of the dispatcher. Finally, consider the case of paramedics communicating to a dispatcher detail not only of 'the patient's condition' but also of 'the treatment administered'. This is likely to comprise a complex and asynchronous dialogue conducted as a series of radio messages between paramedic and dispatcher (Exercise 11.4).

Exercise 11.4

Winograd and Flores (1986) propose the communicative pattern on the figure below as a basic template for much instrumental communication undertaken within business. Some actor A requests something of some other actor B (directive). B promises to undertake the request to A (commissive). At some point B declares completion (declarative) to A of what has been requested. A then expresses satisfaction or dissatisfaction to B (expressive).

Flores believes that establishing such patterns effectively is critical to doing good business, particularly to building trusted relationships between business actors.

Try to come up with two organisational 'conversations' that might fit this pattern. Such a pattern might use email or written memos or even workflow technology as data technology. How would this work?

Request	Promise
DIRECT [I request ...] A → B	COMMIT [I promise ...] A → B
Express	Declare
EXPRESS[I am satisfied ...] A → B	DECLARE[I complete ...] A → B
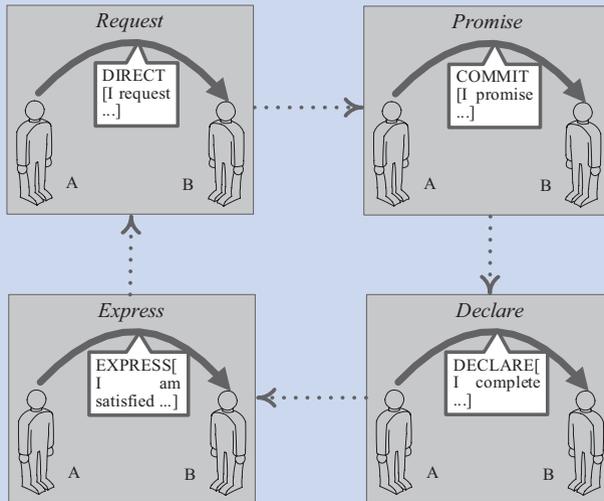
5 Communicative Action by and with Machines

This is not a book about the design of ICT systems. Instead, it is a book about the design of organisation with ICT in mind. As we shall see, a data systems model will go a long way in specifying some of the essential functionality of any ICT system in terms of what we shall refer to as patterns of articulation. The corresponding data model will also detail the data structures transformed in such acts of articulation (Exercise 11.5).

Exercise 11.5

Most customer service helplines use phone menu options to manage customer interaction. Think of these dialogues as information patterns. What is being communicated through the menu and use of the options? Are some of these information patterns better than others? How do you know they are better?

Socio-technical organisation involves interaction between humans and machines, as is evident within the pattern in Fig. 11.3 where much communication is conducted with the aid of 'machines' such as the dashboard kit situated within ambulances. But how do we represent communicative interaction between machines such as ICT systems and humans? A model of the way in which such ICT systems are used by actors is useful in this respect. This is where the idea of a use case model comes in.

A use case model provides a high-level description of major user interactions with some ICT system. Such a model uses two constructs: actors and use cases. An actor is any person, organisation or system that interacts with some ICT system. A use case is a delimited set of actions that we can specify as being important elements of the functionality of some ICT system.

Consider the case of an automatic teller machine (ATM) system. Three main actors might be defined for this case: bank customers, ATM operators and back-end banking systems. Four main use cases might also be defined: withdrawing cash from the ATM, transferring funds between bank accounts, depositing funds in bank accounts and administering the ATM. The first three use cases constitute generic interaction between customers and banking systems. The last use case is a specialised function provided for technicians of the machine. A use case is normally visualised within the design method UML as in Fig. 11.4.

We can do a much better job with a pattern comic than a conventional use case. In other words, we can elaborate more clearly upon the nature of human-machine dialogue as a pattern of communication. In a sense, the user interface of some ICT system can be seen as a collection of dialogues: each dialogue being made up of a series of messages 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 based on information interpreted from the data supplied and action is taken within the encompassing activity system. Hence, we can redraw the use case for the ATM as an information pattern, as illustrated in Fig. 11.5 (Exercise 11.6).

Fig. 11.4 A use case model for an ATM
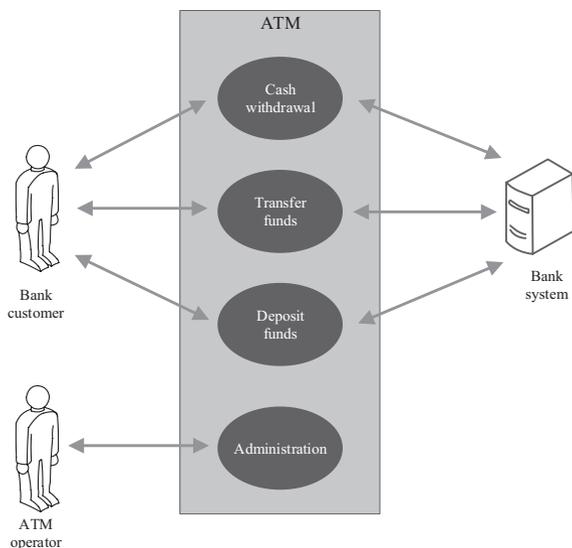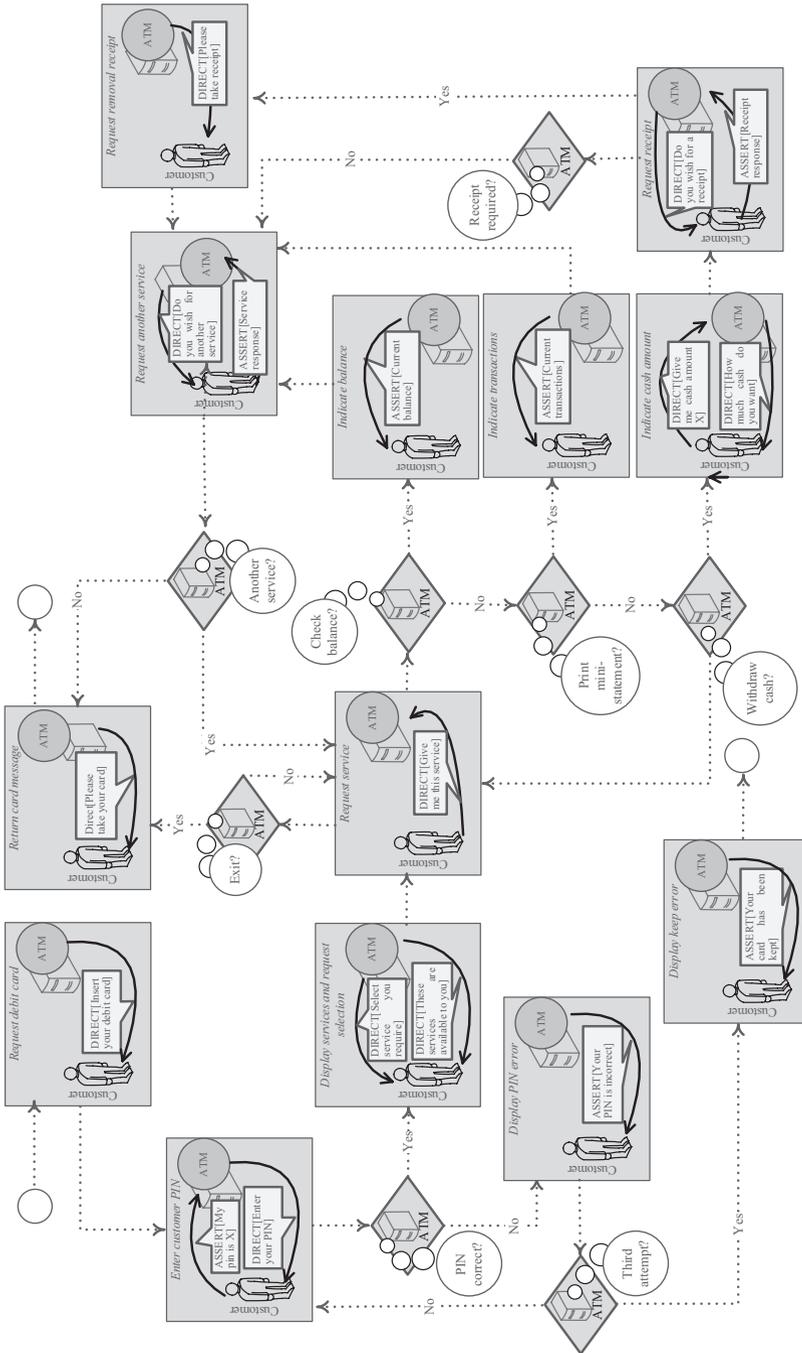
Fig. 11.5   The interface of an ATM as an information pattern

> **Exercise 11.6**
> Consider the case of a medical patient using the telephone to book themselves a medical appointment. This is likely to involve pattern of communication that takes place between not only the appointments clerk and the caller but also between the appointments clerk and an ICT system managing patient data and appointments. Try to use your own experience of this domain to flesh out a possible rough information pattern for this case.

6   Making Sense with Communicative Patterns

The drawing of patterns as comics is a useful way of making sense of both the similarities and differences between domains of organisation. Consider the case of contemporary digital or electronic commerce and in particular the online ordering of goods and services. Modern digital commerce institutions all tend to adopt a common pattern for this domain of organisation. We can document this pattern as a series of pattern comics, of which one of the most critical is that provided in Fig. 11.6. Here, we have a network of human and machine actors undertaking a series of integrated actions to fulfil customer orders.

But as more and more business moves online, commercial organisations are reviewing and re-designing aspects of this business model. Some of the key costs in this way of doing things clearly lie in the costs associated in getting goods ordered to the customer. But what if we can get the customer to take some of this burden away from us? This underlies the rationale of the so-called click and collect business model, which is illustrated as a communicative pattern in Fig. 11.7. Here the customer selects a store for the goods to be delivered to and from which they can collect them. This not only has the advantage of helping to reduce some of the distribution costs associated with online ordering, it also gets the customer back into our stores, perhaps to generate more business from them (Exercise 11.7).

> **Exercise 11.7**
> As we have seen, one of the key advantages of the approach described is that we can model not only human-human communication but also human-machine communication. Think of a case where you utilise an ICT system within some form of work. Try to think of this as a dialogue between you and the machine. Try to represent aspects of this communication as an information pattern.
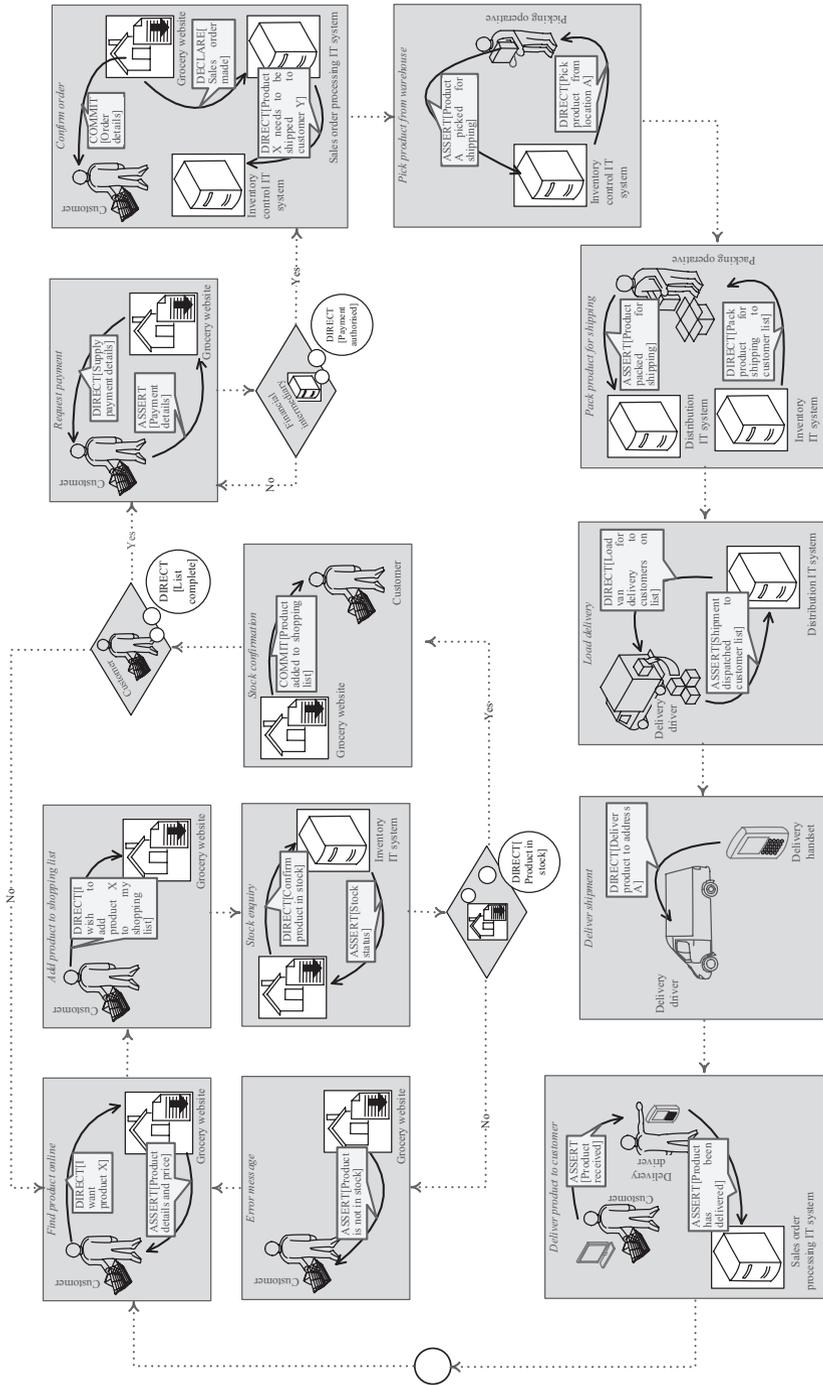
Fig. 11.6 Online ordering as an information pattern
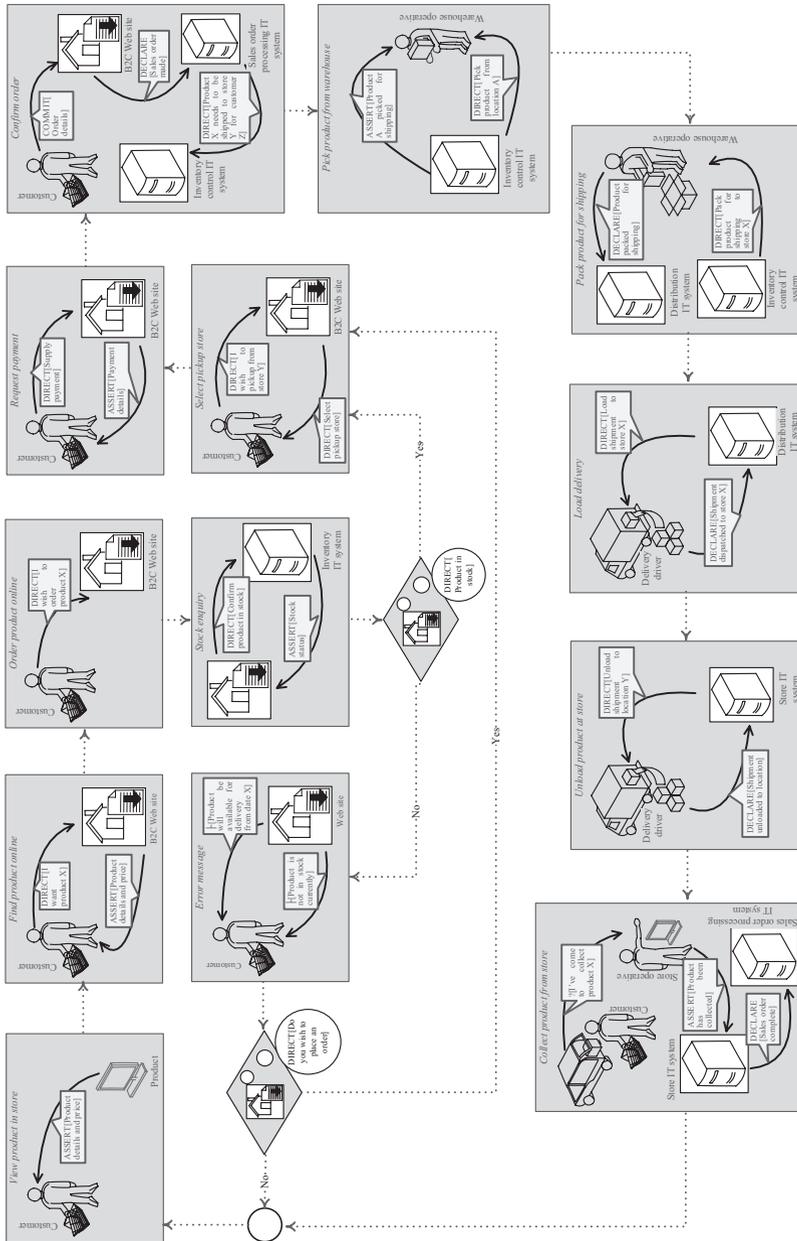
Fig. 11.7 Click and collect ordering as an information pattern

7   Care for the Elderly

Elderly persons falling in their own homes is one of the most common reasons they get admitted to hospital. The use of personal alarms with associated telecare systems is increasingly important to the care of the elderly in their own homes. In this section we shall build a prototype to analyse how this digital innovation works.

To analyse and design any digital innovation you need to understand how the technology works within some system of activity. Talking to key stakeholders in this system or observing the actions they take you might come up with the following sequence of activities:

- Elderly person/carer registers for personal alarm service.
- Registration of lists of contacts.
- Installation of fixed position receiver.
- Training of elderly person/carer in use of personal alarm.
- Wearing of personal alarm.
- Trigger pressed in an emergency.
- Signal sent to control centre and received by call-handler.
- Contact called on the list.
- If no response from contact call next contact on list.
- Contact receives call and attends elderly person.
- Call-handler confirms contact has attended elderly person.

The key actors in this pattern are therefore elderly persons, their carers, the service providers and people to be contacted in an emergency, which may potentially be members of the emergency response service such as ambulance drivers and paramedics. We should not also forget that the ICT system of the service provider is a key actor in this pattern.

A sequence of possible activities applicable to this domain of organisation is illustrated upon a tabletop prototype in Fig. 11.8. Clearly most of the indicated actions upon this figure are communicative acts. Communication occurs to enable installation of equipment—personal alarms and receivers. Communication is important to ensure coordination of actors in response to an emergency. The diamonds are used to indicate decision points that change the flow of action through the pattern. Clearly what is missing from the pattern is some notion of how communication happens. To do this we need to add key acts of data articulation to the pattern. This is the topic of Chaps. 12 and 13 (Exercise 11.8).

> **Exercise 11.8**
> Imagine you are in a world where people had no vocal cords and hence normally communicated through forms of 'dance'. Invent a form of dance with sufficient variety to enable you to instruct people where to deliver post within an office building (assume a building with 4 floors and 20 rooms on each floor). Consider the elements of the dance which can be used to form different messages.
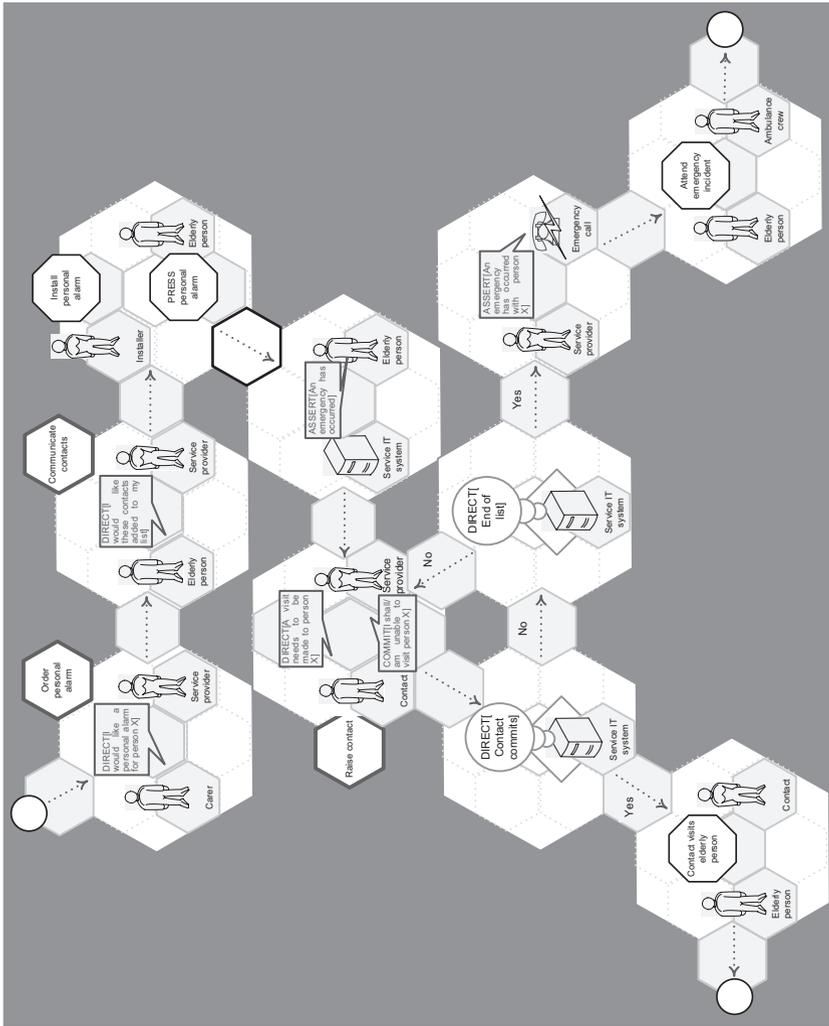
Fig. 11.8 Personal alarms as a pattern of organisation

8   Conclusion

Communication, through communicative acts, is associated with individual and collective control—normally exercised through decision making. Communication occurs in patterns: communicative patterns. Such patterns relate together within information systems. Information systems consist of various actors communicating about various things of interest through patterns of communicative acts. Information classes define the things of interest to a business domain. Such information classes form the core content of communicative acts within business and are the topic of the next chapter (Exercise 11.9).

> **Exercise 11.9**
> Unpack the short communication (the scenario below) which is used within a business setting. Think of the conversation as a series of communicative acts. Can we produce a communicative pattern for this dialogue?
>
> - Barista: Good morning sir! What can I get you today?
> - Customer: I would like a medium cappuccino, please.
> - Barista: Will you be drinking in or taking out sir?
> - Customer: Drinking in, please.
> - Barista: A medium cappuccino? One moment sir…
>   <The coffee is made>
> - Barista: There you are sir—that will be two pounds and forty pence please.
> - Customer: Two forty—Um, I'm sorry I only have a five pounds note.
> - Barista: That's OK. Here is two pounds and sixty pence change…
> - Barista: And here is your coffee sir… Have a good day!
> - Customer: Thank you.

9   Theory

Information systems consist of patterns of informing within and between multiple actors. Information systems are systems for using signs in the sense that they act as a communication medium between different people, sometimes remote in space and time. Therefore, the sign systems of relevance to information systems are best described as semi-formal sign systems: some of their features are designed; some of their features emerge in continuous human interaction. Using this conceptual lens, information systems can be seen to consist of patterns of communicative acts using semi-formal sign systems to make decisions and as a consequence to create, control and maintain coordinated action between a multitude of actors. Information systems are discussed in Chap. 9 of my book *Significance*. The relationship between communication and control is discussed in Chap. 4.

10   Practice

Data flow diagramming is a popular technique for specifying the workings of some information system. Decision analysis using decision tables or decision charts is sometimes used in support of this technique. Many of the features of use case analysis familiar within the development method Unified Modelling Language (UML) can be emulated in drawings of the information system associated with human-machine communication, as we have seen.

References

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Wiener, N. (1948). Cybernetics. Wiley, New York.

Winograd, T. and F. Flores. (1986). Understanding Computers and Cognition: a new foundation for design. Ablex Publishing, Norwood, N.J.

Models of Information

12

1   Introduction

As we mentioned in Chap. 10 the biologist and philosopher Gregory Bateson (Bateson 1972) in his *Ecology of Mind* defines information tantalisingly as *any difference that makes a difference*. By this he means that an environment with no evidence of, what we shall refer to in Chap. 13 as modulation, conveys no information. In other words, if the environment is entirely uniform in nature then it will have no effects upon organisms. Fortunately, differences are endlessly transmitted around the physical environment. Differences in the surface of an object become differences in the wavelengths of light. Differences in light signals become differences in the stimulation of sensory cells making up the eye of some organism, such as a human. These differences stimulate in turn differences in patterns of activity in the nervous system of the organism which in turn stimulate differences in bodily movement such as posture and movement.

Bateson thus argues that differences are continuously being made in the world. However, only those differences that can be perceived by an organism and interpreted (made sense of) can be considered signs (Chap. 2). Hence, differences may have an objective existence over and above perceiving actors in the sense that differences are evident in the signalling of things. But only when such signals become what Sue Holwell and Peter Checkland call *capta* (Holwell and Checkland 1998), are perceived as symbols and assigned some meaning by actors, should we speak of the presence of signs. Signs, as we have seen, consist of things of interest that actors communicate about using symbols in some domain of organisation.

In Chap. 11 we examined a critical layer of organisation which we referred to as an information system—made up of patterns that actors use to communicate about things of interest within some way of organising. In this chapter we consider such things of interest and how we can build formal definitions of such things—to which we shall assign the term *information class*. We shall explain how such information classes help provide structure to the content of acts of communication. This enables

us to establish clear linkage between models of information on the one hand and models of information systems on the other.

An information model is built using three major constructs: classes, attributes and relationships. Within this chapter, we describe each of these constructs in turn. We then discuss one of the ways of visually representing the constructs of an information model. Information models are normally supplemented with relationships of abstraction—particularly that of generalisation and aggregation. Ways of incorporating such abstraction within information modelling are described.

To make clear connections between information system models and information models we propose a novel approach of writing the propositions making up the content of acts of communication in terms of the constructs from an information model. In this sense, information classes are coupled to acts of communication through the content of communication (Chap. 10).

2   Things of Interest

Within Chap. 10 we saw how information fundamentally relates to acts of communication between people, as well as between people and machines or artefacts. But information is always directed at action. The informed person makes decisions about appropriate action in certain situations. An information model is an attempt to represent as a sign-system a limited but important part of what people communicate about: classes, attributes and relationships.

A *class* or more accurately an information class may be defined as some 'thing' which actors within some domain of organisation recognise as important and communicate about currently or wish to communicate about on a regular basis. Other terms used to refer to such things of interest are entity and entity type. An information class, of course, is also a clear example of a sign.

Take, for instance, a university as a large domain of organisation. Universities need to communicate about a number of things to help in the performance of activities such as teaching and learning. These things include students, lecturers, courses and modules. In this domain of organisation, all these things would be valid information classes.

Note, that different domains of organisation will have different things of interest depending upon the perspectives of stakeholders in the domain. Hence, they will need to have a different set of information classes to communicate about. Therefore, a university will be interested in students, lecturers, courses and modules as information classes. An insurance company will be interested in a totally different set of classes such as customers, policies and claims. Goronwy Galvanising will be interested in deliveries, products, jobs and dispatches.

Crucial to the definition of a class is that it is a thing which an organisation recognises as being capable of an independent existence and which can be uniquely identified. Just like a role is an abstraction of an actor, a class is an abstraction from the complexities of things within some domain. When we speak of a class, we normally speak of some aspect of the domain under consideration which can be

distinguished from other aspects of the domain. In other words, we use classes to make some difference—to chunk up some domain through classification.

A class may be a physical thing such as a house or a car, an event such as a house sale or a car service, or an institutional construct such as a customer transaction or order. All such things get referred to as *objects* within information modelling. A class is fundamentally a category, whereas an object is an instance of some category—an actual thing. This means that there are usually many instances or objects of a particular class.

Within the university domain Lecturer or Professor may be a class whereas Paul Beynon-Davies is an instance of this class. Paul Beynon-Davies is an object. Or alternatively Module might be a class whereas Business Analysis might be an instance or object of the Module class. In the case of Goronwy, L1200 will be a specific instance of a steel product (class). In the case of the emergency ambulance service, Jane Smith might be an instance of the class patient (Exercise 12.1).

Exercise 12.1
Gather a small range of actual communications in a domain familiar to you. For instance, collect a range of similar emails sent to you in some domain of organisation. In terms of this collection think about what is regularly being communicated about. What is being classified or categorised in such repetitive communication? What instances can be abstracted into what information classes?

---

3   Relationships of Interest

An information model not only describes the things of interest to some domain, it also defines relationships between such things or classes. In such terms, classes are defined by their linkages with other classes. Typically, such linkages are binary: between two classes (Exercise 12.2).

Exercise 12.2
Each trailer arriving from a customer might be loaded with a number of different types of steel products. Each batch of such products was therefore labelled with a unique order number. As a whole, each trailer was given its own delivery advice note detailing all associated batches on the trailer.
   Identify classes and relationships from this short snippet from the Goronwy Galvanising case.

There are actually four distinct types of relationship we can use on an information model. Normally we would include just relationships of association and sometimes relevant relationships of generalisation and aggregation. But there is also actually a relationship between a class and its attributes, which we refer to as an attribution. We cover relationships of association in this section and defer the discussion of generalisation, aggregation and attribution to later sections within this chapter.

In analysing a particular domain of organisation, we might express the fact that a *customer places a sales order,* or a *supplier handles a purchase order*. An example from a financial domain might be *customer owns savings account*. From the ambulance service case, *incident occurs at a location* would be an example of an association. Within a university domain we might wish to represent the fact that *students enrol on modules* and *that lecturers or professors teach modules*. In these phrases customer, supplier, sales order, purchase order, student, module and lecturer/professor are information classes. The terms places, handles, enrols and teach are labels we might use for relationships of association between such classes.

Within information modelling, more than one relationship can exist between any two classes. For instance, the classes house and person can be related by ownership and/or by occupation. In theory, having identified a set of say 6 classes, up to 15 relationships could exist between these classes. In practice, it will usually be quite obvious that many classes are quite unrelated.

Furthermore, the goal of information modelling is to document only direct relationships: that is, relationships between two classes, with no intervening class. For example, direct relationships exist between the classes parent and child and between child and school. The relationship between parent and school is indirect; it exists only by virtue of the child class.

4   Relationships and Constraints

To each relationship of association, we can add two types of business rule or constraint, which expresses for us how a given organisation works with its associated information classes. One type of rule is known as a cardinality rule, while the other type of rule is known as an optionality rule. These two types of rule help model critical ways in which people and machines communicate within the domain in question.

Cardinality establishes how many instances of one class are related to how many instances of another class. This means that any association relationship may be typed as either a one-to-one (1:1), one-to-many (1:M) or many-to-many (M:N) relationship. If we state that the relationship is one to one, then one instance of a class is always associated with one instance of the other class. Specifying a relationship as one to many means that one instance of a class is associated with more than one instance of the other class. If we state that the relationship is many to many, then many instances of one class are associated with many instances of another class.

For example, in terms of the cardinality of the places relationship between customer and sales order, we ask ourselves the question: how many sales orders can be placed by one customer and how many customers appear on a particular sales order? If the answer to any of these questions is many, we say that the cardinality of that class in the relationship is many; if not, it is one. Hence, in the case of *customer places sales order*, customer is likely to have a cardinality of one and sales order a cardinality of many—one customer may place many sales orders.

The concept of cardinality can best be understood by using an occurrence or instance diagram. These diagrams illustrate how occurrences or instances of

information classes inter-relate. The circles or ovals on the diagrams are meant to represent information classes as sets. Each information class therefore is represented as a set of instances and each instance is given a unique identifier. A line drawn between instances of two sets comprising information classes indicates a specific instance of a relationship of association.

Consider Fig. 12.1. The line drawn between 'Computer Science' and '234' indicates that the lecturer with the identifier 234 is employed by the Computer Science department of this university. Note that the cardinality of the association relationship in this figure is one-to-many (1:M). The department 'Computer Science', for instance, has two lecturers or professors associated with it.

In contrast, in Fig. 12.2 Lecturer to Student is a many-to-many (M:N) relationship. Lecturer 237, for example, teaches students 34698 and 37798. Student 37798 is taught not only by lecturer 237 but also by lecturer 234.

In defining the cardinality of an association relationship, we are actually making two assertions about the domain of organisation we are modelling. In essence, the
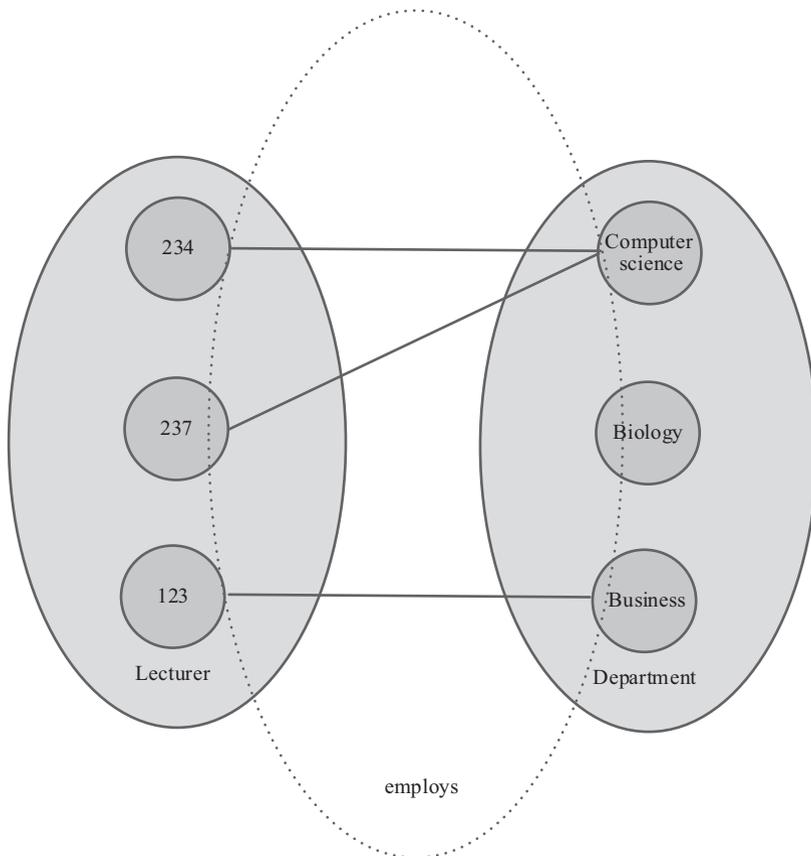
Fig. 12.1   Instance diagram—one-to-many relationship
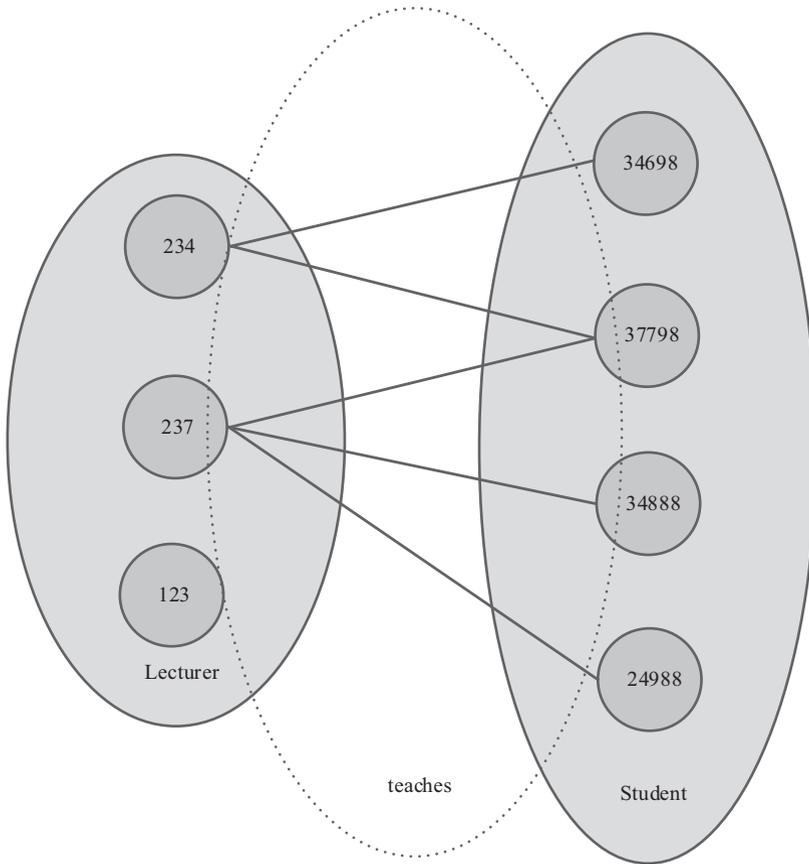
Fig. 12.2 Instance diagram—many-to-many relationship

business analyst is selecting between four possible options for cardinality that might apply to any one association relationship.

For instance, which cardinality is the most appropriate to describe the situation between lecturer/professor and student, as far as teaching is concerned?

- (1:1) A lecturer may teach at most one module and a module is taught by at most one lecturer.
- (1:M) A lecturer may teach many modules, but a particular module is taught by at most one lecturer.
- (M:1) A lecturer teaches at most one module, but a particular module may be taught by many lecturers.
- (M:N) A lecturer may teach many modules and a module may be taught by many lecturers.

The answer, of course, is that it depends on how the particular domain in question works or perhaps wants to work.

In contrast to cardinality, optionality establishes whether all instances of a class must participate in a relationship or not. Hence, each class participating in an association is either mandatory or optional in that relationship.

For example, in the case of customer places sales order the optionality is mandatory both for customer and sales order in the places relationship. This means that we make two further assertions about the business situation:

- A customer must place at least one sales order to constitute being a customer of the company
- A sales order must always be associated with an existing customer—in other words, one for which we have details

Optionality can also be illuminated through an instance diagram. The class Lecturer has mandatory participation in the relationship illustrated in Fig. 14.1 while Department has optional participation. Biology as an academic department or school, for instance, is not associated with any lecturers or professors currently. In Fig. 14.2, the optionality of Lecturer in the teaches relationship is optional; Student is mandatory (Exercise 12.3).

Exercise 12.3
A policyholder may have a number of policies with the insurance company. Each policy is given a policy number and relates to a single policyholder. The company has a range of insurance products and may put together a range of products to form a policy. Examples of motor products are third party, fire, theft, accident damage, windscreen cover and so on.
  Within this insurance domain a policyholder is related to a policy. What is the likely cardinality of this relationship? What is the likely optionality associated with each class in this holds relationship? Produce a possible instance diagram for the holds relationship to confirm cardinality and optionality.

5   Attributes of Interest

An information class is given shape through its properties or attributes. When we define the properties of some class, we actually engage in a process of attribution. Attribution is the process of defining a class in terms of its properties or attributes. We are describing the common attributes of instances of the class (Exercise 12.4).

Exercise 12.4
Identify some likely attributes of an insurance policy as described in Exercise 12.3.
  List some surrogate identifiers that might be appropriate to the insurance domain described in Exercise 12.3.

Consider some form of financial institution which invests money saved by customers in defined savings accounts. Within this domain customer and savings account might be two information classes of interest. Typical properties or attributes of customers include names, addresses and telephone numbers. Typical attributes of savings accounts are start dates and current balances.

In a university domain we normally define a class such as module or student because we wish to communicate about such things and eventually to record some data about the occurrences of these things. To do this we use the properties or attributes of a class. For instance, students have names, addresses and telephone numbers; modules have titles and credit points.

Values assigned to attributes are used to distinguish one instance or object of a class from another. For instance, to distinguish one instance of a student from another we give them a different name, address and so on. A particularly important attribute of a class is the class identifier. Identifiers help ease the process of distinguishing one instance of a class from another. Within the attributes of a class, one or more attributes are chosen as an identifier. Such attributes are selected on the basis of ensuring the uniqueness of instances of the class. To ensure uniqueness organisations frequently create artificial or surrogate identifiers for classes. Examples of surrogate identifiers are employee numbers, student IDs, module codes, product codes, postcodes, QR codes and barcodes.

6   Abstraction

When we communicate about some domain of organisation, we do so using various levels of abstraction. This means that we hide detail within our informative content by exploiting the way in which classes relate in abstraction hierarchies. Such hierarchies are built using three primary types of abstraction relationship: classification, generalisation and aggregation.

Classification

When we state that some thing is an instance of some class, we are classifying that instance. For instance, we might express that *Paul Beynon-Davies is an author* or *Paul Beynon-Davies is a consultant*. In these examples Paul Beynon-Davies is an instance of both the author class and the consultant class. In this process we are categorising some thing as belonging to a particular class (Exercise 12.5).

> **Exercise 12.5**
> Provide an example of classification from the domain of insurance as described in Exercise 12.3.
>   Biologists use classification to describe animals. Provide one example of biological classification.

The opposite process to classification is said to be instantiation. When we value a class with an instance, we instantiate the class. For example, Emily Jane Davies may be the name of a particular person treated as a medical emergency. This person instantiates the class patient within this domain.

Generalisation

Classes or categories enable us to chunk up the world. This process can be exercised to build hierarchies of such chunking—a process referred to as generalisation. Generalisation is the process of extracting common features from a group of object classes and suppressing the detailed differences between object classes. In practice, generalisation allows us to declare certain object classes as sub-classes of other object classes. In this way a generalisation hierarchy may be built in which classes further up the hierarchy cover more instances or objects than classes lower down the hierarchy.

For instance, an ambulance is a class of vehicle. It may have two sub-classes: that of an ambulance used for emergency response and that of an ambulance used to transport non-critical patients between healthcare locations in a more routine manner. The ambulance here is referred to as a super-class of an emergency ambulance, which is a sub-class. Within a stock market domain, stock and share might be seen as sub-classes of a security object. Likewise, debenture and variable stock might be considered sub-classes of stock.

Generalisation is normally used in tandem with classification to build an abstraction hierarchy. The main difference is that generalisation can be considered as the process of extracting from one or more information classes the description of a more general class. Classification involves grouping objects that share common characteristics into an information class (Exercise 12.6).

> **Exercise 12.6**
> The information classes person and employee might be considered as related through generalisation. Identify which is the super-class and which the sub-class in this relationship and explain why. A postgraduate student is a specialisation of a student—true or false?

The opposite of generalisation is specialisation. Specialisation is the process of creating a new information class by introducing additional detail to the description of an existing class. Within an insurance company, car insurance would be regarded as a sub-class of general insurance. Car insurance is thus a specialisation of general insurance.

Generalisation is useful because, through hierarchies, it can be used to provide a more economical representation of some organisational domain. This works through the idea of inheritance—the idea that information classes lower down in some generalisation hierarchy take on the attributes and relationships of information classes

higher up in the hierarchy. For instance, an emergency ambulance and a transport ambulance are both sub-classes of ambulances. They therefore inherit the properties of the ambulance class such as a registration number, and a date of last service. Stock and share might be seen as sub-classes of a security object. Likewise, debenture and variable stock might be considered sub-classes of stock. In this generalisation hierarchy a debenture will inherit properties of both stock and security.

A generalisation relationship has always the same optionality and cardinality. At the super-class level, the optionality is always optional and the cardinality is always one. At the sub-class level optionality is always mandatory and cardinality is always one. For example, if security generalises share then every share is a security but not every security is a share.

However, many applications of the concept of generalisation do not fall into neat hierarchies. In such cases we speak of a generalisation lattice. In other words, a given object class may be a sub-class of more than one super-class. For example, within the stock market, a market maker class could be said to be a sub-class of both an investor class and a financial intermediary class.

In terms of generalisation hierarchies, it is sometimes useful to make a distinction between partial and covering sub-classes. In terms of some information class if its sub-classes are partial then other sub-classes can be included for the super-class. If sub-classes are covering, then no further sub-classes are permitted. For example, if we regard broker and market maker as partial sub-classes of financial intermediary then other sub-classes are possible. If these sub-classes are covering, then brokers and market makers would be the only type of financial intermediary permitted on the stock market.

Disjoint sub-classes do not overlap. However, we can conceive of situations where the concepts referred to by information classes do overlap. If all sub-classes in an information model are disjoint, we have a strict hierarchy of classes. If some are overlapping, we have a lattice structure. Share and stock are disjoint sub-classes of security. A security cannot be both a share and a stock. Broker and market maker are two overlapping sub-classes of financial intermediary since market makers can act as brokers (Exercise 12.7).

Exercise 12.7
Broker and market maker are partial sub-classes of financial intermediary. This means that other sub-classes are possible. True or false?

   Share and stock are disjoint sub-classes of security. This means that a security can be both a share and a stock at the same time. True or false?

If an information class is part of a generalisation lattice rather than a generalisation hierarchy then it engages in multiple rather than single inheritance. In other words, it inherits the attributes and relationships from all its super-classes. For example, a market maker class could be said to be a sub-class of both an investor class and a financial intermediary class. As such it will inherit the attributes of both investor and financial intermediary.

Aggregation

An aggregation relationship occurs between a whole and its parts. An aggregation is an abstraction in which a relationship between objects is considered a higher-level object. This makes it possible to focus on the aggregate while suppressing lower-level detail. For example, in terms of the financial domain we might define a financial portfolio class that aggregates together all the financial products making up a given customer's interaction with the financial company. In such terms, a financial portfolio class can be considered an aggregate of securities, insurance policies, savings accounts and so on. A country can be considered an aggregate of regions which are aggregates of counties which are aggregates of districts and so on. In the case of the health service a patient record can be considered a collection of diagnoses, prescriptions and treatments.

The opposite of aggregation is decomposition: that is, the process of decomposing an information class into its constituent parts. Hence, we could decompose a car into its assemblies. Each assembly could be considered an aggregate in turn made up of a number of sub-assemblies and so on.

But what makes generalisation different from aggregation? It is possible to distinguish between aggregation and generalisation in the following way. If two classes are defined in terms of a generalisation relationship, then both sub-class and super-class effectively refer to the same thing of interest. As signs, the designation of the super-class and sub-class actually refer to the same referent. In contrast, within an aggregation hierarchy the whole and its part refer to different things. The aggregation class is used merely as a convenient 'container' for a group of distinct and separate classes (Exercise 12.8).

> **Exercise 12.8**
> In what way might a customer order be considered as an aggregate?

In summary, the critical elements of an information model are as follows. Classes are significant things of interest that classify a range of instances. Attributes are significant properties of interest that serve to define a class and distinguish one class from another. Associations are significant linkages between the instances of one class and that of another. Generalisation enables us to build a hierarchy of abstraction, where one class is considered a sub-class of another. Aggregation allows us to collect together a range of information classes and treat it as a container class.

7   Visualising Information Models

Business analysis and design, as we have seen, is very much a discipline reliant on visualisation. It therefore comes as no surprise to find that information models are usually mapped out as diagrams.

A class is represented on an information model diagram by a rectangular box in which is written a meaningful name for the class. Note that it is conventional to denote an information class with a singular noun. This is because, as we have seen

Fig. 12.3 Example
information classes
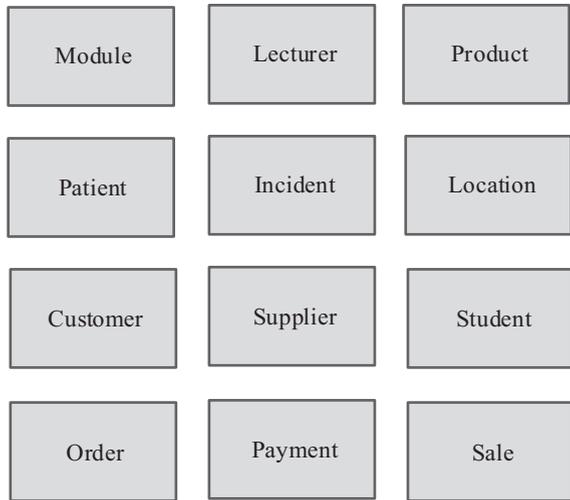
in a previous section, a class represents a category of something. There is only one instance of a category. We speak of an order and not of orders, a patient and not of patients. Figure 12.3 provides some examples of information classes from different organisational domains.

An association relationship between classes is represented by drawing a line between the relevant boxes on the diagram.

In some notations labels are placed on the relationship lines. This is a useful technique in resolving ambiguity. There are however a number of problems with this convention:

- It is frequently difficult to think of a meaningful label for relationships.
- Most relationships are best represented by verbs. Verbs however usually imply some direction. Hence the relationship between person and grade might be read as person is graded by grade in one direction and grade grades person in the opposite direction. This is cumbersome to represent on a diagram.

Therefore, we would suggest placing a label on a relationship line only in cases where the meaning of the relationship is likely to be unclear. Figure 12.4 illustrates a number of relationships, some labelled and some unlabelled, between information classes.

Upon an information model, we represent attributes by adding their names to the appropriate class box. They are enclosed within the class box itself to represent the way in which they add detail to the information class. However, when an information model becomes sufficiently detailed, the attributes associated with particular classes are likely to be left off an information model diagram. Instead, they will be included within an accompanying document to the diagram. Figure 12.5 provides some examples of attributes appropriate to a number of different information classes. The chosen identifiers for each class are underlined.

Fig. 12.4 Example
association relationships

| Incident | Involves | Patient |

| Incident | | Location |

| Lecturer | teaches | Module |

| Student | enrolled | Course |

| Customer | places | Order |

| Product | | Order |
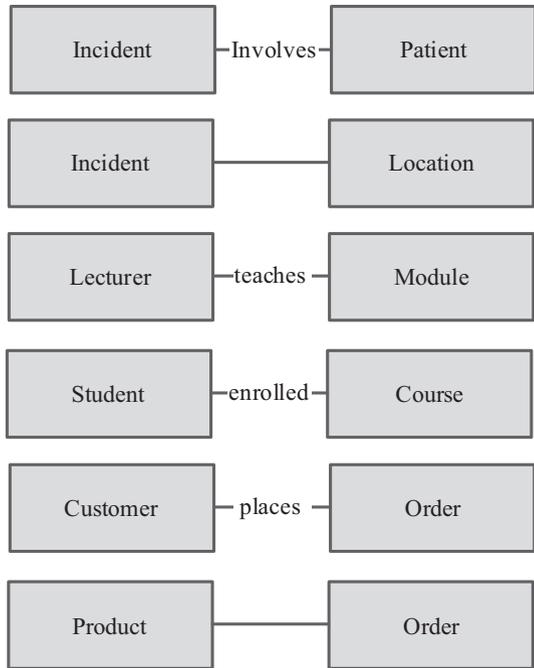
Fig. 12.5 Example
attributes

Incident

incidentNo
incidentDescription
incidentCategory
incidentStatus

Patient

patientNo
patientName
patientAge
patientCondition
patientMedicalHistory

Lecturer

employeeNo
lecturerName
lecturerStatus

Module

moduleCode
moduleName
credits
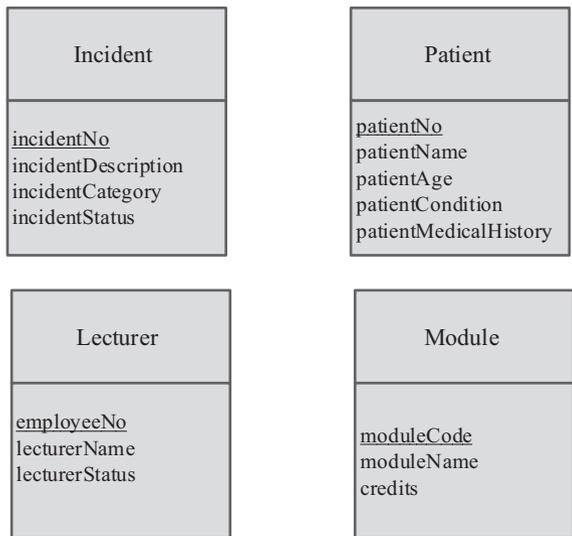
There are a number of competing notational devices available for portraying the cardinality of an association relationship. We choose to represent cardinality by drawing a crow's foot—so called because it looks like the foot of a bird—on the many end of an association relationship.
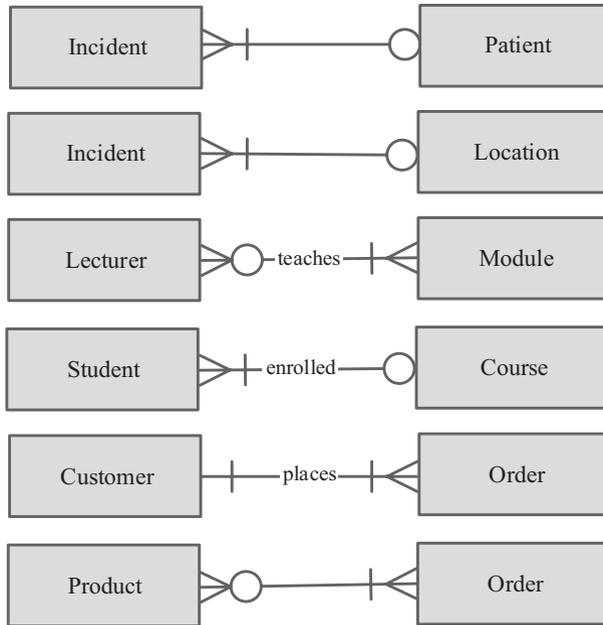
Fig. 12.6 Example relationships

We assume that the default optionality of a class in an association relationship is mandatory. If the optionality is optional, we add a circle (an 'O' for optional) alongside the relevant class. Hence, if no 'O' is present we assume that the optionality of a class is mandatory. If we want to be certain of our definition, we can use a strike symbol next to the appropriate class to indicate mandatory status. A number of relationships with expressed cardinality and optionality are illustrated in Fig. 12.6 (Exercise 12.9).

> **Exercise 12.9**
>
> An Employee uses a Company Car; a given Company Car will be used by a number of different employees. Draw the information model and include the appropriate cardinality on the diagram.
>
> Some employees do not use any company car; all company cars are used by at least one employee. Add the appropriate optionality to the information model.

A generalisation relationship is indicated on an information model diagram by a line drawn between sub-class and super-class with a triangle placed at the head of the line, next to the super-class. Disjoint generalisation is represented by the labels disjoint or overlapping expressed in brackets and placed next to the triangle. Partial generalisation may be indicated by the keywords incomplete or complete expressed in a similar way. Figure 12.7 illustrates examples of the diagramming of generalisation relationships.
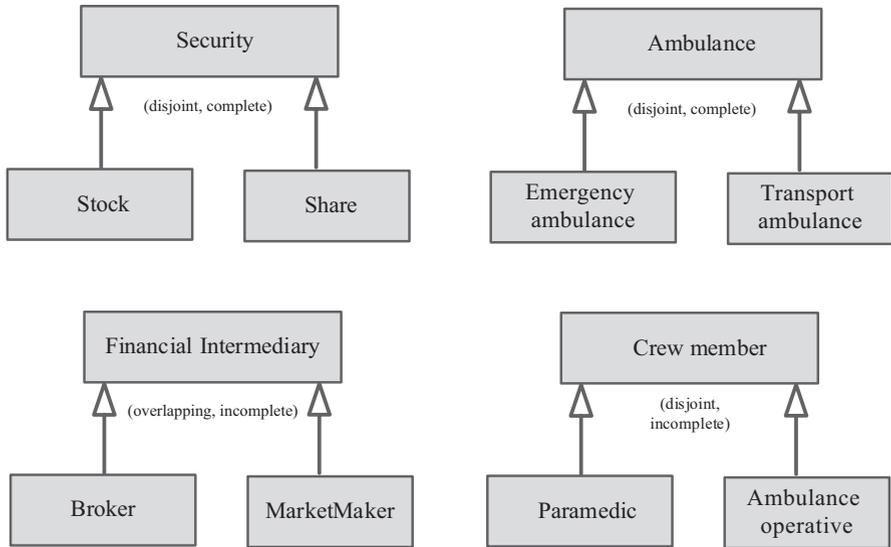
Fig. 12.7 Generalisation
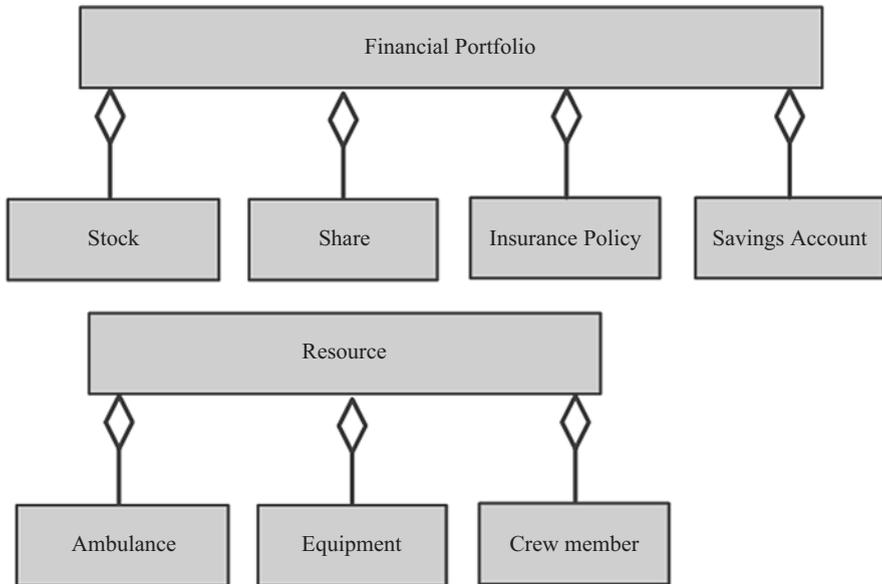
Fig. 12.8 Aggregation

Graphically we may depict aggregation as a series of lines or a forked line between the whole and its parts. A diamond is also placed next to the aggregate class as in Fig. 12.8.

8   Communicative Acts and Information Models

So, an information model is typically represented visually or the elements of an information model can be represented as a collection of propositions. We have particularly found it useful within practice to use the idea of a binary relation—subject-predicate-object triples—for this purpose. Such relations are also useful as ways of defining the content or 'material' of relevance to communicative acts. This helps us relate an information model to an information systems model (Exercise 12.10).

> **Exercise 12.10**
> Read one of the remaining three cases of domains of organisation as specified in the back of the book. *Try to draw a complete information model for one of these cases.*

Within such triples subjects typically correspond to information classes or properties of a class. Four keywords are used as *predicates* to represent attribution (HASA), classification (ISA), generalisation (AKO) and aggregation (PART OF) relations. An association relationship is represented by a free-ranging predicate. In other words, we think of an appropriate label to define the association. The object element of a triple is typically used either to indicate a constant value or a free-ranging placeholder for values.

This means that each of the informal sentences that are used to specify the propositional content of communicative acts within a pattern comic can be transformed into a more formal specification using classes, attributes and relationships from the information model.

9   Information Models from Communicative Practice

Let us demonstrate how to build information models from an analysis of the communicative practices within some domain. The discussion in this section is a simplification of the approach proposed in (Beynon-Davies 2018).

In Chap. 11 we considered an information system model for the socio-technical system of emergency response. Figure 11.3 presented this model as a pattern comic made up of a sequence of communicative acts. One such communicative act taken from the domain of emergency response is the following:

ASSERT[*A medical emergency has taken place at this location on this person*]

The propositional content of this communicative act, which consists of the phrase *a medical emergency has taken place at this location on this person*, can be rewritten in terms of certain classes, attributes and relationships. Hence, the communicative act then becomes something like:

/Caller/ ASSERT[*Medical emergency occurs at Location; Medical emergency description D; Medical emergency involves Person; Person name N*] \Call-taker\.

Within this more formal specification of the communicative act, Medical emergency, Location and Person are information classes. Description is an attribute of Medical

emergency and Name is an attribute of Person. Medical emergency involves person and establishes the context of the relationship between the named person and the specific medical emergency. Medical emergency occurs at Location and specifies the relationship between the particular medical emergency and an established map location. This decomposition becomes even clearer if we write it as a series of binary relations:

[Medical emergency occurs at Location]
[Medical emergency HASA description]
[Medical involves Person]
[Person HASA Name]

However, to be complete we need to add both actors involved in the communicative act—Caller and Call-taker—to the information model. We will probably also wish to record data relating to the medium by which the communication occurred. In other words, we need a class Emergency call. This adds the following binary relations to our specification:

[Call-taker HANDLES Emergency call]
[Call-taker makes Emergency call]
[Emergency call about Medical emergency]
[Emergency call called from Location]

This translation from a communicative act represented on a pattern comic to part of an information model is illustrated in the visualisation in Fig. 12.9.

Of course, we need to perform this translation for each communicative act visualised on a pattern comic and collate the various classes, attributes and relationships together to form a complete information model which adequately describes the communicative practice in this domain. Such a model is illustrated in Fig. 12.10.
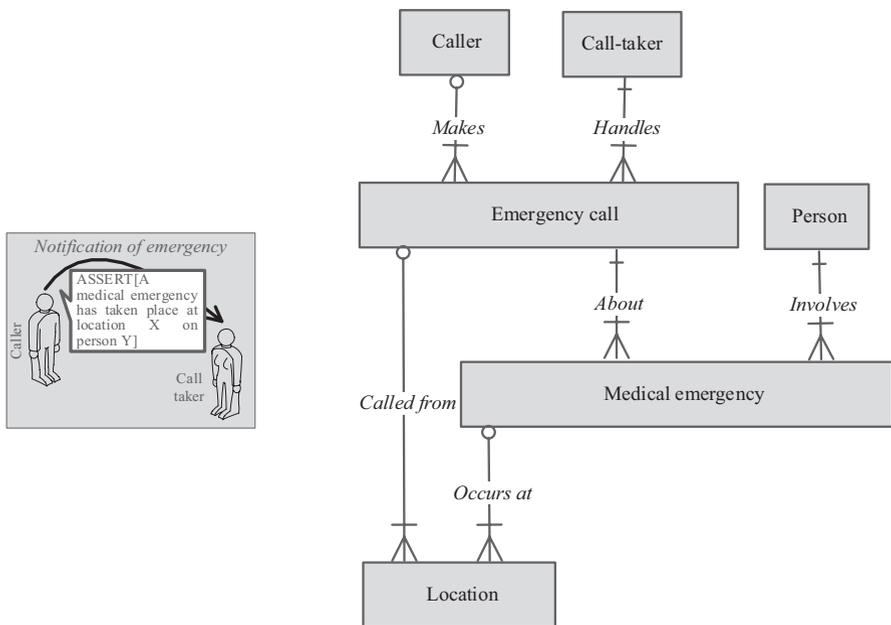
Fig. 12.9 Translating a communicative act into an information model
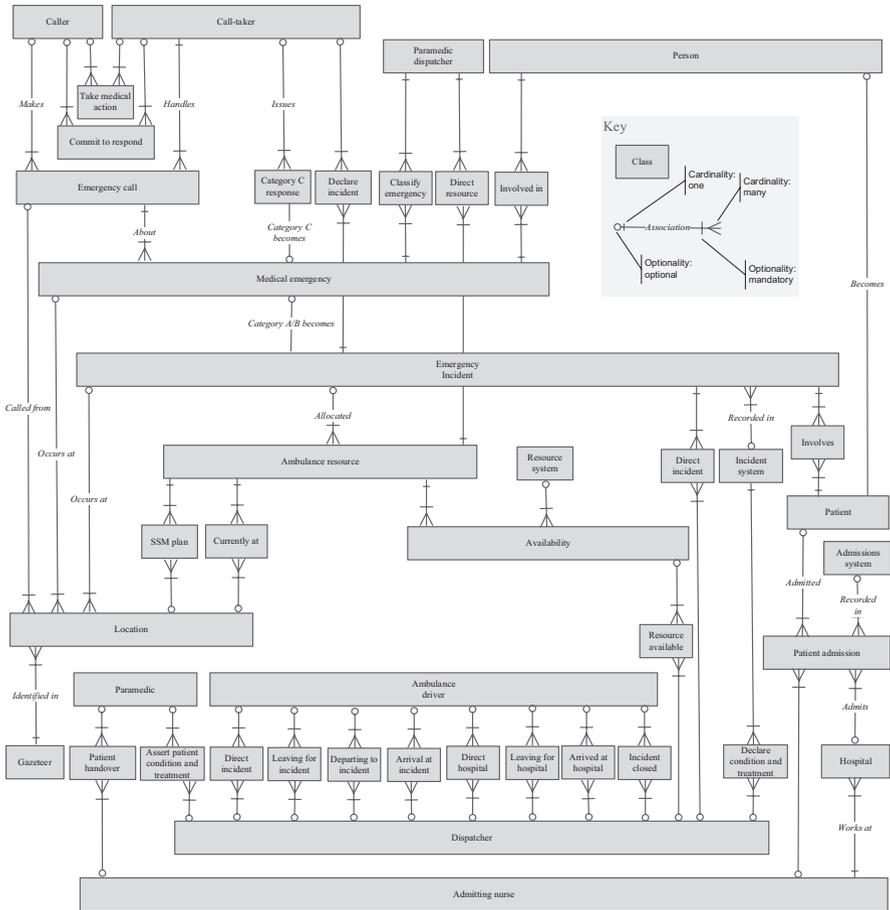
Fig. 12.10 A complete information model for emergency response

At first glance, the information model illustrated in Fig. 12.10 may appear over-complex, because it attempts to encapsulate all, not part of, the communicative context illustrated in Fig. 11.3. The classes and associations on such an information model might appear to represent undisputed things of interest for actors within this domain. In practice, classes such as patient, medical emergency and emergency incident serve to create this institutional order for participating actors. What constitutes or should constitute a patient and what constitutes a true emergency and thus a valid emergency incident is a continuous source of sense-making for participating actors within the domain of medical emergency response. An emergency call only becomes a medical emergency and consequently an emergency incident through the ways in which actors such as paramedic dispatchers triage events. An emergency call only becomes the institutional fact of an emergency incident if it is deemed sufficiently 'serious' to warrant dispatch of an ambulance.

10   Conclusion

In any domain of organisation actors will be continuously communicating about things of interest. Such things of interest we have called information classes. It is possible to analyse the communication evident in some domain and generate a model of such classes and how they relate together. It is also possible to prescribe on the basis of some as-if information system model the likely basis of communication within some new domain of organisation. This can be used to generate a designed collection of classes and relationships. In both cases we refer to the collection of classes and relationships as an information model (Exercise 12.11).

> **Exercise 12.11**
> In the University Short Courses case a booking clerk makes the following assertion to a customer: ASSERT[*A place on a presentation for your nominated course is available on the following date*].
>
> • Identify the information classes in this statement
> • How are the information classes likely to be related?
>
>   Can you write some binary triples formalising the content of this communicative act?

Three basic constructs are used in information modelling as a business analysis and design technique: classes, relationships and attributes. One information class can be associated with another information class. Association relationships are characterised by two sets of rules: cardinality rules and optionality rules. Cardinality defines how many instances of one class are related to how many instances of another class. Optionality establishes whether all instances of a class must participate in a relationship or not. An information class is characterised by a number of properties or attributes. One or more attributes of the class are chosen to be identifiers for the class. A class may be a sub-class of another class in which case it is related through a relationship of generalisation. When we group a set of similar objects together and provide a category for such a group, we classify such objects. Objects are then said to instantiate the class. A class may be part of a container class. In which case, it is related through a relationship of aggregation.

An information model is related to an information system model through the content of informative acts. This means that information classes, relationships and attributes help frame the content of the communicative acts from some domain. Such classes and their relationships can be expressed more formally as binary triples.

11   Theory

It should be evident from the discussion of this chapter that the idea of an information class has much similarity with the idea of a sign within semiotics. In this sense, an information model can be interpreted as a model of some limited sign-system appropriate to a domain of organisation. The general notion of a sign and more generally that of a sign-system is discussed in Chaps. 1 and 3 of *Significance*. The basis of communication in sign-use is explored in Chap. 4. The linkage between models of information and communicative acts and how to make such linkage is considered in my article entitled 'Declarations of Significance' (Beynon-Davies 2018).

12   Practice

Information modelling had its genesis in attempts to develop more expressive data models for the dominant database systems of the 1970s (Gray 1996). During this period, the hierarchical and network (DBTG 1971) data models dominated (Tsitchizris and Lochovsky 1982). In 1970 Ted Codd published his landmark paper on the relational data model (Codd 1970), which was set to influence the design of database management systems for many decades hence. But during the 1970s and 1980s many alternative data models to the relational data model were published which became known as the semantic data models (SDMs) because they attempted to provide formalisms for building better semantics into database systems. One of the most cited of such SDMs was the entity-relationship model proposed by Peter Chen (Chen 1976). Although developed originally as an alternative to the relational data model, developers soon latched on to the usefulness of the graphic approach provided by Chen to express his data model and adapted it to the purposes of database design. A number of extensions to the approach have been proposed over the years, particularly the inclusion of abstraction mechanisms such as generalisation and aggregation (Hammer and Mcleod 1981; Winston et al. 1987). This led many to propose the use of extended entity-relationship modelling as the appropriate way of conducting conceptual modelling, as opposed to logical or physical modelling for database systems. In early 2000 the Object Management Group adopted many of the features of extended entity-relationship modelling within its specification for class diagrams within the Unified Modelling Language (UML) (Rumbaugh et al. 2004). Although various updates have been made to UML as an approach, the conventions of class diagramming have remained consistent for well over a decade.

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Making Sense of Business Data

13

1   Introduction

In a scene from Billy Wilder's movie *The Private Life of Sherlock Holmes* (1970), the character of Sherlock Holmes scolds his landlady for tidying up his room, despite his orders to the contrary. '*I made sure I didn't disturb anything*', she responds. '*Dust is an essential part of my filing system*', retorts Sherlock indignantly—'*By the thickness of it I can tell the date of any document immediately*'. '*Some of the dust was two inches thick!*' the landlady protests. '*That would be March 1883*', says Sherlock.

In this chapter, we shall move our innovative account of the nature and conduct of business analysis and design forward from considering the purpose of communication to how we communicate—the medium of communication. We use the term data to denote this focus upon representation—how we physically form structures to communicate. Data stands for the various ways we use substance to form and re-form symbols. Such substance could, for a person such as Sherlock Holmes, consist of dust!

We shall particularly highlight the distinction between persistent and non-persistent forms of data. This helps us establish why people make records of things and how such data structures assert, direct and declare things.

Therefore, the key question for business analysis about business data is what do we represent, about what we do and communicate? Note, within our analysis we may consider all forms of representation—of form-ing symbols for things. Hence, a facial expression is data, as is a spoken word or a written paper form or an electronic record—or perhaps even dust on documents! However, because of their central place within business communication we particularly focus upon the persistent record within this and the following chapter (Exercise 13.1).

Exercise 13.1

Actors within organisations make different records for different intended audiences. For example, studies of US policeman a number of decades ago revealed that they make arrest reports for an external audience (the courts), internal documents such as patrol log sheets for an internal audience (other policemen) and personal records such as on their pad (for themselves). Apply this typology to your own use of records.

We shall first discuss how any representation involves the linked ideas of modulation and coding—creating patterns of form in some substance. Then we make a distinction between natural, embodied and persistent forms of representation. All data involves manipulating artefacts of representation, which we shall refer to as data structures, elements and items. Since we focus upon persistent representation—upon records, we could rephrase our key question about data—what do we record about what we do and communicate within the domain of organisation focused upon?

2   The Nature of Data

Data like information is a taken-for-granted concept. We all use the term frequently and assume that we all know what this term means. But, let us sense break and consider two non-standard examples that illustrate the nature of data. For some decades, the Search for Extra-Terrestrial Intelligence (SETI) has been monitoring electromagnetic radiation emanating from outer space. This organisation has not yet found a coherent signal amongst this traffic, which suggests that there is currently no evidence of an alien civilisation attempting to communicate with us. In contrast, animal scientists have been studying the squeaks and whistles emitted by dolphins for some time. They have become convinced that such signals are a form of communication.

The example from SETI shows no evidence of data, while that of dolphins shows substantial evidence of data. This is because these two examples have one thing in common—the differences or lack of differences made in some substance. For something to be data there must be differences made in a substance by an actor that makes a difference, in the sense of informing an actor of some thing of significance.

The graph in Fig. 13.1 uses human speech as a primary example of data and plots both SETI signals and dolphin signals against this baseline. Human speech is made up of spoken units of sound termed phonemes. If you plot such differences made in some language such as spoken English against the frequency of 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.

When no variation is evident, then no differences are being made in the substance in question and nothing can be communicated. This is the case in relation to the electromagnetic radiation monitored by SETI and emanating from outer space.
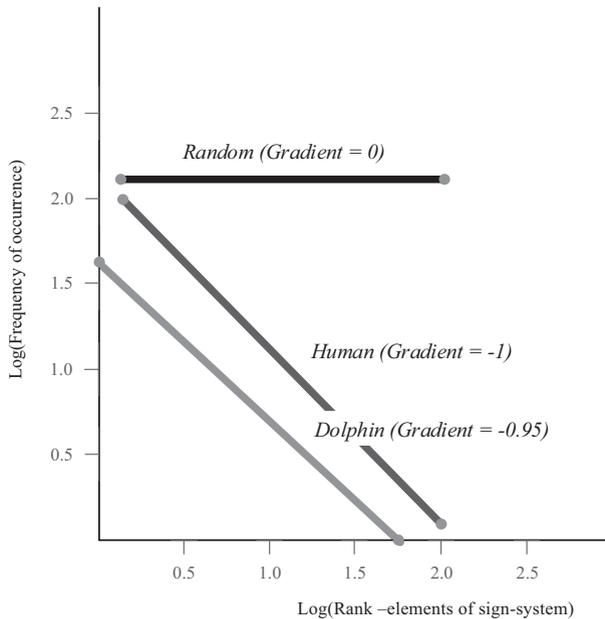
Fig. 13.1 Determining the presence of data

But interestingly, the slope of differences made by dolphin squeaks and whistles is similar to that of human speech, providing strong evidence that these mammals are communicating. But we do not yet know what.

The graph illustrated in Fig. 13.1 is actually an example of something known as Zipf analysis, after George Kingsley Zipf, an American linguist and philologist, who studied statistical occurrences in different human languages. In his studies he found that a small collection of elements, such as letters and words, in natural languages are used very frequently, but most elements are used infrequently. This insight provided Zipf with an appropriate method for determining whether a signal consists of a code based on a language. If you count the number of times certain letters appear in written extracts of English, you get a graph with a –1 (negative) slope. Hence, in written English the letter E occurs very frequently, while the letter X occurs only infrequently. The same is also true of most other human written languages. A random string of letters, which cannot be used to inform anybody of anything, appears as a flat slope on the graph.

3   Modulation and Coding

What is being plotted upon the graph in Fig. 13.1 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 which is sound is a pressure wave that travels through a solid, liquid or gas. In this

form, differences correspond to the peaks and troughs of the soundwave, and this variation corresponds to the modulation of the signal.

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 a 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, or they may be also used to record details of things—to build collective memory of some things (Exercise 13.2).

Exercise 13.2

Imagine that the only way you have of making records is using a set of paper clips of differing colours. Your task is to come up with a rough and ready scheme of representing some business data using only these artefacts in some form of combination. For example, in terms of a delivery advice as in the figure below, what data do you need to represent? How are you to code the data using just the paper clips?

Blackwalls steel products		Delivery advice	

Advice No.	Date	Customer name	Instructions
A3137	20/01/2020	Goronwy Galvanising	Galvanise and return

Order No.	Description	Product code	Item length	Delivery Qty	Weight (Tonnes)
13/1193G	Lintels	UL150	1500	20	145
44/2404G	Lintels	UL1500	15000	20	1450
70/2517P	Lintels	UL135	1350	20	130
23/2474P	Lintels	UL120	1200	16	80

Haulier	Received in good order		
International 5	X		

---

4   Data Structures as Messages

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 some thing. 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 that all other forms of coding can be collapsed into this basic coding in bits and explains 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.

5   The Medium or Substance of Data

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) (Exercise 13.3).

> **Exercise 13.3**
> So, when a human sees something across a room what type of data is this? When a human speaks something to another human what type of data is this? When we record a telephone conversation using a voice recorder what type of data is this?

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 with the human larynx or the muscles in the face. 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 these structures can only be used as transient messages.

In contrast, amongst 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. The Inka created a large empire stretching along the high Andes in South America, which was administered by a bureaucracy that made data structures using assemblages of knotted cord constructed from llama and alpaca wool and cotton (Fig. 13.2). *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 upon the cords and position the knots at different places upon these cords. We know something of how certain symbols were coded by using differences made in the construction of a *khipu* (Fig. 13.2).

The idea of persistence is inherently related to that of memory. Records are tools that we not only use to communicate the past but also use them to create the future. We particularly utilise these data structures as a means to help us memorise things or events. Records in fact act as collective memory for actors within some domain of organisation.

Note that any act of making a collective instance of memory is also inherently an act of forgetting. For instance, airlines may decide to keep records of the flight you take and even your seat allocation—they are unlikely to record what meal you chose or what movie you watched. Nurses have had to fight hard to preserve the nursing record (Bowker and Leigh-Star, 1999). Even so, much of the work with records
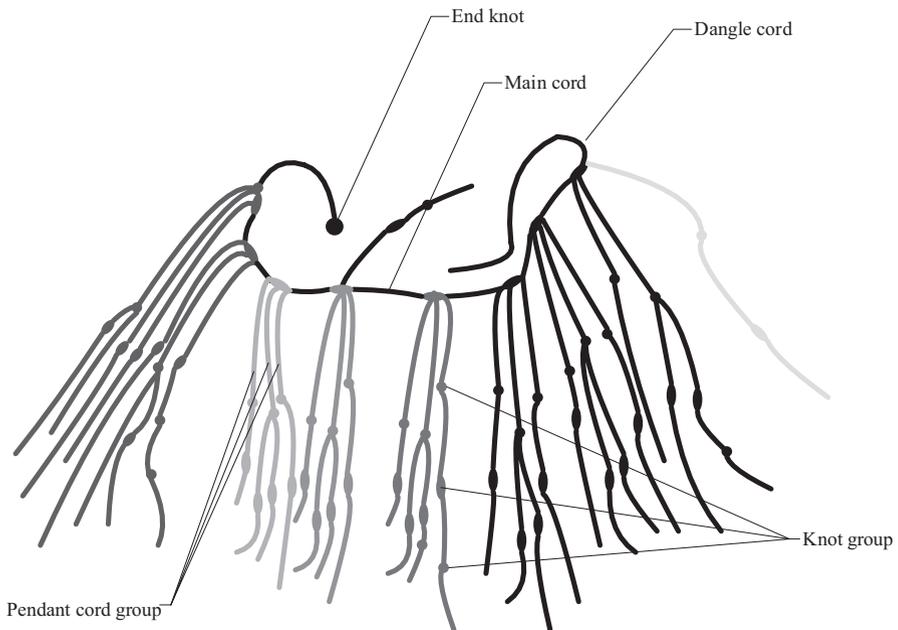
Fig. 13.2 Components of a khipu as a data structure

undertaken by nurses is frequently discarded when a patient is discharged from hospital. Presumably, because such care records are not seen as of value by the powers that be, unlike medical or clinical records.

Persistent data then have a number of inherent advantages over other types of data. Because such data can persist beyond the body it can be used by multiple actors perhaps at different times and situated in different places.

Consider the Inka *khipu*. How do we know that these were not merely personal memory aids for particular bureaucrats in the Inka Empire? How do we know that they communicated things between two or more actors?

Well, there is sufficient evidence to suggest that a given maker of *khipus* (*khipucamayuq*) would create a *khipu* then wrap it up as a ball and give it to a runner who, as part of a relay team, might transport it many thousands of kilometres along the Inka transport network. At its destination it would be unwrapped and read by a different *khipucamayuq*, who would act upon the message it contained. Here, we have two different actors in different places using the same artefact. This is clearly evidence that something was communicated in the form of a *khipu*.

But the persistent record also has a number of problems—many of which are now considered within the area known as records management (Organisation, 2001). One particular problem is that because the creator of some record is likely to be different from multiple readers of the records, certain intentions of the original creator might get lost or be forgotten about in the record. This reinforces the idea that making a record is as much an act of forgetting as that of remembering.

Consider the case of criminal records checking, which has become a minor industry in the UK. For the highest level of such checking an investigation is made of police records. A minor comment made perhaps innocently by a neighbour and recorded by the police but not investigated might be sufficient for an individual to fail a criminal records check.

Or consider another related scenario. John is nine years old. He has been learning about alcohol abuse in one of his school lessons. John is a disruptive pupil in class so his teacher holds a meeting with him to see if he needs extra support. In this meeting John claims that his mother is an alcoholic; he also mentions that his father is in prison. When John is 14 he gets into a fight with some youths and he ends up with a caution from the police. Some ten years later, John applies for a job with one of the UK central government agencies and supplies a number of personal identifiers as part of this process. A background-screening programme picks up within the record a history of alcohol abuse and criminal activity in his family. He does not get the job. Here, the 'sins of the father' rather unfairly come to haunt the son, through the presence of institutional records.

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 structure	File		Khipu		Table	
Data element	Record		Pendant group		Row	
Data item	Field		Pendant cord		Cell	
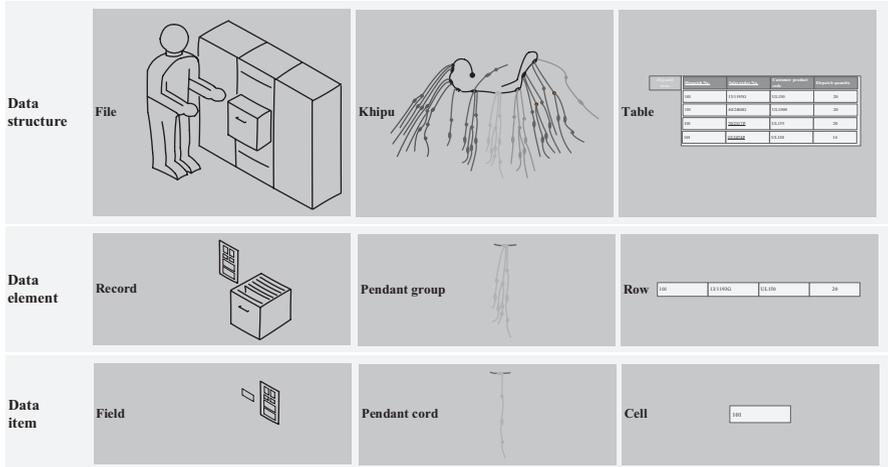
Fig. 13.3 Various data structures

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 while 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 (cell) would comprise a data item (see Fig. 13.3).

7   The Importance of Data Structures

A data structure is a term which is used broadly to refer to some systematic format for organising data (Tsitchizris and Lochovsky, 1982). This concept is clearly central to the interests of the information disciplines (Information Science, Information Management, Information Systems, Computer Science). Much of the infrastructure of information and communication technology, for instance, is clearly taken up with the mechanics of data structures, particularly as it pertains to applications within business and government.

However, although much research and development continues to be devoted to finding better ways of storing, retrieving and manipulating data structures, this concept is only rarely examined critically within the information disciplines. By this we mean that the data structure is treated largely as a technological artefact, helping to support but somewhat isolated from considerations of institutional order. As such, data structures appear to form part of the accepted and unexplored background to the conduct of investigation and explanation in these disciplines.

Although data structures are not really thought about much the 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 learn to drive and apply for a driver's licence. You purchase a car and you apply for a vehicle licence. 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 decide to travel but must prove your citizenship by applying for a passport. 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. When you retire crucial records held about your public and private pension scheme will determine the income available to you. Finally, your death triggers a death certificate, which is used by your descendants to resolve issues of probate (inheritance).

8   Data Technology

Khipu, paper forms and electronic records are all examples of data technology. Let us try to examine in more detail what we mean by this.

The humorous and fictitious example cited of Sherlock Holmes and his dust filing system is representative of a much more serious and real phenomena. For instance, a study of a domain of organisation consisting of bed allocation on an intensive care unit in Australia found that the use of a manual whiteboard by nurses was critical to effective performance (Lederman and Johnston 2011). The observed state of the whiteboard as well as that of the intensive care ward itself were used by nursing staff to make situated choices about bed allocation. Elsewhere, a simple piece of laminated card was introduced into the orthopaedic wards of a UK hospital. Known within this setting as the 'Ticket Home' this card which displayed mainly an expected discharge date was attached to each patient locker. Surprisingly, introduction of these simple cards significantly improved discharge rates for the orthopaedic unit involved (Webber-Maybank and Luton 2009).

We use the term data technology to denote any set of artefacts that has the potential to be used for the purposes of being informative within some domain of organisation. This potential is defined by the affordances of a particular technology: the concept of affordance (Norman 1999) we used previously in Chap. 2 when we discussed the affordance of the metro map. An affordance refers to a property of a certain artefact that allows an actor to perform an action. Any technology is a set of artefacts created by a set of actors for doing something, for taking action. For instance, a post-it note clearly affords actors the potential to write upon it. But a

post-it note can clearly also be stuck somewhere, usually in relation to other such artefacts, perhaps upon a whiteboard. This positioning is an additional affordance of this particular data technology.

But it is important to separate out the act of creating or forming the artefact from its use for doing something. Within the context of situations in which we are interested it is important to separate out (at least for the purposes of analysis) the act of placing a post-it note somewhere from the accomplishment of being informed by this action. In other words, it is important to separate out the act of articulating some structure from its use for communicating something.

There are two main reasons for this. First, that the act of forming an artefact may be accomplished by a different actor from that being informed by the artefact. Second, that the association between the act of manipulating some artefact and the act of being informed by it is an arbitrary one. A certain artefact may hold significance for one actor but not for another. The same artefact may also inform two different actors differently. Hence, the thickness of dust upon documents in his study is an affordance to Sherlock Holmes, but it is mere annoyance to his landlady.

9 Data Structures as Actors

Within Chap. 3 we indicated that we believe it important to take into account within our designs of organisation how data structures act. The key premise here is that data structures are key actors in modern domains of organisation. Indeed, in previous work we have argued that data structures *scaffold* institutional order (Beynon-Davies 2015).

Consider the sequence of events from the pattern of organisation relevant to Goronwy Galvanising illustrated in Fig. 13.4. Here, an outbound logistics controller produces a physical data structure known as a dispatch advice. Once created, the dispatch advice as a data structure acts independently of its creator. Some time after its creation the data structure will inform a human actor, namely a dispatch driver, that she should load a trailer of the indicated material and deliver it to the designated customer. This communication occurs independently of any further intervention by the outbound logistics controller and triggers some instrumental activity, namely
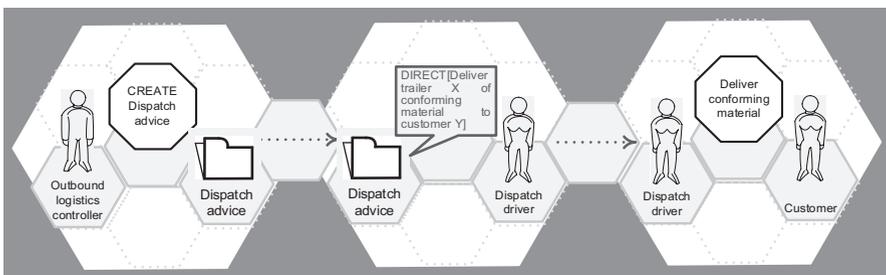
Fig. 13.4 Coupling of articulation to communication and to coordination

that the material is delivered to the customer. This coupling of data structures to communicative acts and in turn to coordination is what we mean by the scaffolding of data structures.

Scaffolding has been applied particularly as a metaphor within areas such as learning theory, child development and distributed cognition. In such areas *scaffolding* is a term used to refer to augmentations that allow humans to achieve goals that would normally be beyond us. The scaffold helps structure human action by supporting and guiding it. But such scaffolding also serves to discipline or guide such action. This idea appears to have a certain synergy with Giddens' constitutive cycle discussed in Chap. 4.

Conventionally, data structures or their elements are taken to represent propositions about things in some domain of organisation. The organisational reality is also assumed to be observer-independent, meaning that it is the same for all actors. Within formal logic data items as propositions may take only one of two values, namely true or false. We either assert the truth of a given proposition by writing a data element or data item to the data structure or retract a given proposition by deleting the corresponding data element or data item from the data structure. This implies that the state of a data structure at any given time consists of true statements about the real-world domain it represents. This so-called correspondence view of truth implies that there is a necessary separation between institutional reality and data structures. It also implies that a data item as representation is taken to correspond to some real-world thing, or more likely a set of things important to some institutional reality.

We have made the case in previous work (Beynon-Davies 2015) for positioning data structures as critical to institutional ontology through the part they play within communicative acts. The purpose of the articulation of data structures such as packing lists, delivery notes and warehouse records is to scaffold communication across time and space to multiple actors, sometimes working in different and dispersed institutions. The purpose of such communication is, in turn, to scaffold coordinated action.

The purpose of creating a data structure is to enable communication across time and space. The elements of a data structure persist beyond their act of production. The very persistence of a data structure enables it to fulfil a purpose subtly different from speech: that of identifying and describing things across time and space to multiple actors. This means that the creator of a data structure is likely to be remote in time and space from the consumer of this data structure.

These properties of a data structure lead us to break with not only the conventional view but also the typical view of the data structure espoused in much of the literature of the information disciplines. Much of this literature still inherently assumes that only humans act in relation to data structures. In other words, humans have agency but data structures do not. We feel it important to think through some of the consequences of applying our design theory to the idea of data structures—namely, to think of data structures as having a certain agency or actability (Beynon-Davies and Wang 2019). If data structures do not act, what is the point of such artefacts? In other words, if a data structure cannot inform one or more actors

independently from the creator of such a data structure, what is the purpose of having data structures?

10   Adding Data Structures to a Tabletop Prototype

For any pattern or system of organisation we need to know how each communicative act is accomplished. In other words, it is often useful upon our models of patterns or systems of organisation to indicate what act of articulation corresponds with what act of communication. This is important because redesigning the medium of communication might be an important part of business design.

This is why within our tabletop prototyping kit we include a range of icons to indicate the medium of communication. A range of such icons are represented in Fig. 13.5 and include not only physical data structures such as postal letters but also electronic data structures such as email and app interaction. These icons are open-ended and can be added to as required within some prototype or pattern comic.

We should note that data structures are not only important as constituent elements of communication between the internal actors of some pattern or system; they are also important for external actors, particularly those that seek to control certain patterns of activity. For such external actors data structures are important for the measurement of performance. Certain data structures used as part of the pattern itself might be used for performance monitoring and control. Other data structures may need to be added in to the design of a pattern as stores for critical performance data. The important point here is that data structures come at a cost which must be factored into any evaluation of the efficacy of a designed pattern.
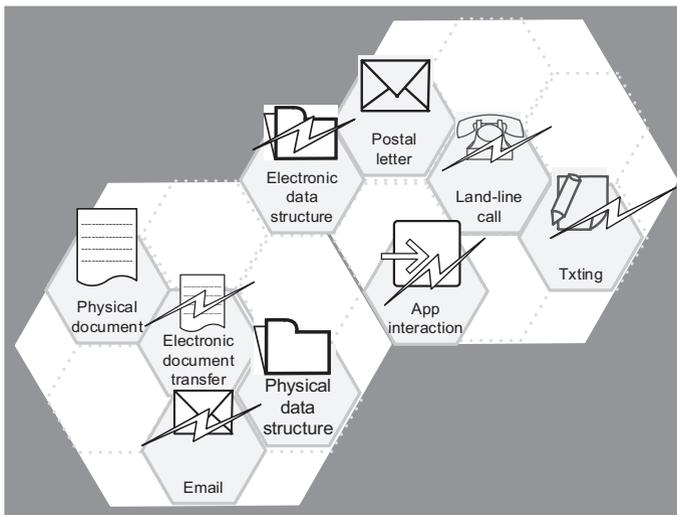
Fig. 13.5 Icons for the medium of communication

11   Revisiting the Grand Challenge

So, it is often useful when prototyping patterns of organisation to indicate clearly what act of articulation corresponds with what act of communication. Consider the act of communication in which a carer for some elderly person orders a personal alarm. This communication can clearly be articulated in many ways. It could be done via a telephone call, a postal letter, a form sent through the post, via an electronic form, via an email or perhaps through some mobile app interaction. It is useful therefore to use a series of icons upon the tabletop prototype to indicate the relevant articulation and its medium. A possible pattern which includes the dimension of articulation for the personal alarms case is illustrated in Fig. 13.6.

Data structures are clearly important to the measurement of performance. As a by-product of many acts of articulation data may be collected and stored as a by-product of the pattern concerned. For instance, consider the call made by the carer to the service provider to order a personal alarm. The order is likely recorded as a data structure which identifies and describes certain things useful for performance management. For instance, the data structure can clearly tell the service provider how many orders they have taken in various months of the year. However, for other aspects of performance management certain other data structures as well as their articulation may have to be designed into the pattern. For example, to determine a customer's satisfaction with the service provided a call will probably be made to the elderly person and a data structure updated to record her answers to the questions asked (Exercise 13.4).

Exercise 13.4
Organisations typically collect lots of lists of things of interest to them. Some of these lists are used to assert things, others to direct things to happen. What sorts of lists are collected by an organisation known to you? (Provide examples of lists of assertives, directives and commissives.) Who is responsible for maintaining the accuracy of these lists? What are these lists used for? What does accuracy mean in this context?

---

12   Conclusion

There is evidence of symbolic manipulation by humans for at least 50,000 years. Some suggest that representation inherent in symbolism emerged with our species: Homo sapiens (Marshack 2003). Homo sapiens means wise man in Latin. But Homo sapiens is also Homo habilis (man the toolmaker). However, man is not unique amongst species as a user of tools. Many species of monkey and ape, for instance, have been shown to use simple tools to transform aspects of their world, such as in the use of sticks to dig for termites by chimpanzees. Nevertheless, as a species we do appear unique in complex ways in which we manipulate signs as

Fig. 13.6 Alarms pattern with data structures

'tools'. Signs therefore seem inherently associated with fundamental aspects of human existence. Genevieve Von Petzinger (Ravilious 2010), for instance, has identified 26 signs painted on cave walls with a world-wide distribution and dating to the Upper Palaeolithic period (35,000–10,000 B.C.). Probably, ever since Homo sapiens evolved we have been a maker of signs (Exercise 13.5).

> **Exercise 13.5**
> Why do we need records? What are records typically used for in your organisation? Can record-making be disabling in any way? How much of your life is recorded somewhere in various organisations? Can modern society work without records?

Data concerns how we represent things within communication. We use the term data to stand for the various ways we use substance to form and re-form symbols. Data involves the modulation of some matter or energy to code symbols and comes in three major types: natural, embodied and persistent forma. Within business analysis and design, we take a particular interest in persistent data such as cave symbols, *khipu* and of course electronic records.

Data work within larger collections, which we refer to as articulation or data patterns and systems. Such patterns and systems consist of sequences of articulation acts. This is the topic of the next chapter.

13 Theory

The symbol we have used to denote data is taken from communications engineering and is meant to stand for a signal. It is meant to remind us that each sign has a physical or material form. We use the term data as a term to stand for this physical or material aspect of a sign. Data is considered in some detail in chapter 6 of my book *Significance*. The idea of data structures as scaffolding for institutional order is discussed in several papers (Beynon-Davies 2015, 2016, 2018).

Data systems are systems of data. Within a data system we are interested not only in the formation of symbols from matter and energy but also in how such symbols relate in larger structures. Symbols relate together and are operated upon in data systems. Data systems are discussed in chapter 7 of my book *Significance*.

14 Practice

Records management very much concerns itself with the nature of data structures, elements and items. In other words, it provides a set of best practices for organising data. Database design techniques such as normalisation and determinancy diagramming are often used to help construct inter-related models of data structure (Beynon-Davies 2004). These are introduced in Chap. 15.

The conception of data systems as sequences of operations performed on data structures is familiar in the idea of transactions and transaction analysis within database theory (Beynon-Davies 2004). Business rules analysis tends to build upon the idea that an integrated set of data structures is modified by defined business rules triggered by external events. Such events are sometimes determined in business event analysis.

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Making Sense of Data Systems

14

1 Introduction

The Second World War was a 'wireless' war. The fast military movement of machinery, men and equipment demanded constant radio inter-communication between units, generally using transmission by Morse code. All such military messages were encrypted by the German armed forces using a complex electro-mechanical device known as the Enigma machine. The problem with radio signals as a medium for data is that they can be intercepted by anybody with an appropriate receiver tuned to the right radio frequency. Not surprisingly, the encrypted German military messages were intercepted by a global network of intelligence operatives known as Station Y. These messages were passed on to Station X—otherwise known as the Government Code and Cypher School (GCCS), which was based at Bletchley Park in the UK during the entire period of the Second World War (Smith 1998). This establishment successfully unravelled the data system employed by the German war effort and in doing so invented a number of devices that contributed to the development of the modern computer.

We use the term data system to denote any system which involves the manipulation or articulation of data structures. Much of what we mistakenly call 'information' technology effectively amounts to sets of technologies for data processing, manipulation or what we prefer to denote as articulation. But data systems also include the use of low-level technologies such as paper forms, whiteboards, Post-it notes or even knotted strings and clay tokens.

In a similar manner to our definition of an activity system and an information system, we define a data system as a set of inter-related patterns of articulation. In turn, a pattern of articulation consists of a set of inter-related acts of articulation. In this chapter we examine issues relating to the design of data structures and their articulation. Information and/or data is normally seen to be the stuff of information and communications technology. These two terms are thus used interchangeably but also in very loose ways. This chapter argues for the importance of being precise about the distinction between data and information and how this distinction matters

to the design of organisations. The chapter centres on the concept of a data structure and demonstrates that data structures are not only informative but also performative (they get things done). We then focus on ways of designing not only data structures but the life cycle of articulation that such structures experience.

2   Data systems

Articulate is a verb typically used to denote the expression of something through verbal means in a clear or coherent manner. In Chap. 13 we made the case for considering a verbal statement as a data structure. An actor articulates the substance of air through use of her larynx to express some message. But articulate is a verb we use to refer to any other ways in which actors transform some substance with the intention of informing some other actor or actors.

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 numerous 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 that involve 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. Finally, read involves decoding the symbols of some existing data structure, element or item.

Figure 14.1 illustrates a typical high-level pattern of articulation which expresses in an abstract way the life of a data structure. The curved arrows on the tabletop prototype indicate repetition or iteration–that a read or an update is likely to happen many times in the life of a data structure. There is an additional act of archiving added to the figure which is subtly different from a delete. Many organisations are required to archive data for a number of years before being allowed to delete it by law. The data structure is stored in the archive but never read or updated during this period (Exercise 14.1).

> **Exercise 14.1**
> When someone makes an utterance in some business situation, what is the data structure involved? In what sense is it appropriate to think of this structure being created? Can such a structure be updated?
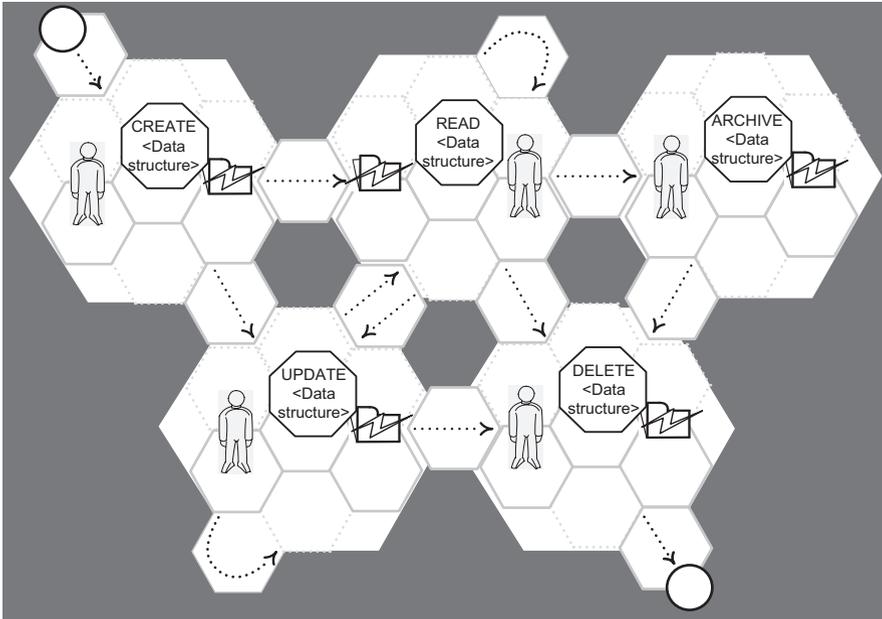
Fig. 14.1 The life cycle of a data structure

3 Acts of articulation

Thus, an act of articulation involves the application of some operation upon some data structure, element or item. The operations of create, update, delete and read are sometimes known collectively as CRUD operations. The CRUD operations help us think of the 'life' of a particular data structure. An actor normally brings some such structure into existence in a create act. At some point another actor might decide to remove the structure from existence in a delete event. Between create and delete events a given structure may be read in a number of events undertaken perhaps by a number of different actors. Finally, the data structure may also be changed a number of times in events of updating (Exercise 14.2).

Exercise 14.2
In what sense are emails the same as or different from business records? What problems emerge with the reading of emails as records? Is the management of email the same as the management of records? Consider this issue in relation to other forms of messaging: Facebook messaging, SMS texts or tweets.

Let us look at each of these operations in more detail.

Create

When we create some data structure, we bring it into existence by manipulating some substance to form data (Fig. 14.2).

- In USC we might create a new course record.
- In the Ambulance service we might open up an incident record.
- At Cwmni we might enter the details of a new company into a record.
- And at Goronwy we might create a new job sheet.

In the past, the substance manipulated to produce a record would have been the paper form. All of the examples above probably now involve interacting with some ICT system–the substance manipulated being the electronic record–which materially consists of changes to some electro-magnetic medium. In such cases, the acts of articulation are controlled by human actors but initiated by business rules and transactions within the ICT system.

Read

We make records so that they can be used not only by ourselves but more likely by other people performing different roles within some domain of organisation. Hence, such records will be read by key actors or roles and such records will inform decision making (Fig. 14.3).
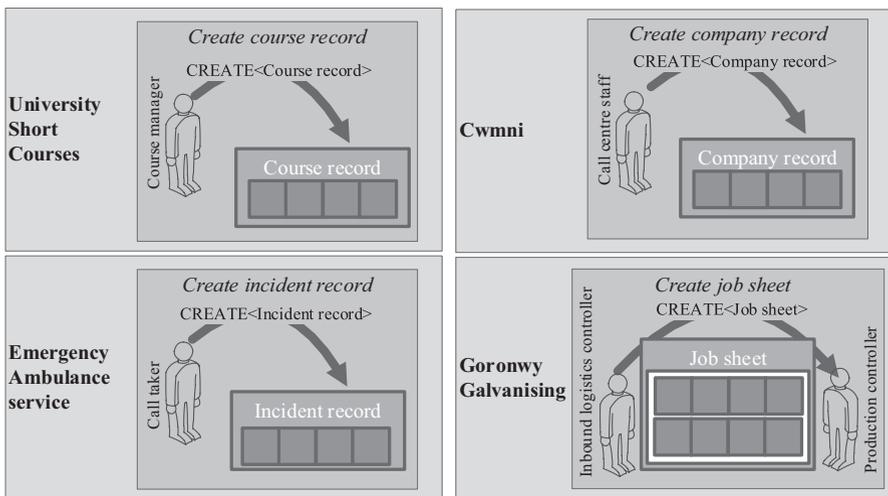
Fig. 14.2 Create <data structure>
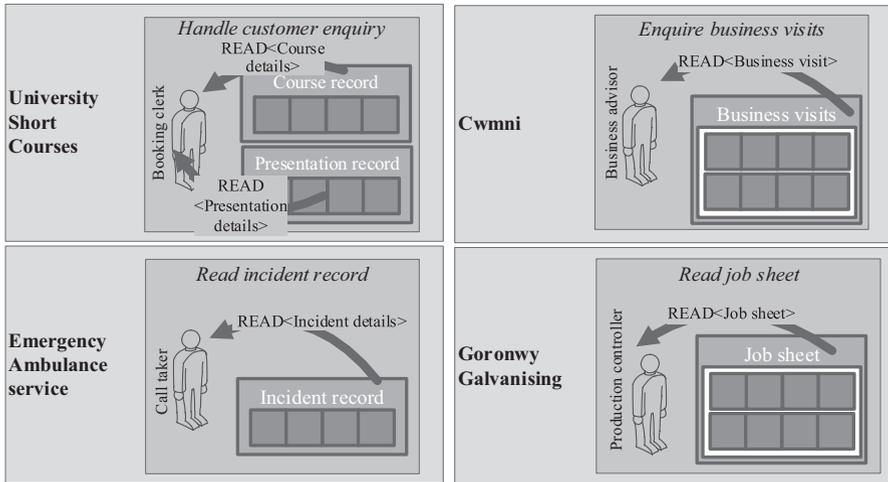
Fig. 14.3 Read <data structure>

- At USC, handling a customer enquiry may involve reading records of courses and presentations.
- Incident details will be read by various actors within the emergency ambulance service.
- At Cwmni business advisors will continuously read their diaries to know when to conduct particular business visits.
- At Goronwy, a job sheet will be read as part of the process of monitoring production.

Update

Once a data structure is created it is normally updated. The idea is that records represent institutional facts (Searle 2010). They represent important things of interest and as such these records act as a collective declaration of what the organisation has done, is doing or is intending to do for organisational actors. Hence, changing aspects of a data structure actually involves declaring some change to the institution itself (Fig. 14.4) (Exercise 14.3).

> **Exercise 14.3**
> Think of situations in which the updating of organisational records leads to a mismatch between what is recorded and what has occurred. How are such situations resolved in your experience?
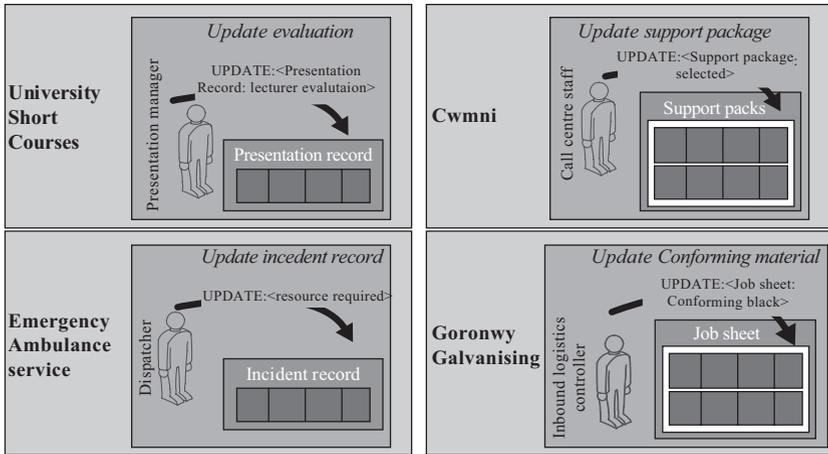
Fig. 14.4 Update <data structure>

- Within USC a presentation record might be updated with an evaluation of the given lecturer.
- Within the ambulance service an incident record might be updated with details of the ambulance team sent.
- Within Cwmni a support package record might be updated with that selected for a particular company.
- Finally, a job sheet might be updated within Goronwy with the amount of conforming black material to be processed.

Delete

Because records serve to declare institutional facts and hence act effectively to model the organisation, when things are no longer the case in a particular organisation the data structures which identify and describe such things need to be deleted (Fig. 14.5) (Exercise 14.4).

- Defunct courses at USC will need to be removed.
- Incident records that are no longer 'active' might be archived within the ambulance service.
- Companies that have gone out of business might be removed from the active register at Cwmni.
- After a certain length of time job sheet records might be deleted at Goronwy.

Exercise 14.4
In many situations organisations are required to keep historical records for a number of years–why? Does this mean that they should never delete organisational data? What does delete mean or signal in this context?
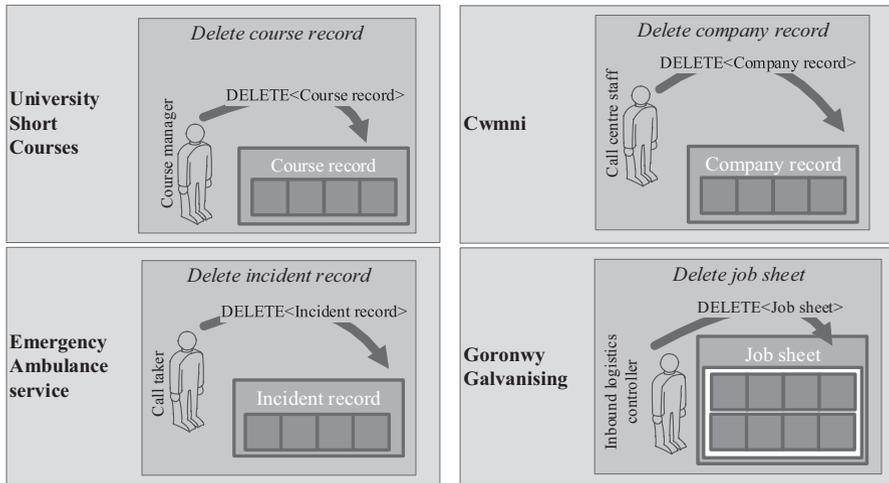
Fig. 14.5   Delete <data structure>

4   Institutional facts

We mentioned in Chap. 13 that data structures scaffold ontology–some expression about what things are taken to exist by a community of actors within some domain of organisation. But data structures can scaffold two types of facts: brute facts and institutional facts. Brute facts are matters of brute physics, chemistry and biology, and as such these facts exist independently of human institutions. An example of a brute fact is that *the sun is 93 million miles from the earth*. In contrast, institutional facts are matters of culture and convention. They exist only within the context of human institutions, such as *John Smith is a British citizen*.

The primary difference between a brute fact and an institutional fact relies upon the different status that such facts have in relation to some theory of existence–some ontology. Brute facts are observer independent. Within a brute fact the status of the thing referred to has an existence independent of institutions. In contrast, institutional facts are observer relative. Within an institutional fact the status of the thing depends upon a collective attitude or acceptance by the actors concerned that the thing has a certain function (Exercise 14.5).

> **Exercise 14.5**
> Organisations typically collect numerous lists of things of interest to them. Some of these lists are used to assert things, others to direct things to happen. What sorts of lists are collected by an organisation known to you? (Provide examples of lists of assertives, directives and commissives.) Who is responsible for maintaining the accuracy of these lists? What are these lists used for? What does accuracy mean in this context?

One might be tempted to use this polar distinction to claim that institutions deal solely with institutional facts. Institutions, such as manufacturing companies, healthcare organisations or higher education institutions, clearly have to deal with both brute facts and institutional facts. Indeed, many things can be referred to and described not only by brute facts but also by institutional facts. Consider a thing familiar within the institutional context of manufacturing organisations such as Goronwy Galvanising–that of a stillage. Stillages are physical things and as such have an existence independent of the institution. In other words, they can be described in terms of brute facts such as: a stillage is a steel box approximately 1 metre in depth, height and width. These brute facts can be confirmed by any observer of such objects, making such facts observer independent. But what is the function of a stillage? A stillage may be a physical structure, but these physical structures are assigned a particular status within the institution concerned. A stillage is used to store various stages of finished product–'stock'–within the context of the manufacturing plant. Data structures might be used to build many institutional facts which refer to stillages as units of stock, such as stock locations and stock movements.

5   Patterns of articulation

Data structures are rarely articulated in isolation. Instead, the inter-leaving of the articulation of a multitude of data structures forms patterns or wider systems, which we refer to as a data system. 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 Fig. 14.6, as a pattern of acts of articulation performed with data structures. This figure illustrates, as a tabletop prototype, the various data structures utilised by USC, the actors who articulate them and the order in which the articulation occurs.

6   Conclusion

The power of data structures to act and the importance of designing data structures with such agency in mind is evident in an example cited quite a while ago by the American anthropologist Benjamin Lee Whorf. Whorf came to linguistics from a background as a fire insurance inspector. What first attracted him to the issues of language was the way in which workmen he inspected acted in relation to petrol drums, or more precisely to the labels placed upon these drums. Normally, workmen were extremely careful with drums labelled as being *full* of petrol. However, they tended to take a very casual attitude towards petrol drums labelled as being *empty*. In fact, empty petrol drums are far more dangerous than full drums of petrol. Empty petrol drums are a natural fire hazard because petrol vapours, which remain in the drum for some time after they have been emptied, are extremely flammable. Whorf therefore concluded there was something about the labels placed upon such drums and what these labels communicated–the concept of *empty*–that was

Fig. 14.6 The data system at USC

triggering what might be conceived as dangerous behaviour amongst workmen. If the labels had been changed to indicate something like the concept of *danger* then more appropriate handling of drums might be expected.

Data structures have a life consisting of a pattern of acts of articulation. Acts of articulation are either create, delete, update or read acts. Create acts involve bringing a new data structure (element or item) into existence while delete acts involve removing a data structure from existence. Update acts involve changing the value or values of some data structure while read acts involve accessing the values of some data structure. A pattern of articulation consists of a series of inter-related acts in which data structures are manipulated. Patterns of articulation inter-relate to build data systems.

7   Theory

Data systems are systems of data articulation. Within a data system we are interested not only in the formation of symbols from matter and energy but also in how such symbols relate in larger structures. Symbols relate together and are operated upon in data systems. A data system is a concept which has wider application than that simply of contemporary ICT systems, and is discussed in Chap. 7 of my book *Significance*.

8   Practice

The conception of data systems as sequences of operations performed on data structures is familiar in the idea of transactions and transaction analysis within database theory (Beynon-Davies 2004). Business rules analysis tends to build upon the idea that an integrated set of data structures is modified by defined business rules triggered by external events. Such events are sometimes determined in business event analysis.

References

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Models of Data

15

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 a number of purposes. First, it served to document the liability of estates in terms of the King's 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.

The makeup or constitution of these records can be described by a data model. A possible data model for the Domesday book is provided in Fig. 15.1. The goal of this chapter is to explain not only why such models are important but how to construct such models.

A data model details the structure of data relevant to some domain of organisation. In contrast, an information model details the structure of the content of communicative acts relevant to some domain of organisation. There should in principle be some apparent vertical coupling of the data model and information model relevant to a designated domain of organisation. This means that a data structure defined within a data model should correspond to one or more information classes expressed within an information model. These data structures will constitute the primary 'material' transformed in a data system model.

Landlords	Landlord name	Seat	CivilOrEcclesiastical			
Locations	Location name	Notes				
LandlordLocations	Landlord	Location name	Year Surveyed			
TaxableHoldings	Landlord	LocationName	Yearlevied	NumberofPloughs	IsWaste	RevenueYielded
Tenants	TenantName	NumberofTenants				
TenantHoldings	TenantName	Landlord	LocationName	Yearlevied		

Fig. 15.1 The Domesday book as a data model

2   Natural, Embodied and Persistent Data

To refresh the material considered in Chap. 13, data refers to the physical substance used to form something with the intention of informing some actor. We also made a distinction between three types of data: natural, embodied and persistent.

Natural data refers to that produced from the natural environment. Hence, objects in the external environment of some actor are continuously signalling their properties and can be picked up by the senses of some actor. But an actor may also use his, her or its body to create data. The changes in bodily structure will signal to other actors and hence also act as data. Finally, actors may produce artefacts which are given existence beyond the body. Such artefacts can hence persist beyond any one communication and can signal to multiple actors sometimes remote in time and space. This is what we mean by disembodied or persistent data. It is this latter form of data that we focus upon in this chapter.

Clearly, the idea of persistent communication relies on the use of some persistent substance to record messages. Human speech is non-persistent as data because it is reliant upon sound waves which disperse rapidly in air. However, khipu were made from twisted strands of camelid wool and such artefacts have lasted for hundreds of years. Although the bodily acts of some human actor, a khipucamayuq, was necessary to produce a given khipu, this artefact then achieved an independent existence from the actor who created it. This enabled such an artefact to be transported through time and space by other actors and indeed 'read' by such actors (Exercise 15.1).

Exercise 15.1
Journalists frequently refer to their sources speaking *on record* or *off record*. What do they mean by this? Managers will frequently prefer to communicate using non-persistent data such as speech rather than using persistent data such as an email. Why might this be the case?

3   The Importance of Records

Thus, to be a record this structure must persist. But the substance or material used to make a message persistent varies between domains of organisation–from notches cut in wood, to shapes made in clay, to strands of camelid wool, to sheets of paper or variations in the electro-magnetic makeup of a piece of silicon.

As we have already mentioned, persistence is also related to the notion of memory. Contrast a message expressed as a spoken sentence with that of a written record. Suppose a nurse wants to tell other nurses that a prescribed drug for a given patient has been administered. She decides to speak to the nurse taking over from her at shift-change. But this nurse later forgets what she has been told and administers the drug again in a 24-hour period, causing the patient to experience discomfort from an effective overdose of this medication. This is one reason why nurses maintain records of nursing care. Because it persists beyond any one act of communication the record turns individual memory into social or collective memory. This collective memory also overcomes some of the limitations of individual memory, such as our limited ability to remember things.

Consider one of the earliest attempts to develop records–that of the Sumerian clay token–which we considered in Chap. 2. Human memory was sufficient in the first agricultural communities consisting of small numbers of individuals cooperating in simple activities. As such communities turn into the first city-states, activities, particularly those reliant on economic exchange, need to take place between strangers and generally are more complex in nature, typically reliant on some division of labour. At some point in the development of human communities signs started to be used to make persistent records of things. The key purpose of records is to extend and compensate for limitations of human memory. Records of economic transactions 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. Records account not only for the types and quantities of commodities exchanged, they are also important for supporting social relationships of ownership and debt.

4   Signs of the Person

We also established in Chap. 13 that your life is documented in records, but your life is also lived through records. Records are not passive devices that catalogue major events in your personal biography. They are very much active. You cannot act as an individual within modern society without some reference to records held about you. If you cannot prove certain institutional facts held about you in data structures, you are often prohibited or proscribed from acting.

In the Book of Revelations one of the prophecies states *And he causeth all, both small and great, rich and poor, free and bond, to receive a mark in their right hand.* A classic example here of the centrality of records to modern existence is the

importance of personal identifiers in modern life–'marks' of personal identity. Personal identity is critical to many data systems in contemporary society, because of the way in which identity increasingly becomes reified in personal records. Enrolment in the activity systems of modern life is frequently reliant upon identification as a process of information accomplishment.

Personal identity is a critical part of the accomplishment of modern organisation. It is actually accomplished in three critical steps which cross the three layers of system–activity system, information system and data system–we have discussed in previous chapters.

At the level of data, a person's identity is authenticated through various forms of persistent and non-persistent identifier. Authentication involves answering the question *Am I who I claim to be*? Authentication is typically signalled by lists of identifiers, stored within some data system. Within face-to-face inter-action standard or 'natural' identifiers are used for the communication of identity such as appearance or personal names. The contemporary problematic of remote communication in support of remote inter-action demands the use of surrogate identifiers such as codes and biometrics.

At the level of information, identifiers are critical to identification–a communicative act that primarily informs actors of certain properties associated with the individual identified. Identification largely involves answering the question *Who am I*?–and typically works though an identifier designating certain attributes or properties of the individual, including a history of events in which the individual has participated.

At the level of activity, the possession of appropriate identity is critical to enrolment in various systems of human activity and the coordination of mutual performance amongst a multitude of actors. Enrolment generally involves answering the question, in relation to a particular activity system: How am I expected to perform and how will others perform towards me (Exercise 15.2)?

> **Exercise 15.2**
> How many tokens of identification do you carry around with you such as credit cards, debit cards and loyalty cards?
>
> - What are such tokens useful for?
> - When do you typically need such tokens?
> - What happens when you fail to produce the relevant token at the right time?

This relationship between these three facets of personal identity is illustrated in Fig. 15.2.

For instance, to validate or authenticate someone's identity as a taxpayer that person first needs to produce an identifier such as a tax reference. This identifier will then be used to determine details of the person held in personal records which serve to identify the person to the tax authorities. Successful personal identification will enrol the individual in a whole range of rights, responsibilities and expected actions in the activity systems associated with matters of personal taxation. It will also
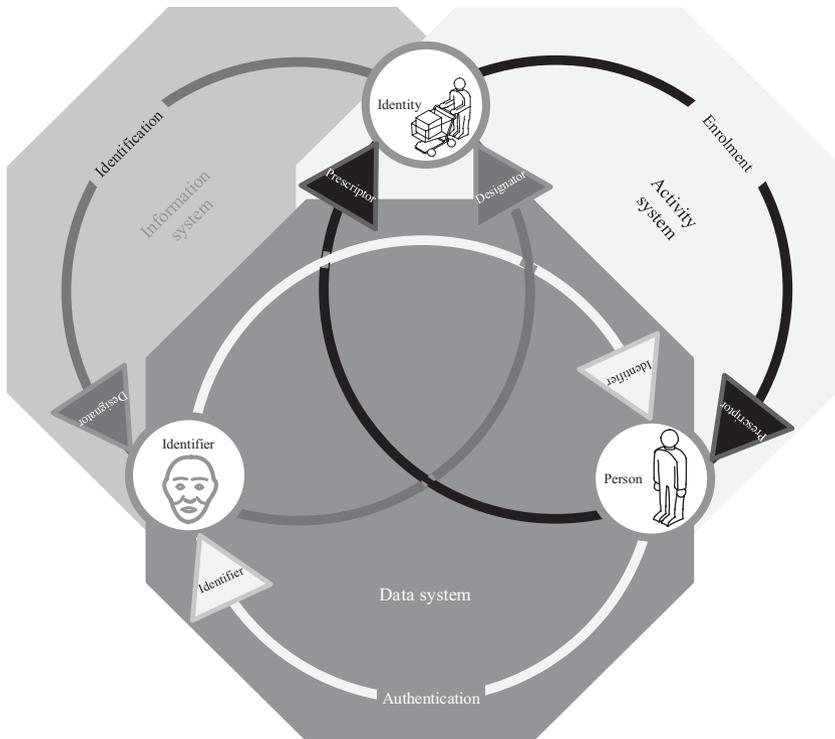
Fig. 15.2 The accomplishment of personal identity

entitle the individual to access services provided by the tax authorities of a particular nation-state.

But entry in the personal records of some organisation may not only enrol persons; it may also prohibit such enrolment for particular individuals in particular activity systems. Hence, if an identifier for you appears on a credit rating blacklist, this will prevent you from obtaining credit from financial institutions that use such records to guide performance.

5   Records as Structures

As we have seen in Chap. 13, records are best described as data technology. Records are used to represent instances of things of interest to a particular organisational domain. Records are used specifically to represent what the philosopher John Searle (Searle 2010) refers to as institutional facts about some domain. Institutional facts are matters of convention which serve to define or constitute the institution in which they are used.

Any model of data must be an abstraction from such instances of institutional facts. In the case of records the business analyst needs to abstract from instances of records certain commonalities of structure. We refer to such an abstraction as a data model. A data model primarily describes structures of data and how these relate together. As we have seen, data structures consist of data elements which in turn consist of data items (Tsitchizris and Lochovsky 1982). Data items act as placeholders or 'containers' that take or are assigned values. Valued items, elements or structures are used to represent things of interest to some domain, to build institutional facts which actually serve to constitute the domain of interest.

Take a historical example. With the rise of the modern office in the nineteenth century, the technology of filing cabinets, paper folders and paper forms was invented and used to organise data. Within this data system a typical record consists of a series of data items which serve to represent an instance of something of interest to the organisation. For instance, a business organisation might create a typical record, consisting of a paper form, for each of its customers, with fields such as customer name, customer address and customer telephone number. Such a form might then be placed in a suspension folder for easy access.

Records (such as paper forms), in turn, are typically collected into the data structure of a file–consisting perhaps of a filing cabinet and representing some association between these data elements. For instance, a customer file assembles a series of customer records. Various different customer files might be created, with a specific criterion used to decide which record goes in which file: customers located in different areas of the country, or handled by different account managers, for instance. This data model served administrative organisations effectively for over 200 years. More recently another model for managing data as electronic records has gained dominance. This is generally known as the relational data model.

6   Relations

It is useful to approach the relational data model through the idea of a list. A list is another key example of a persistent data structure. Fundamentally, it amounts to a set of symbols, each of which serves to stand for some thing within some community of actors. The symbols persist in the act of representation beyond that which they represent.

At its most basic a list corresponds to a set of elements: a collection of distinct 'objects', considered as an object in its own right. There are two ways of describing or specifying the members of a set. One way is by intentional definition, using a rule such as *A is the set of colours of the French flag*. The second way is by extension–that is, listing each member of the set. An extensional definition within mathematics is denoted by enclosing the list of members in brackets such as A = {*blue, white, red*}.

Most lists used for modern institutional purposes are actually ordered sets known as sequences or tuples, implying that both the elements of the list and the position of the elements in a list are significant–hence the tuple <1,2,3,4> is different from the tuple <2,4,3,1>. Within institutional contexts, simple lists consist of an ordered

collection of data items, typically, as we shall see, identifiers for persons, things or events. More complex lists consist of ordered collections of data elements (such as records) or even data structures (such as files) (Exercise 15.3).

> ### Exercise 15.3
> Consider another data structure of interest to modern organisation–the electronic mail or email. Analyse an email as a data structure. What constitutes its elements and what are likely data items?

The mathematician Ted Codd (Codd 1970) had the key insight of mapping aspects of this theory of sets, particularly the idea of tuples, onto that of files, records and fields. Codd proposed mapping the data structure of a file onto that of a mathematical relation, being a set of tuples. This data structure fundamentally underlies the data management systems used within mainstream digital computing systems.

The relational data model uses the data structures of tables, consisting of multiple data elements or rows, which in turn consist of a series of data items or columns. Consider a typical business form such as the dispatch advice in Fig. 15.3, which was much used originally within the Goronwy Galvanising case.

The data on this form can be stored in a relational database using the two data structures illustrated in Fig. 15.4 (Exercise 15.4).

> ### Exercise 15.4
> Primary keys act as identifiers. How does the idea of a primary key relate to the notion of an object identifier such as a person or actor identifier?

The table named Dispatch notes in Fig. 15.4 consists of four data items (Dispatch No., Dispatch date, Customer code and Instructions) and three data elements

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	UL150	1500	20	145	20	150
44/2404G	Lintels	UL1500	15000	20	1450	20	1460
70/2517P	Lintels	UL135	1350	20	130	20	135
23/2474P	Lintels	UL120	1200	16	80	14	82

Driver	Received by

Fig. 15.3 A dispatch advice

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

Fig. 15.4 A simple relational database

corresponding to three rows in the table, one for each dispatch note that arrives with a delivery of steel product.

Each row in a table is identified by values in one or more columns of the table, called the table's primary key. To act properly as an identifier, the values of a primary key must be unique and not null. In other words, we must have a value for each element of the primary key and each value must be unique in terms of other values of the primary key. For instance, in the Dispatch notes table the Dispatch No. data item is the only item having both of these properties. It is therefore the most suitable candidate for a primary key for this table.

Values in columns may also act as links to data contained in other tables. Such columns are called foreign keys. A value for a foreign key must either be the value of some primary key elsewhere in the database or be null. The primary key of the Dispatch items table is actually composed of two data items: Dispatch No. and Sales Order No. Both of these data items individually are in fact foreign keys to two other tables in the database. Dispatch No. acts as a foreign key back to the primary key of the Dispatch notes table. Sales Order No. acts as a foreign key back to a Sales orders table. The values of these two foreign keys can never be null because we must always know which dispatch note and sales order a particular dispatch item relates to.

7   Forming Data Structures

A convenient shorthand for representing a data model for something like a relational database is illustrated in Fig. 15.5. This is actually a data model for the ambulance service case.

Ambulances	Ambulance no.	Ambulance type	Ambulance equipment	Vehicle Reg. No.	
Crew members	Member no.	Member name	Member DOB	Member grade	Ambulance no.
Locations	Location code	Location name	Map reference		
Incidents	Incident No.	Incident description	Patient no.	Incident category	Incident status
Patients	Patient No.	Patient name	Patient age	Patient condition	Patient medical history
Resource allocations	Ambulance No.	Incident No.	Allocation status		
Resource locations	Ambulance No.	Location code			
Incident locations	Incident No.	Location code	Movement date	Movement time	Delivery No.	Dispatch No.

Fig. 15.5 A data model for the ambulance service case

Each table is given a unique name. The list of attribute names is then provided for each table. Primary keys are underlined. Foreign keys are identifiable through common attribute names in two or more tables.

Alternatively, each data structure could be written as a definition, such as:

Ambulances (ambulanceNo., ambulanceType, ambulanceEquipment, vehicleRegNo)
Crew members (memberNo, memberName, memberDOB, memberGrade, ambulanceNo)
And so on…

8   Data Structures and Information Classes

Every item, element or structure of data has the potential to inform–or it would not be data. For instance, consider the Sumerian clay token. It is likely that such clay tokens could have fulfilled a number of distinct purposes within these early societies. The creation (Create<clay token>) of a clay token might have been used to make commitments such as a given actor promising to hand over one unit of cloth as tribute to the temple. It might also have been used to declare that the signified tribute had been paid to the temple. Finally, it is likely to have been used to assert that a given quantity of a particular commodity was held in the temple stores (Exercise 15.5).

Exercise 15.5
Within an intensive care unit of a hospital nurses place coloured magnetic tokens next to bed icons drawn upon a physical whiteboard. What do you think placing these tokens next to a bed location signifies to these healthcare workers? In other words, what information might be associated with this item of data?

Fig. 15.6 An excerpt from the USC information model

Here we have the linkage between a clay token as data and its multiple uses as information. A given clay token is merely a piece of physical substance–clay–that is shaped and incised in a particular way. But the way in which it was used, such as being placed in a particular clay envelope, and placed in a particular spot, signified particular intentions on the part of the actors involved.

Or consider a more recent case. Within a production organisation known to the author, workers place small, coloured magnets with representations of human facial expressions (particularly the expressions for happiness and sadness and the neutral face) upon whiteboards (Beynon-Davies 2018). These small artefacts are extremely important for the workers themselves as collective expressions of satisfaction with their own performance, such as levels of production or levels of stock accuracy. The data in this case constitutes the coloured magnet, but also its physical positioning upon a whiteboard. The information constitutes what the magnet at a particular position signifies to actors in this domain of organisation.

The coupling of an information model and a data model is expressed through the relationship between a data structure and an information class. In particular, an information class is defined in terms of its attributes. Each attribute can be unpacked as a data item, with each instance of an information class being a data element within a wider data structure.

Consider an excerpt from an information model of relevance to USC, as illustrated in Fig. 15.6. These three classes would end up as three relational tables courses, bookings and customers. Properties of the presentation class might include a presentation number, a course number, a presentation date and so on. Each of these properties would become an attribute of the presentations table. One or more of the attributes of each table would be chosen to act as the primary key of the table. Hence, in terms of the presentations table, presentation number is the most suitable attribute.

9   Visualising Data Structures

In our discussion in the previous section we have assumed the presence of an information model for some domain of organisation. This information model then suggests to the business analyst how to structure a data model for the relevant domain.

But what if no such information model exists? What if we want to start from the bottom up, perhaps by analysing documentation or other artefacts relevant to the domain? In such a situation, how do we go about designing data structures to support communicative acts in some new domain of organisation? One useful approach

is to diagram the dependency or determinancy between data items of significance to such a domain.

A data structure such as a table, as we have seen, is a collection of data elements such as rows. Each data element is made up of a series of data items. In the relational data model such data items correspond to columns or attributes of the table. A data item is the atomic unit within a data model because it can take one and only one value at any one time. In a sense, then, a data structure is a logical collection of data items. What points the designer in the right direction as far as assembling a group of data items as a data structure is a map of the dependencies between such data or formative items.

Two data items, A and B, are said to be in a determinant or dependent relationship if certain values of data item B always appear with certain values of data item A. Determinancy/dependency also implies some direction in the relationship. If data item A is the determinant data item and B the dependent data item then the direction of the determinancy is from A to B, and not vice versa.

Data item B is said to be dependent on data item A if for every value of A there is one, unambiguous value for B. In such a relationship data item A is referred to as the determinant data item, while data item B is referred to as the dependent data item. Dependency or determinancy is based on the idea of a mathematical function. A function is a directed one-to-one mapping between the elements of one set and the elements of another set.

For example, in a human resources database, staffNo and staffName are in a determinant relationship. StaffNo is the determinant and staffName is the dependent data item. This is because for every staffNo there is only one associated value of staffName. For example, 345 may be associated with the value J.Smith. This does not mean to say that we cannot have more than one member of staff named J.Smith in our organisation. It simply means that each J.Smith will have a different staffNo. Hence, although there is a determinancy from staffNo to staffName the same is not true in the opposite direction–staffName does not determine staffNo. Staying with personnel information, staffNo will probably determine departmentName. For every member of staff there is only one associated department which applies. A member of staff cannot belong to more than one department at any one time within this domain.

A diagram which documents the determinancy or dependency between data items is referred to as a determinancy or dependency diagram. Data items are drawn on a determinancy diagram as labelled ovals, circles or bubbles. Dependency is represented between two data items by drawing a single-headed arrow from the determinant data item to the dependent data item. Figure 15.7 illustrates a number of dependent relationships (Exercise 15.6).

If you can map the dependent relationships between data items as a diagram it is relatively straightforward to devise efficient data structures to contain such data items. Let us illustrate this process with a very simple determinancy diagram, as in Fig. 15.8.

Fig. 15.7 Dependencies
between data items
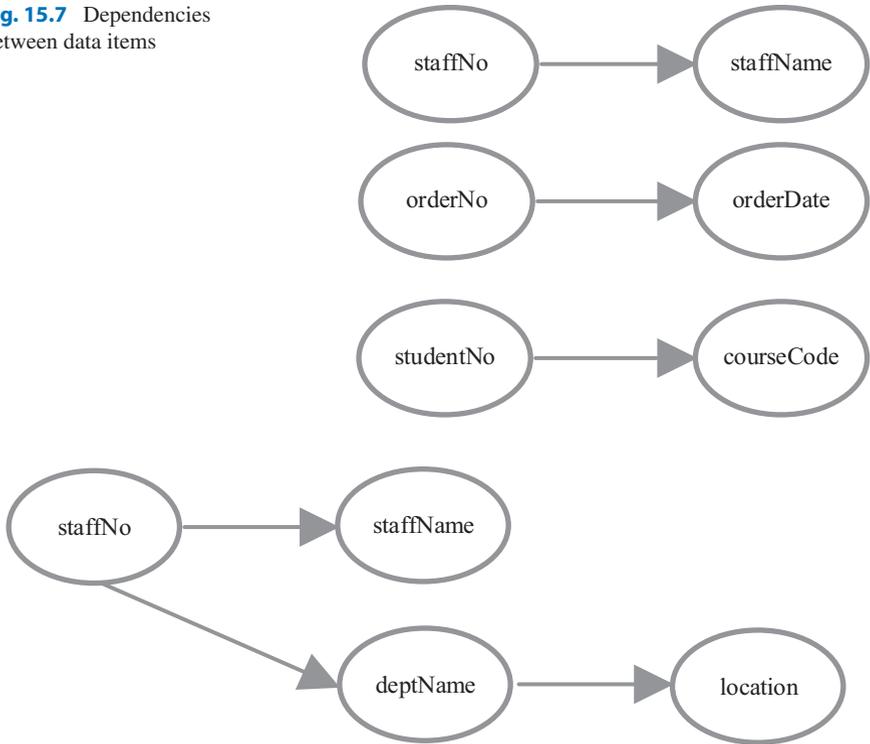
Fig. 15.8 A simple determinancy diagram

Exercise 15.6

As well as the ability to manage dispatch advices as data structures, Goronwy Galvanising also use a structure known as a job sheet to help coordinate production activity. An example of such a job sheet is given below.

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				

By inspecting this diagram we should see that we need two data structures to build the data model for this domain. In other words, the number of determinants in the diagram (ovals with arrows emerging from them) indicates the number of tables needed. The determinant becomes the primary key of the table. All immediate dependent attributes for a particular determinant become non-key attributes of the table.

Hence, in the determinancy diagram in Fig. 15.8 we have two determinants, staffNo and deptName. This means that one table is formed with the structure (staffNo, staffName, deptName); the other table is formed with the structure (dept-Name, location). Note that by following these simple steps we have also created a foreign key (deptName) which connects the data stored in one table with that in the other.

10   Data Structures and Acts of Articulation

Data models are not only coupled to information models in the vertical direction, they are coupled to data system models in the horizontal dimension. This is because data structures comprise the content of acts of articulation.

Consider the case of USC. In the early years of its administration USC used a paper-based records system. However, the company experienced a number of problems with this manual data system. For example, to ensure effective coordination of activity, data needed to be communicated amongst a number of people such as venue operators, lecturers and a multitude of USC administrators. This meant that copies had to be made of documentation such as presentation schedules, consuming much-needed time and resources. A considerable amount of time was also spent in transferring data from manual records onto other documents such as course schedules. Administrators frequently made errors in entering the wrong data onto records or other forms of documentation. Further valuable time and effort was therefore expended in resolving such errors by administrative staff. Finally, it proved difficult to use the data stored in records for strategic as well as operational purposes. For example, it was difficult for managers to collate and analyse data to determine trends such as the popularity or otherwise of particular courses. To conduct such analyses meant a considerable investment of time and effort on the part of both administrative and managerial staff.

At the start of the 1990s, problems such as these persuaded USC to consider investing the construction of an ICT system to handle basic administrative functions. Computing technology was also becoming much more affordable for the small and medium-sized enterprise during this period.

Since ICT systems are essentially data processing or data articulation systems, they rely on a core repository for the data used within 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 we have seen, as a data model. Essentially, this data model defines what data will be stored within the system and in what form. The USC data

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	

Fig. 15.9   The USC data model

model consisted of a series of definitions for the data structures making up the database, as illustrated in Fig. 15.9.

Each data structure in this specification is made up of a number of data elements. Hence, the courses record consisted of an identifier for each course (courseNo), 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 (courseManager) and the number of days specified for the training (courseDuration).

These data structures are updated by a number of update functions which trigger transactions fired at the database. Transactions change the state of a database from one state to another. Hence, in the USC case sample update functions might be Create a new course record or Create a new booking or Assign a new lecturer to a course presentation. Other functions implement update and delete formative acts such as Delete a booking or Change a presentation venue. Yet further functions read and present data for the user such as Produce a list of presentations over the next month or List all lecturers qualified to teach Business Analysis as a course.

11   Conclusion

A data model is used to represent the structure of data relevant to some domain of organisation. It expresses the appropriate data structures, elements and items and how they are related. Such structures are manipulated in acts of articulation. A given data model is coupled to a given information model through attributes or properties. Such a data model may be produced directly from an information model or in a bottom-up manner through determinacy diagramming.

12   Theory

The concept of data structures is discussed in chapter 7 of my book *Significance*. The concept of a data model is frequently conflated with that of a database model, for which there is a vast literature. The classic book by Tsitchizris and Lochovsky (1982), although published in the 1980s, still does a good job of explaining the concept of a data model in abstract terms.

13   Practice

The notion of a data model is taken from the whole area of database design (Beynon-Davies 2004). Determinancy diagramming is a well-established technique to help in the so-called normalisation of relational databases. But it is equally useful as a way of conducting good file and record design. The key advantage of a so-called fully normalised data repository is that it is easy to maintain in the sense of update. The coupling of a data model and an information model can be specified using a variant of a CRUD matrix. A CRUD matrix is typically used in association with techniques such as a class diagram and use case diagram. Classes from some domain are listed along one axis of the matrix while use cases are listed along the other axis. Each intersection on the matrix is then classified in terms of a formative act, such as Create, Read, Update or Delete.

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Understanding Digital Innovation

16

1   Introduction

As we mentioned in Chap. 4, 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 organisation (in the broad sense of patterns of order) and as such are in a state of continual flux. A human is effectively a collection of billions of cells that die and regenerate. A river is effectively a continuously changing assemblage of H_2O molecules–of moving water.

In this chapter we consider issues of innovation and change, particularly digital innovation and its effect upon ways of organising. Innovation involves thinking differently with the aim of doing things differently, hopefully to make a difference. In terms of digital innovation we demonstrate that it is impossible to just design ICT. Whenever information and communications technology is designed, we inherently re-design patterns of communication and activity. Hence, any digital innovation must involve the design of business models which outline the sequences of action necessary for the achievement of certain goals, which may have strategic consequences.

Also in Chap. 4, we defined the idea of socio-technical organisation as a complex system of human and machine action. Human and machine actions continually re-create patterns of organisation. But such action is also the motor for organisational change. In a typical domain of socio-technical organisation the predictability of action is reliant upon defined patterns and the roles involved in such patterning. In the process of performing their roles and enacting patterns of action actors reconstruct the organisation. However, innovation in action always has the potential to occur, and is particularly evident in times of environmental disturbance. At such times, organisational action has to 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 affect 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 particular 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, because of its focus upon socio-technical organisation, is inherently concerned with business change. The very idea of setting or defining problems and solving such problems suggests change to existing systems. But implementing change in an effective manner is notoriously difficult. In this chapter we consider some of the best practices for managing change–particularly the transition between an as-is business model and a to-be business model, as illustrated in Fig. 16.1 (Exercise 16.1).

Exercise 16.1

Information and communication technology is seen by many to be a significant 'agent' of change. The application of such technology has proven to be a disruptive force in many industries. In other words, it has changed the ways in which goods and services are produced, distributed and consumed. Examples of such industries include the music industry and the movie industry. How have such industries been disrupted and how have organisations coped with such change?

Fig. 16.1 Business change

2   Innovation

Change to socio-technical 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 identify 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 typically seen as a creative act. As we have seen, Edward de Bono (1969) believes that *creativity involves breaking out of established patterns in order to look at things in a different way*. This is why in Chaps. 2 and 3 we portrayed the exercise of analysing and designing organisation as engagement with convention and potentially the attempt to break with convention. 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 or unconventionally is at the heart of being creative. Creativity often involves challenging existing convention–existing ways of doing things. However, 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 because design is always an exercise in change. In engaging with change, designers attempt to innovate–to do things differently, to communicate something differently or to make something different. Design theory and the techniques that arise from it (Chap. 3) are useful 'crutches' to help designers think differently and to innovate divergent solutions from problems set.

3   Digital Innovation

Much modern innovation within domains of organisation 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 publishing, music and movie industries have changed in recent times is largely a result of digital innovation. The same is true of the taxi and bed and breakfast sectors. In all of these examples the innovation is not simply in the introduction to ICT, it is in the use of ICT to do things differently.

However, there is an inherent assumption that ICT can be employed in innovation relatively seamlessly, and that such innovation will inherently introduce changes to activity that improve 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 in contemporary ways of organising, alongside humans. This gives us a potentially creative way of designing organisation with and through ICT.

In the approach suggested in this book we have found it useful in terms of design to think of computers, or more accurately ICT systems built from computing and communication technology, as social actors. ICT systems are usefully conceived of as critical actors in systems of action that serve to constitute (construct and reconstruct) institutional life. 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 both in time and space by a multitude of different actors.

If 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 in a particular domain of action. Generally speaking, there are three distinct roles that ICT can play in some domain of organisation: support, supplant and innovate.

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. Generally speaking, such change is an attempt to improve aspects of the efficacy (Chap. 8) of the system. For instance, by using electronic communication the same data can easily be shared amongst many dispersed actors.

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. This is typically an attempt to improve the efficiency (Chap. 8) of the system, with decisions and communications being made faster and with fewer resources.

Finally, ICT can be used to innovate new ways of organising. This is the most radical use of ICT, in the sense that new, sometimes radically different, activity, information and data systems are brought into existence through the application of ICT. This is often a way of improving the effectiveness (Chap. 8) of the system– what a certain way of organising contributes to its super-system.

It is important to emphasise the point that ICT is no longer a technology that can be bolted onto existing organisation in the hope that it will increase the efficiency of existing ways of doing things. ICT is embedded within the system of organisation to such an extent that the design of any new way of doing things will inevitably involve considering the role that ICT plays in ways of organising.

4   Disruptive Innovation

As we have seen, innovation in organisation is clearly linked to changing ways of doing things with the aim of improving things. In the domain of capitalist organisation 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…*. Schumpeter is arguing here that capitalism is in a continuous state of change through innovation.

The capacity of ICT to efficiently articulate data structures has been used to disrupt major industries and sectors, allowing organisations to innovate with business models. There are many examples of such creative destruction afforded through digital innovation. For instance, 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 and sick pay. Uber considers that its drivers are self-employed and hence not entitled to these rights. This was challenged in the courts, which have since declared that Uber drivers are employed workers and hence have the same rights as regular workers (Exercise 16.2).

> **Exercise 16.2**
> In terms of change within socio-technical organisation what do we mean by change? What actually changes in such domains? How is the pace of such change important to the management of change?

Innovation through ICT is thus not as straightforward as many would make out, largely because any such innovation generally impacts upon people and their work. In such a socio-technical domain any such innovation inherently has an ethical dimension to it. It involves not only questions about efficacy (doing the right thing), efficiency (doing things with the minimum resources) or effectiveness (doing things that contribute to the super-system)–it also involves questioning the moral nature of change.

5   The Nature of Change to Organisation

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 have to make an effort to ensure that existing ways of working continue to be existing ways of working.

In practice, however, when business analysts refer to change, they mean planned change. Such planned change may be incremental or evolutionary, or radical and revolutionary. Incremental change involves small improvements to existing ways of doing things. Radical change involves overhauling the existing way of doing things and replacing it with an entirely new way of organising.

On whatever scale, in terms of the approach discussed in this book such change will typically involve the implementation of a new form of socio-technical organisation for some domain. This new way of organising things will be based upon a planned to-be business model, which may in turn replace an existing as-is business model.

The issue of business change actually lies between two other important activities which we describe in this book: expressing business motivation (Chap. 18) and evaluating business change. Business motivation involves the need to document explicit reasons for change. Without some clear sense that things have to be different there is little reason to change. But we also need to make sure that the changes we make are worthwhile. This is where business evaluation comes in. We particularly need some assessment once the change has been embedded in the success or otherwise of our design.

Perception of the need for change and the ways in which change is perceived are heavily influenced by what we called in a previous chapter our *worldview*. The concept of a worldview is highly influenced by the related idea of organisational culture. A culture is the set of behaviours expected in a social group. We know that any long-standing social group develops its own set of expected behaviours or norms, and people frequently speak of differences in culture between nation-states or regions. More recently commentators have suggested that differences in organisational culture are important to both the perception of change and to the way in which change is received.

Organisations are frequently seen as coherent social groupings and hence it makes sense to speak of an organisational culture that exists within a larger societal culture. Nowadays, top managers are called upon to create 'strong' cultures within their organisations. In making this call, management writers make three assumptions about organisational culture: it is open to manipulation and can be designed by business leaders, it is a unifying force, and it is linked to organisational effectiveness/performance via employee motivation.

Each of these assumptions is open to question. Sociologists would argue that groups develop strong cultures if they have stable and homogeneous membership and stay together for long periods. Culture forms and changes slowly if only because it takes time for new members to be socialised into the culture, to learn and accept new conventions of action. Organisation culture may also be a major conservative force within organisations preventing improvements in work practices and adoption of digital innovations.

It is also a dangerous simplification to assume that all organisations have a single 'culture'. In practice, medium to large-scale organisations are likely to feature a number of interacting sub-cultures. 'Sub-culture' refers to a sub-group within a broader social unit (such as an organisation), who share sets of values and meanings

(worldview) that are not the same as, and distinguish its members from, the wider group and culture around them. Sub-cultures can grow up in structural units (such as departments) or within different stakeholder groups (managers, shop-floor employees, shareholders etc.).

For example, in a utility company in which the author conducted some business analysis and design work, two distinct groups of workers displayed quite different sub-cultures, even though the work performed by both groups was actually very similar and both groups were sited close together in the headquarters of the utility company. Both groups of people were 'lines-people', that is, workers with responsibility for inspecting, maintaining and repairing parts of the utility network. However, one group of lines-people serviced low-power electricity lines while the other group serviced high-power electricity lines. The low-power lines-people worked as a group, with decisions about which lines to service and what maintenance was to be conducted made at the centre. In contrast the high-power lines-people worked very much as individuals, with maintenance decisions delegated to the lines-people themselves. Part of the rationale provided for such differences in behaviour was the more dangerous nature of the high-power line maintenance and the consequent need for delegation of authority.

Hence, in planning any business change it is essential to take culture into account. This typically means an attempt at some form of cultural analysis alongside other business analysis actions such as stakeholder identification. It is evident from our discussion that culture may be directly experienced in differences in the expectations that stakeholders hold. Such expectations effectively act as a resource for individual actors in suggesting appropriate action in particular situations (Exercise 16.3).

> **Exercise 16.3**
> Various bodies have estimated that the global population exceeds 7 billion people at the current time. They also project that the global population will rise to somewhere between 8 and 10 billion people by 2050. Some believe that somewhere along this trajectory of population growth a tipping point will occur. What might such a tipping point be and what might be its consequences?

A convenient framework for analysing differences between cultures is to consider a number of dimensions along which you might place different sets of expectations. For instance, Geert Hoftedte (Hofstede 1991) argues that cultures differ on dimensions of individualism/collectivism, risk-taking/risk aversion, masculinity/femininity and equality/inequality, amongst others.

In certain organisations there may be a general expectation that people will work and be rewarded as individuals (individualism). In contrast, in other organisations there may be a general expectation that people should work and be rewarded in teams (collectivism). The utility company example cited above displayed such a difference between the two groups of lines-people. High-power lines-people worked as individuals whereas low-power lines-people worked in groups.

In some organisations, there may be a general expectation that people should take risks as individuals (risk-taking). In other organisations people are expected not to take risks (risk aversion) and hence to refer decision making up to higher managerial levels. In the utility company example, rather surprisingly perhaps, much decision making was devolved to individuals in the case of high-power lines-people. In contrast, low power lines-people always deferred to decisions made at the centre by their managers.

Masculinity refers to a set of values including the importance of assertiveness in personal relations, acquisitiveness for money and things, and a lack of care in interpersonal relationships. Femininity refers to a set of values focused around people and the importance of nurturing inter-personal relationships. In the utility company both sets of workgroups tended towards 'masculinity'. It was notable at the time of the business analysis exercise that we engaged in that no female workers were employed in the maintenance of the utility network.

In some organisations inequalities in the distribution of power amongst individuals and groups is accepted. In other organisations power is expected to be distributed more equitably amongst organisational members. It was interesting in the utility company case that the reward system differed amongst the two groups of lines-people. The relatively flat management structure amongst high-power lines-people led to quite low differentials in pay structure. In the case of low power lines-people the central management team were rewarded significantly more than their workers, apparently because of the perceived extra decision-making responsibility they bore.

6   Leveraging Change

But where should we make change to ways of organising? One useful idea taken from the realm of system dynamics (Senge 2006) is that of a change lever. This idea originated with Donella Meadows, who formulated it in relation to her work on modelling ecosystems. She made the observation that there are key places within the organisation of a complex system such as a firm, city or ecosystem where a small shift in one thing or a way of doing something can produce big changes in every other thing making up the system. In other words, a small change in a key part of some complex system may leverage a large effect on the performance of this system.

Change in some such levers may frequently cause what Malcolm Gladwell refers to as a *tipping point* in the complex system (Gladwell 2001). For instance, environmental scientists are convinced that increasing levels of CO_2 emissions are contributing to global warming, which in turn is contributing to loss of ice at both the North and South Poles. If this process continues at current rates, then at some point the very viability of the ice shelf at the Arctic and Antarctic will be compromised. The loss of ice will reach a tipping point where the ice-sheet itself will become irredeemable. After such a point the inevitable process of sea-level rise across the globe will become irreversible.

The idea of a change lever has much similarity to the so-called Pareto principle, named after the Italian economist Vilfredo Pareto. This states that for many events approximately 80% of the effects come from 20% of the causes. For instance, that 80% of the wealth of a country belongs to 20% of the population or that 80% of the fighting in battles is conducted by 20% of the fighting force of both sides, or that 20% of the issues within some domain of organisation cause 80% of the perceived problems for actors (Exercise 16.4).

> **Exercise 16.4**
> As hinted, the Pareto principle is a useful technique to apply within a business analysis workshop. Set up a small workshop of a few persons reasonably knowledgeable about some domain of organisation. Now ask each participant to write down what 20% of the issues in this domain they feel contribute to 80% of the problems experienced.

When planning for any change it therefore becomes important to apply the Pareto principle and search for change levers. Meadows actually published a list of what she saw as a guide to the most significant change levers to be found in any complex system–some 12 change levers in total. She explicitly uses a conception of a system as a dynamic thing containing stocks which define its state at any one time (Chap. 4). The state of the system is dynamically affected by flows: inflows coming into the system and outflows going out of the system. The system also has a goal to be in a given state, and the difference between the current state of the system and its goal state is the discrepancy.

Consider a reservoir as a system, which contains a certain amount of water–its stock. Inflows constitute the volume of water coming from rivers, rainfall, the effects of drainage from nearby land and wastewater from a local industrial plant. The outflows comprise the water used to irrigate adjacent fields, water taken in by the industrial plant and a local campsite, water lost through evaporation and the trickling out of surplus water when the reservoir is full.

Local inhabitants situated close to the reservoir perceive a problem with this system. They complain of the water level reducing over time, of the increase of pollution and the potential release of hot water from the industrial plant on local wildlife, particularly fish. This perception of a problem is evidence of a discrepancy between the current state of a polluted lake and the desired goal of a lake free from pollution for such stakeholders.

In terms of such a conception of a system, change levers or leverage points fundamentally constitute interventions in flows, stocks and feedback loops. But different levers have different levels of effectiveness in terms of establishing sustainable change. The 12 leverage points in increasing order of effectiveness are changing parameters, affecting buffers, understanding infrastructure, minimising delay, strengthening negative feedback, slowing down positive feedback, increasing the flow of information, maintaining constraints, exercising self-organisation, changing goals, changing worldviews and transcending worldviews.

Parameters are the lowest and most clearly recognised points of leverage. However, a change in the value of a parameter is likely to have little long-term impact because it does not cause any significant change in the long-term behaviour of the system. For example, widening or dredging upper river streams to improve the inflow of water is likely to have a short-term impact but leaves intact the general systemic elements of the problem of the polluted reservoir.

A buffer is a type of stock in some system which has the potential to stabilise its behaviour, in the sense that when the stock amount is considerably higher than potential inflows and outflows it acts to provide stability for the system. Affecting the size of buffers and other stabilising stocks relative to flows can be a lever for change. For instance, inhabitants worry about the inflow of hot water from industrial plants as potentially harming fish. However, the large amount of water in the lake has a consequently large heat-bearing capacity–it is a strong thermal buffer. If the volume of water in the lake is large enough, then its size alone might prevent fish extinction.

The infrastructure supporting stocks and flows in the system may have an influence on possible system changes. The limitations and potentiality of this infrastructure regarding the problem situation has to be understood. For example, the local industrial plant may directly discharge water into the lake without treatment. If this water is to be diverted to a waste treatment plant then this will require re-building the underground used water system, which could be expensive.

The rate of system delay as compared to the rate of system change can be a lever. System delays or lags are frequently causes of oscillation or fluctuation in some system. If delays can be minimised, then appreciable system change can be enabled. For instance, the local council might consider building a waste treatment plant. It is estimated that this will take five years to build, a considerable period of time in which the water remains untreated.

The strength of negative feedback loops relative to the process they are attempting to control can be a lever. Increasing the strength of negative feedback loops can have an appreciable effect on promoting stability in a system. For instance, one way of preventing further pollution of the reservoir might be to impose a tax on the amount of water released from the industrial plant. This is likely to cause the industry itself to reduce its discharge by regulating the amount of water it consumes.

Self-reinforcing or positive loops can cause wild behaviour in a system, sometimes leading to system collapse. Hence, slowing down the action of positive feedback loops can contribute to system change. As an example, increasing use of nitrate fertilisers by local farms can cause a trickling of nutrients as inflow into the reservoir. In the short term this is likely to cause growth in plankton and consequent growth in the fish population. However, as a greater amount of plankton die, they fall to the bottom of the lake where their matter is degraded by decomposers. The decomposition process requires large amounts of oxygen, which is depleted from the lake. Eventually, no more oxygen is available, all oxygen-dependent life dies, and the lake becomes a smelly place where no life can be supported (Exercise 16.5).

> **Exercise 16.5**
> Consider one of the cases at the back of the book. Think of the case as a dynamic system in the terms used by Donella Meadows. For instance, what constitute stocks, flows and buffers in the case of USC? How might various change levers affect the state of USC as a system?

Simply increasing the flow of communication in a system can be a powerful lever. For example, a monthly public report on pollution levels in the lake may lead to appreciable opinion change towards industry, leading in turn to self-curbing by the industrial plant itself.

Changing the rules or constraints by which some system operates is a good leverage point for changing system behaviour. For instance, strengthening of the rules relating to the release of chemicals by industry into public water supplies will have a strong impact on water quality.

The capacity of a system to evolve or self-organise to counter environmental disturbance is a powerful lever. Hence, micro-organisms may adapt to polluted conditions and may even evolve to biodegrade certain chemical pollutants (Exercise 16.6).

> **Exercise 16.6**
> Many recent management theorists have made the analogy between a natural ecosystem, such as the one described in this section, and a business ecosystem. Work through some examples of change levers applicable to this business ecosystem.

A change in the established goal for a system is likely to impact every system element. Hence, a local level of government might decide to designate a lake as an area for conservation and tourism rather than a reservoir. This is likely to cause radical changes in what is allowed in terms of activity with lake waters.

As we discussed in Chap. 7, people have established worldviews, but most worldviews are amenable to change. The lake was seen as a resource to be exploited. A change in worldview may cast it as an asset to be conserved and enjoyed.

Alternative worldviews may be transcended such that a higher level of worldview which incorporates earlier perspectives might be possible. For instance, environmental scientists have established clear and complex inter-relationships between the physical world and the living world. The lake and its place in the biosphere and its link with the social sphere may be worked through in dialogue, leading to significant activity change in relation to the lake by various stakeholders.

The search for change levers is a variation on a common theme in business analysis and design which is sometimes referred to as impact analysis. Impact analysis is a systematic approach to assessing likely impacts of proposed changes to some domain of organisation. Any change is typically analysed in terms of the intended consequences such impacts have upon organisation structure or working practices.

But change frequently generates unintended consequences such as changes to worker motivation or changes to relationships with external stakeholders (Exercise 16.7).

> **Exercise 16.7**
> Breaking down habits of action is frequently difficult because such action is taken on the basis of tacit knowledge. Tacit knowledge is knowledge which is important to action, but which actors find difficult to explain. Jot down some reasons why action based upon tacit knowledge may be particularly difficult to unfreeze.

7   Unfreezing, Changing and Refreezing

The next question is: How does change happen? The social psychologist Kurt Lewin famously talked about 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*. In other words, introducing any change to organisation is not easy. This is frequently because in the very nature of business patterns people and technologies are habituated to particular ways of performing, communicating and representing.

Breaking down or 'unfreezing' patterns of conventional or habitual action first involves thinking differently. This explains why we have spent so much time in this book attempting to make familiar things strange as preparation for considering change. We have described various ways of attempting to do this throughout the book, such as setting up workshops, building tabletop prototypes, drawing pattern comics and thinking through problem situations.

What Lewin calls change we conceive of as the key act of design. On the basis of a close analysis of existing patterns new ways of acting may have to be designed and represented. We have suggested that this is best achieved by drafting elements of a business model–coordination (activity), communication (information) and articulation (data)–as described in various chapters in this book.

The third clear step is to implement change–to get people and machines to act differently. This last stage, which Lewin refers to as refreezing, is perhaps the most difficult to achieve. This is the primary focus of the current chapter. We aim to answer the question: What are good ways of implementing new business 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 business evaluation. To use Lewin's analogy, this is taking the 'temperature' of the refreeze. At some specified time after the change has been implemented, we need to examine the new business patterns and see if they match up to the motivation expressed for them (Exercise 16.8).

> **Exercise 16.8**
> The sociologist or more precisely the ethnomethodologist Harold Garfinkel (Garfinkel 1967) used a number of devices to help his students understand how people accomplish everyday actions through employing arbitrary conventions of behaviour. One such device involved getting his students to go home during the Christmas vacation 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 in design workshops? How would you set up such 'experiments' and what would be their objective?*

8   Digging Up the Cow Paths

To refresh, we have maintained throughout that business analysis and design is all about building business significance. Business analysis involves making sense of how business organisation is now, or how people would like business to be. Models are critical tools to enable co-creation between the business analyst and organisational stakeholders (people who have a stake in the business domain being considered). Many stakeholders will be 'would-be-improvers' of the 'system'. Such actors are critical to the identification of motivations for change.

A useful adage for what is frequently needed through some exercise of business analysis is digging up the cow paths. During the business process re-design or re-engineering movement of the 1990s (Hammer 1990) this saying was used to describe a key problem in organisations. The reasoning runs as follows. Cows tend to traverse a landscape using paths they have made through the simple practice of one cow following another. Humans created the first roads in countries such as the UK by paving over the cow paths (or sheep paths if you live in the South Wales valleys). 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 cow paths and establish new directions. This is not easy.

9   Stimulating Change

But in attempting to analyse any reasonably complex domain of organisation with the aim of getting to grips with the coupling of performance, communication and representation, the key question is usually one of: Where do I start?

Scenarios

The famous film director Alfred Hitchcock once described drama as *life with the dull bits cut out*. But when deciding how to construct a business pattern it is usually best to start with the concrete rather than the abstract–with actual instances of organisational behaviour, either observed or imagined. The term scenario is typically used to denote a patterned instance of action undertaken by specific actors at specific times and in specific places.

For example, a place to start in a domain such as ambulance command and control might be with collecting a series of caller/call-taker dialogues. From a close examination of such scenarios of communication, classes of communicative pattern are likely to emerge. In other words, by using such an investigative resource you will be able to abstract common ways in which people communicate and might find the types of communicative acts previously discussed useful as a way of helping you to abstract from the actual action.

Another method of using scenarios is as a way of verifying aspects of our business models. Collecting or 'walking through' scenarios in a structured manner is frequently a useful way of conducting the acid test of whether the model makes sense to organisational actors. Does it usefully encapsulate the key features of what it is attempting to represent? Will it work in practice?

Telling Stories

Business analysis and design of organisation is normally a process of telling stories, conveying narrative. Part of the reason we have used tabletop prototypes and comics as a central genre for representing business patterns is that they are particularly good as a medium for telling stories. But to get to the point where you can visualise the story you frequently need to organise the plot. Hence, some people find it useful to jot down the plot as a series of statements about key events that happen in the business pattern under investigation, such as *this happens first, then this happens, followed by this thing happening*…, and so on. But in making the list of things happening, think about who or what is making things happen, what is being transformed by the event in question, and whether any other actor receives or consumes the results of such transformation.

Using Low Technology

In analysis and design workshops it is frequently better to utilise low technology such as index cards, Post-it notes, flipcharts and white boards as aids for building significance than high technology such as PowerPoint presentations and prototyping tools. Such simpler technologies are preferred for a number of reasons. First, no or little training is required in the use of such technology. Second, the elements of such technology are easily wiped or discarded. Third, these technologies are

physical. This encourages people to position such technologies in innovative ways in some analysis or design space. All of these advantages make these technologies particularly good for co-creation between the business analyst and representatives of stakeholders.

Here is one example. In an analysis workshop a flipchart and pen were given to each stakeholder. Each stakeholder was then told they had to introduce a new member to the organisation and explain to them how things worked in the domain under consideration. They were asked to write down as a 'recipe' their understanding of how a particular organisational routine was accomplished. Each recipe was then taken, and a composite description was created by the business analyst. The composite description was then used as a guide to formulate initial storyboards for the domain in question.

Here is another example. In a design workshop participants were divided into groups. Each group was given a series of large Post-it notes. The group was then asked to draw an act on each Post-it for the domain in question. The next task was to try to group Post-it notes together into patterns. Each wall of the room used for the workshop had a whiteboard and was assigned to a particular group for this purpose. Once a coherent collection of acts developed, the groups were encouraged to draw arrows between particular Post-its to represent sequences or swim lanes of action.

And yet another example… Each participant in a workshop was given a small number of index cards. They were asked to write on each index card a particular perceived problem with the domain in question. These cards were then collected, and piles of cards were created which contained cards documenting similar issues. This is similar to the technique of affinity mapping described in Chap. 7. Each card was taken as a 'vote' for a particular issue. The issues identified were then written on a flipchart in order of greatest number of votes to smallest number of votes. These were then used to help formulate a motivation to change (see Chap. 18).

Rich Pictures as Framing Devices

Another key way of starting modelling of either the current situation or an envisaged situation is with a rich picture. As we discussed in Chap. 7, a rich picture attempts to frame the elements of a problem situation in visual terms. A rich picture documents, in a very informal manner, the major actors and their perspectives (worldviews) on some problem situation. Such a picture might be used to highlight the key actors to be considered in modelling an existing domain of organisation. Depending upon the level of detail it may also suggest some of the elements of performance, communication or record-keeping that have to be considered in modelling. Finally, a rich picture can usefully document some of the key motivations for change in terms of some problem situation. This can help in initiating modelling some possible future or desired states in terms of the domain of organisation considered.

10   Managing Change

The term change management is normally used to denote that range of activities involved in the implementation of new business systems, particularly ICT systems. The assumption here is that it is possible to manage change, particularly as a defined project or programme of work. In other words, change should be managed as a project (Chap. 5) with defined team members, just like other parts of business analysis such as business 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.

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 to start the process of managing change.

A typical conception of where change is likely to need to be applied is in terms of organisation structure (roles, responsibilities and resources), processes, people and technology. This is sometimes referred to as a four-view model of change. In a sense, our notion of a business model covers all four of these views, but in a subtly different and integrated way. For instance, the three layers of system model all help relate actors (people and technology) to action (processes) through roles and responsibilities (structure) (Exercise 16.9).

> **Exercise 16.9**
> Management is frequently driven by the concept of change. A new manager will frequently feel that they must change things. Business analysts also inherently assume that if they are called to look at some situation then they must come up with some proposed change to this situation.
>
> Is this necessarily a good attitude to have on the part of managers and business analysts? Write down two examples where change might be bad rather than good. *Can you think of any ways such devices might be useful as a technique to employ in design workshops? How would you set up such 'experiments' and what would be their objective?*

A key advantage of a defined motivation model is that it can form the basis for communicating to participating staff about the reasons for the expected change. Business motivation will specifically express changes to business policies and procedures and the goals they relate to.

A to-be model is a particularly good tool in the hands of any change agent. It gives change agents a map to use to implement changes both to work and technology. A to-be business model can also be used as a clear basis for defined changes to roles and responsibilities (job and task design). Such a to-be business model will be used by technical staff to help direct the build of new systems or the adaptation of existing technical systems.

When it comes to implementing a new business model this can take place in a number of different 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 for the domain in question. There is no overlap between the implementation of the new way of working and the business systems 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 any significant problems with the new system, the organisation can revert to the old way of working 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 many change managers feel it is best to plan for phased implementation wherever possible. Perhaps piloting change in one unit–then evaluating lessons before releasing across the organisation.

It may be feasible to decompose a large business model into smaller elements or modules. Hybrid implementation involves introducing business modules in a phased manner as replacements. This is therefore an evolutionary approach in the sense that the impact of implementation is distributed more evenly over time than in direct conversion.

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. This means that 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 domain of organisation. 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*.

But do not forget that 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.

11   Revisiting the Grand Challenge

In previous chapters we considered the digital innovation of personal alarms and developed a socio-technical pattern of how this technology is framed through sequences of action. Now consider a different technology and how this changes the pattern of organisation. For more than 100 years healthcare workers have been monitoring vital signs. Such measurements as heart rate are taken using electronic instruments and recorded on patient charts. More importantly, these vital signs communicate to healthcare workers not only the general condition of the patient but when to take action in terms of certain aspects of healthcare. In more recent times

various monitors such as wristbands have come onto the market which measure certain vital signs of the wearer. The key question is whether a personal monitor such as this could be useful in situations of caring for the elderly in their own homes. More importantly, what would the pattern of organisation look like in relation to such devices?

A good place to start here is to take the pattern already established for personal alarms and modify it in relation to how socio-technical action would work with personal monitors. A number of questions arise here. What changes would be needed to the pattern to accommodate some vital signs monitor? What data would be collected by such a vital signs monitor? What would it communicate and to whom? Finally, what benefits might arise from such change?

An attempt has been made in the tabletop prototype illustrated in Fig. 16.2 to specify such change. Here, different flows or swim lanes of action are undertaken depending on the signal from the monitor. It is assumed that the signal or signals can be calibrated in terms of three ranges: green, amber and red. If the signal is in the green region no action is taken. If the signal moves into the amber region then a communication to a contact is made to check up on the elderly person. If the signal is in the red region then a call is made directly to emergency services.

12   Technology as a Change Lever

Technology, particularly information and communications technology, is not always designed with a specific problem in mind. Technology domains frequently have different and various areas of application. The challenge is usually to adopt and adapt certain technologies to the challenge of changing ways of organising. In this section we briefly describe three technology domains that might act as change levers in design exercises: the Internet of Things (IoT), machine learning and the blockchain.

Traditionally, the Internet has been used to connect computing and communication devices, such as personal computers and laptops. But many other modern devices are digital in the sense of having software controlling them as well as sensors that monitor critical things about them. When such devices are given the ability to communicate over the Internet then they can interact at a distance with human and non-human actors. This is the central notion of the Internet of Things. There are literally billions upon billions of potential digitally enabled things that could make up the IoT over the next decade. So now your home central heating controller might monitor its output and give you a breakdown of your energy usage. Or in the near future, your home fridge might monitor the food contained within it and create an electronic shopping list for you.

Many researchers have become convinced that it is theoretically impossible to program any form of artificial intelligence from scratch. Instead, they pin their hopes on building various intelligent actors through learning conducted upon large datasets. Such data-driven machine learning relies upon a construct known as a neural net, which is typically built from three inter-connected layers of nodes. The input layer is fed data appropriate to describing the range of differences found

Fig. 16.2 A possible pattern of organisation for vital sign monitors

within a certain domain, and the output layer defines appropriate and different responses in terms of a defined set of inputs. The links between nodes within the net acquire weightings based on a comparison of inputs to outputs. One to many hidden layers implement the heuristic algorithm of the net by forming linkages between certain inputs and outputs. Data-driven AI has already been applied in areas such as recognising car number plates, spotting false insurance claims and making medical diagnoses.

The blockchain is normally associated with the digital currency Bitcoin but this much-hyped data structure may have much wider applications. Blockchains are particularly used to build distributed ledgers. A distributed ledger is not stored in one place but distributed across many sites within some computer and communications network. The reason for this is that a way of controlling a distributed ledger can be built which removes the need for a central controlling registry such as a clearing house. Another advantage claimed for the blockchain is that it has the potential to reduce fraud as every transaction is recorded and available for viewing on a public register. 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 through computing hash keys. A new record, such as a financial transaction, is placed within a given block. The block is then broadcast to the nodes of the block-chain network. These nodes all either 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 nodes within the network.

All three of these technologies have the potential to lever change in activity systems within the economy and in wider society. Hence IoT has the potential to build an infrastructure of pervasive objects that act and communicate with humans and enable them to better manage scarce resources such as energy. Machine learning is being used to build software actors that make decisions and act independently of human actors. Thus initial medical consultations in the near future may involve software actors of this form which communicate with the patient and triage access to medical practitioners. Finally, the blockchain is being proposed as a way of building smart contracts. A contract is a legally binding document that recognises and governs the rights and duties of the parties to an agreement to exchange goods, services or money. Effectively, a contract is a data structure which communicates a series of commitments made by the parties to the contract. In the 1990s it was realised that a distributed ledger, such as that implemented in the blockchain, could be used for smart contracts in which the block in the blockchain stores software code which when executed implements the various phases of a contract (Exercise 16.10).

> **Exercise 16.10**
> The example of a vital signs monitor as a digital innovation in care for the elderly is actually part of a wider range of innovations, which has collectively been referred to as the Internet of Things. Investigate further technologies in this technology area and consider if they have applications within the grand challenge we have been considering.

13   Conclusion

Innovation for us involves thinking differently with the aim of doing things differently, to hopefully make a difference. Digital innovation involves thinking differently about ICT and considering technology as a change lever in ways of organising.

Socio-technical organisation is a complex system of human and machine action. Human and machine actions continually re-create patterns of organisation. But such action is also the motor for organisational change. Part of the reason for this is that the environment of organisation is also continuously changing, and the organisation must continuously adapt to this 'heaving landscape'.

Change frequently happens because we have evaluated our current ways of doing things and found them wanting. We need to express the need for change as business motivation. We also need to plan for change and manage the implementation of change.

But change can be levered or leveraged in different ways. The lowest point of leverage is to change certain attributes of the system. The highest point of leverage is to adopt a new worldview of what a domain of organisation constitutes and use this change of perspective as a stimulus for change.

Change involves breaking down existing patterns of action, designing new patterns of action and habituating new patterns of action. The approaches of analysing domains of organisation and designing business models discussed elsewhere in this book support planned change. Implementing a new business model can take place in a number of different ways: direct conversion, parallel implementation, modular implementation and phased implementation.

Do not assume that implemented changes will stick. Changed action needs effort to make sure it becomes habituated into the patterns of action of some domain of organisation (Exercise 16.11).

> **Exercise 16.11**
> Two other technology areas that have received wide coverage in the literature are machine learning and the blockchain. Investigate these technologies but consider which activity systems might be changed by their application.

14   Theory

Theoretically there are clear linkages between the ideas of change and control. In the physical theory of thermodynamics, the natural state of the universe is one of disorder–known in more formal terms as entropy. Systems (or more specifically open systems) are islands of order–negative entropy or negentropy–in a universe of disorder. Another term for negentropy is organisation (Stonier 1994). Organisation requires continual work and work requires energy.

Take a biological example of organisation. Are you the same person you were ten years ago? At the level of yourself as a complete organism you would certainly say you were. At the cellular level, however, you are probably not since virtually every

cell in your body has renewed itself over this period. So as a system your component parts have changed but as a whole you have maintained identity and remained viable. This process of ensuring the identity and viability of organisms is exercised through many layers of control.

15   Practice

The term change management is typically used to encapsulate the approach taken to change in the practice of business analysis. This idea developed initially out of recognition that constructing good technical systems for organisations did not guarantee that these systems would be introduced and used effectively. The early literature in this area specifically focused on why ICT systems were frequently 'resisted' by the people encouraged to use them. Change managers were therefore developed as a mediating role between technical actors and organisational actors and given the remit to tackle issues such as user resistance head on. In more recent times there is increasing recognition that technical change cannot be separated from business change–that any digital innovation requires socio-technical change. This expanded notion of business change and what this means for the associated discipline of change management has informed the current chapter.

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Building Digital Business Models

17

1 Introduction

In the 1940s Herman Hesse published his enigmatic novel *The Glass Bead Game* (Hesse 1943), set in a fictional province of central Europe known as Castalia at the beginning of the twenty-fifth century. The central plot revolves around the life of a member of an intellectual order which devotes itself to the cultivation and playing of a complex game called the Glass Bead Game. Hesse describes this game as involving:

… a mode of playing with the total contents and values of our culture; it plays with them as, say, in the great age of the arts a painter might have played with the colours on his palette. All the insights, noble thoughts, and works of art that the human race has produced in its creative eras, all that subsequent periods of scholarly study have reduced to concepts and converted into intellectual property – on all this immense body of intellectual value the Glass Bead game player plays like the organist on an organ. And this organ has attained an almost unimaginable perfection; its manuals and pedals range over the entire intellectual cosmos; its stops are almost beyond number. Theoretically this instrument is capable of reproducing in the Game the entire intellectual content of the universe …On the other hand, within this fixed structure, or to abide by our image, within the complicated mechanism of this giant organ, a whole universe of possibilities and combinations is available to the individual player. For even two out of a thousand stringently played games to resemble each other more than superficially is hardly possible. Even if it should so happen that two players by chance were to choose precisely the same small assortment of themes for the content of their game, those games could present an entirely different appearance and run an entirely different course, depending on the qualities of mind, character, mood and virtuosity of the players.

Within the novel the rules of this intriguing game are never spelled out in any detail, presumably because they are so sophisticated that they are not easy to imagine. Essentially the game is an abstract synthesis of all human knowledge and as such playing the game requires years of hard study in diverse disciplines including Mathematics, the Natural Sciences, the Social Sciences and the Arts. It proceeds by players making deep connections between seemingly unrelated topics and thereby opening up new forms of dialogue and understanding.

In our terms such a game provides a useful metaphor for making sense of the entangled systems of patterns and signs we have attempted to unravel in this book.

The Glass Bead Game can be envisaged as being played with a vast array of small beads or pebbles, similar to those used in the Japanese game of Go. These beads constitute the data structures of the Glass Bead Game. However, unlike those used in Go, these glass beads are of many different colours and have many different forms of marking upon them—a bit like the clay tokens we discussed in earlier chapters. Such beads can also be laid upon the playing surface in innumerable different ways. Figure 17.1 imagines part of the board for this game with some beads positioned upon part of the playing surface.

The developing form of the collection of glass beads positioned upon the board is continuously used to in-form. It is used by players of the game to signify multiple layers of complex meaning about concepts and their relationships. Markings upon beads are probably ideographs signifying concepts; the positioning of the beads close to each other being used to signify relationships between things—a bit like affinity mapping. In this manner, other players 'read' the current state of the game and in doing so understand its communicative significance (Exercise 17.1).

> **Exercise 17.1**
> Can you make sense of the state of the Glass Bead Game played in Fig. 17.1?
> What does this disposition of beads mean to you?
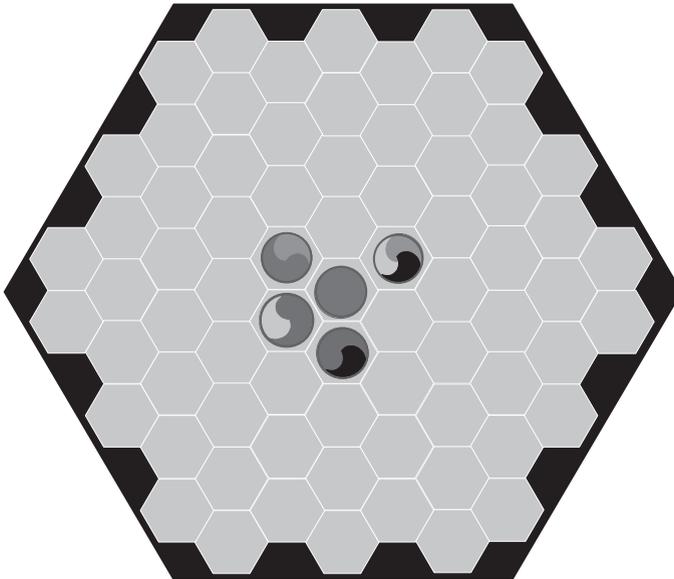
Fig. 17.1   Playing the Glass Bead Game

Such acts of communication serve to stimulate further acts of performance. Players take turns to select a particular bead and place it upon the playing surface. The act of taking a turn changes the state of data within the Game. Fellow players respond to the current state of this playing surface in deciding how to take their particular turn in the Game.

Playing the Glass Bead Game is a useful analogy for the continuing accomplishment that constitutes socio-technical organisation. The conventions of patterns of articulation are used in conventions of patterns of communication, which in turn are used in conventions of performance. The process of using such patterns as resources for action re-creates such patterns and in so doing re-creates continuously ways of organising.

Within this chapter we begin to discuss how we bring these entangled patterns together in a business model. The concept of a business model is much used in both business literature and practice. However, it is very poorly defined and conceptualised in many domains. We spend time in this chapter explaining not only what a business model is but what it is not. We shall show how in terms of a design orientation it is productive to view a business model as a complex of business patterns appropriate to some domain of organisation.

2 Business Models

The concept of a business model has been much considered in recent literature and is clearly 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. 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's 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 Chap. 4)—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 Chap. 8). 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 business design.

These features clearly closely align to our notion of organisation as a socio-technical system (see Chap. 4) and more precisely to elements of design thinking outlined in Chap. 3. A business model is a way of expressing the core design for some value-creating system. We use the term business model in a straightforward sense as the core logic for creating value (Osterwalder and Pigneur 2002). Such logic is encapsulated in the nature of business organisation—it involves answering the question: *how do we organise to create value?* Hence, our 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. Organisation consists of three inter-related 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. An articulation (data) pattern consists of sequences of articulation of data structures. All three patterns or sub-systems are needed to express a business model, as well as some notion of how these patterns inter-relate (Fig. 17.2).

Exercise 17.2
Consider some aspect of organisation you are familiar with. Use the interrogative words from the poem *I Keep Six Honest Serving Men* to help make sense of your knowledge of this domain. Can you present this knowledge to other perhaps less-knowledgeable persons using this rubric?

To refresh, we have now covered the three major types of system and how we represent such systems as models. We have also considered how these three models can be coupled together to provide a more complete picture of some business domain. This complete picture we refer to as a business model, or perhaps more generally as a domain model since it can refer to any type of organisation, including types from the public and voluntary sectors. In this chapter we consider the process
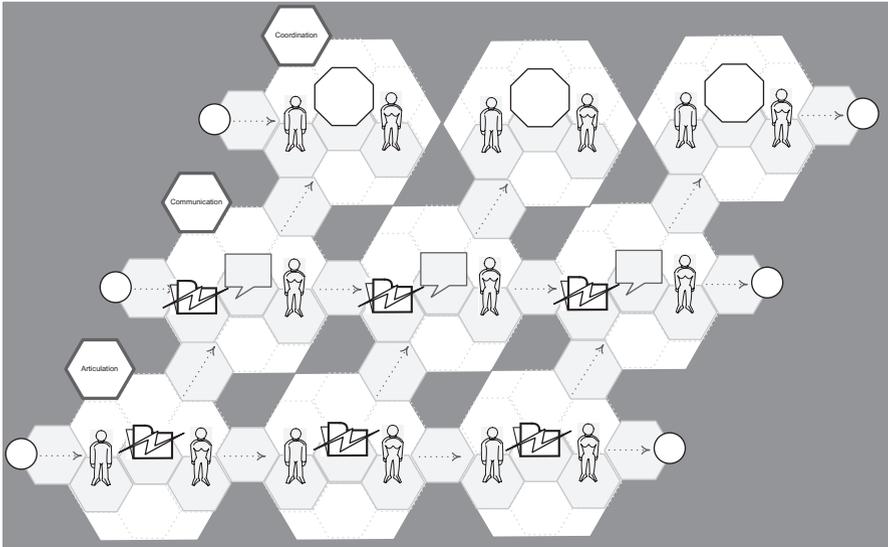
Fig. 17.2 The coupling of action

of building such a business model in terms of some key questions that need to be asked in the process of making sense of some domain of organisation.

In conducting practical work involving sense-making within situations of actual organisation, we have found it useful to employ the device indicated in Fig. 17.3. Here, we have the three facets of organisation expressed as a multidirectional arrow. This visual device is meant to express the notion that the designer can shift perspective or viewpoint by concentrating attention on any one facet of organisation at any one time. This means that, for the purposes of analysis, we can effectively decouple one layer of significant action from its neighbours. However, to properly unpack any one facet of organisation, its significance to the two other types of action must be taken into account. In other words, the shape of articulation is made significant only in communication and the shape of communicative action is made significant only within instrumental activity. This means that you cannot, in terms of some business domain, consider activity separate from issues of communication and you cannot consider communication effectively without issues of representation.

The three-directional arrow in Fig. 17.3 implies that you can start anywhere in constructing a business model—in terms of coordination, communication or articulation. So, let us look at some key questions we can ask of each domain of action.

Coordination

If you start with coordinated activity, the key question is *what do you do*? This question can then be elaborated upon in terms of a number of possible sub-questions.

- What is the central purpose of the activity system? Or, to phrase it differently we might ask what value is created by this system?
- What activities transform value in the domain?
- What value is transformed in these activities?
- Which actors are involved in and responsible for the transformation of value?

We can use Rudyard Kipling's poem *I Keep Six Honest Serving Men* to help elaborate upon the significant patterns relevant to any particular layer of organisation. In other words, we can elaborate upon WHAT performance, communication or representation is relevant with WHO, WHY, WHERE, WHEN and HOW.

- WHAT is done?
- WHO does it?
- WHY is the action taken (for what purpose?)
- WHERE is the action undertaken?
- WHEN does the action normally take place?
- HOW does this act relate to other acts?

Acts of coordination, communication and articulation are all situated acts. In other words, such acts are undertaken in particular settings, at particular places and at particular times. Therefore, the answers to the aforementioned questions can be used not only to specify the collection of coordinated activities appropriate to a domain of interest but also to indicate spatial and temporal relationships between acts: in other words, which acts precede which other acts and where the action takes place over a period of time. This entire activity pattern may then be expressed as a tabletop prototype before being worked up into a pattern comic (Exercise 17.3).

> **Exercise 17.3**
> Next time you receive some cold call from an organisation try to record the conversation. Then attempt to unpack the conversation as a pattern of communication using the questions indicated above.

Consider the case of USC. We might describe the central purpose of this activity system as *presenting short courses to industry*. The key value created by this organisation as a system is a service—that of providing education or training to industrial organisations. A number of instrumental activities are important to achieving this goal: creating courses, scheduling courses, assigning lecturers, taking bookings and so on. A number of different actors or roles are involved in such activities such as a course manager, presentation manager, bookings administrator and so on. There are
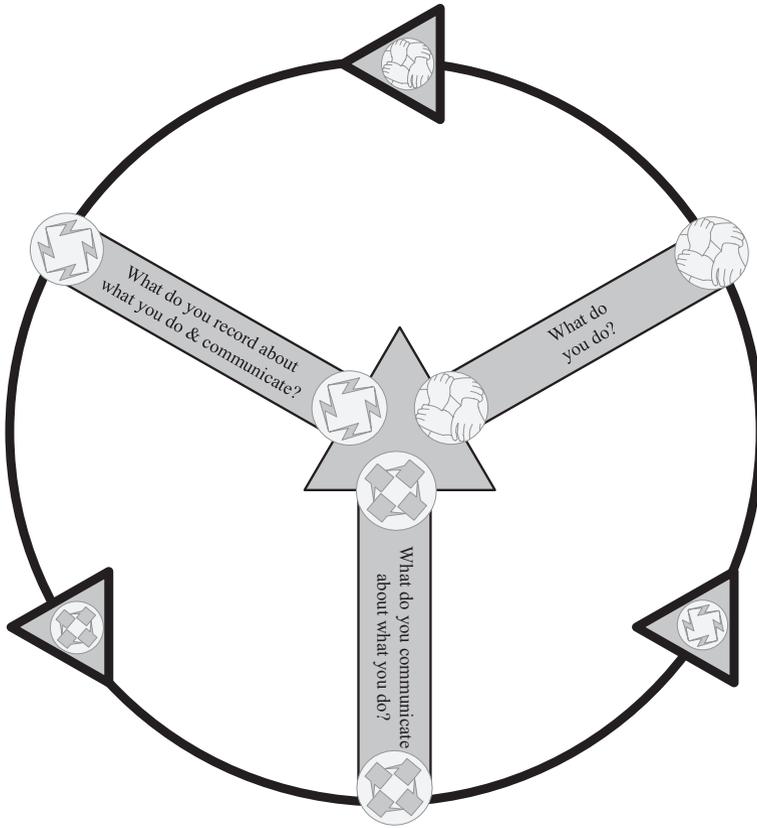
Fig. 17.3 Cyclical questioning of organisation

clear relationships of precedence evident within this domain such as courses have to be created before they can be presented and the like. A complete pattern visualising the coordination domain of USC is presented in Fig. 17.4.

Communication

Suppose you then turn your eye to examining the nature of business communication within your chosen domain. The key question directing inquiry here is *what do you communicate about what you do*? More detail can then be provided on this key question by asking a number of possible sub-questions:

- WHAT do you communicate about? In other words, what is the content of such communication?
- WHO communicates with whom? In other words, what actors are senders and receivers of communication?
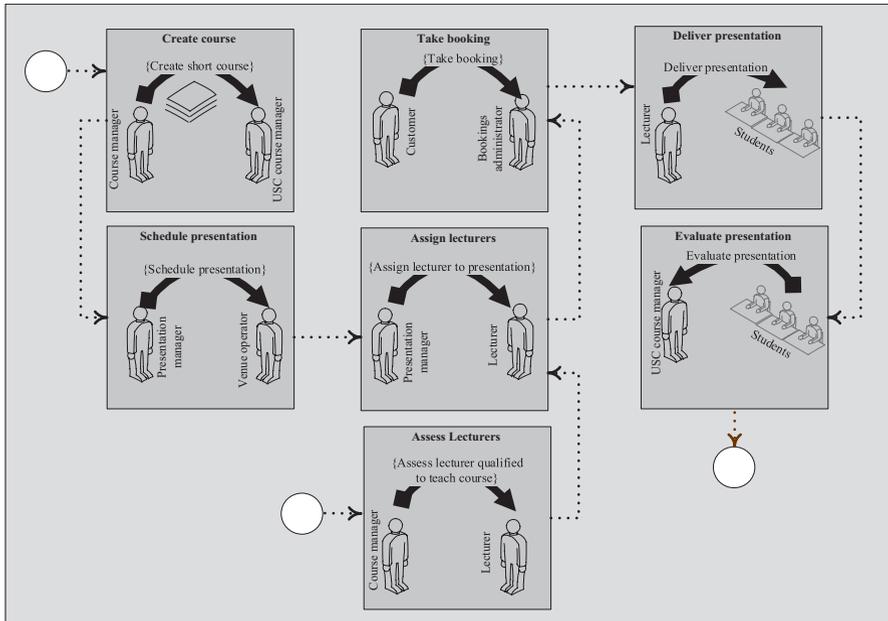
Fig. 17.4 The USC coordination domain

- WHY is the communication undertaken? In other words, how would you describe the intent of such communication? Is the act of communication an assertive, commissive, directive, declarative or expressive?
- HOW do acts of communication inter-relate? In other words, what communicative acts precede others, and what acts of communication follow others?
- WHERE is the communication undertaken?
- WHEN is the communication undertaken?

The next step is to build an information system model as a tabletop prototype or pattern comic—building each cell as a communicative act and assembling such acts into patterns. For instance, in the case of USC, we might identify a range of information classes that help define the content of messages within this domain—classes such as course, presentation, student, attendance and so on. Particular communicative acts will be composed of not only content but also intent—for example, declaring a new course, asserting that a given lecturer is assigned to a particular presentation and more. We also need to indicate who communicates with whom, such as course manager communicates with presentation manager. Finally, we need to establish the precedence of communicative acts. For instance, a new course must be declared before a schedule can be communicated. A complete pattern visualising the communication domain of USC is presented in Fig. 17.5.

You can also try building a corresponding information model detailing classes and relationships. A starting point for such an information model applicable to the USC case is visualised in Fig. 17.6.
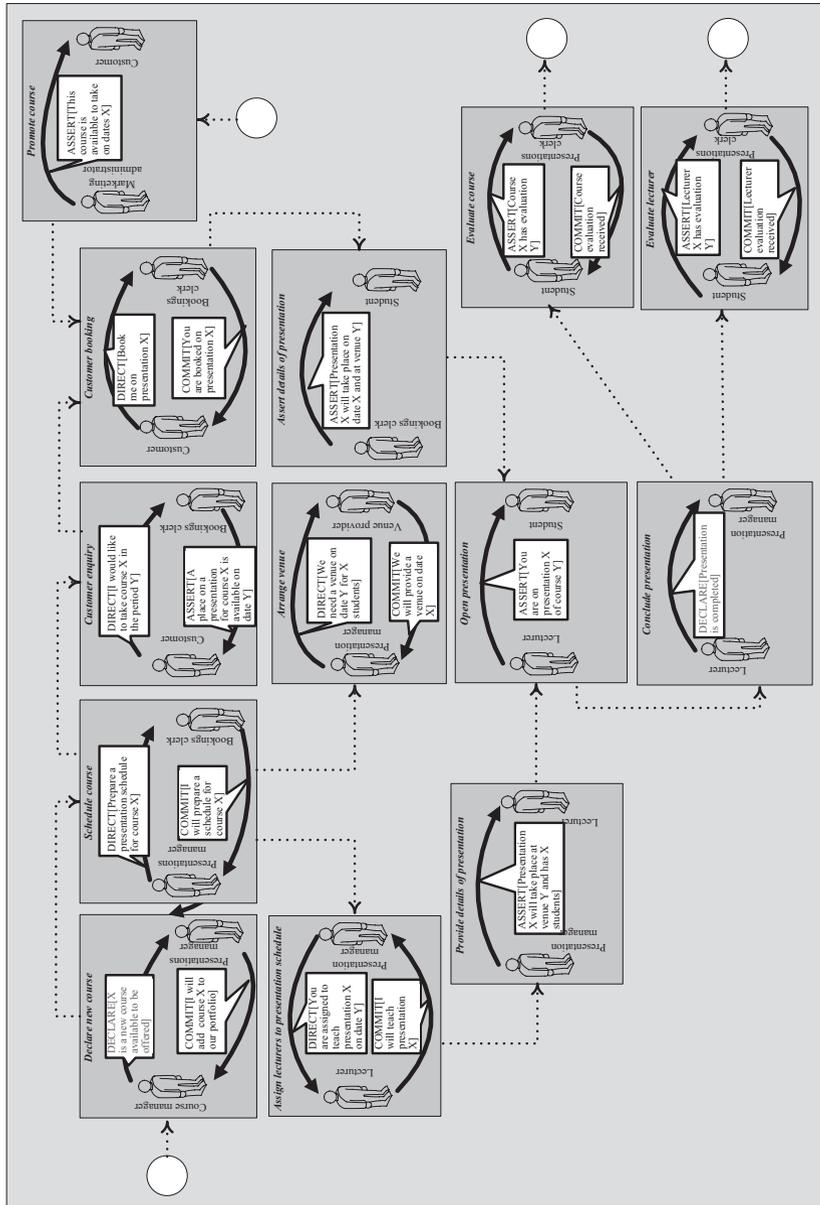
Fig. 17.5 The USC communication domain
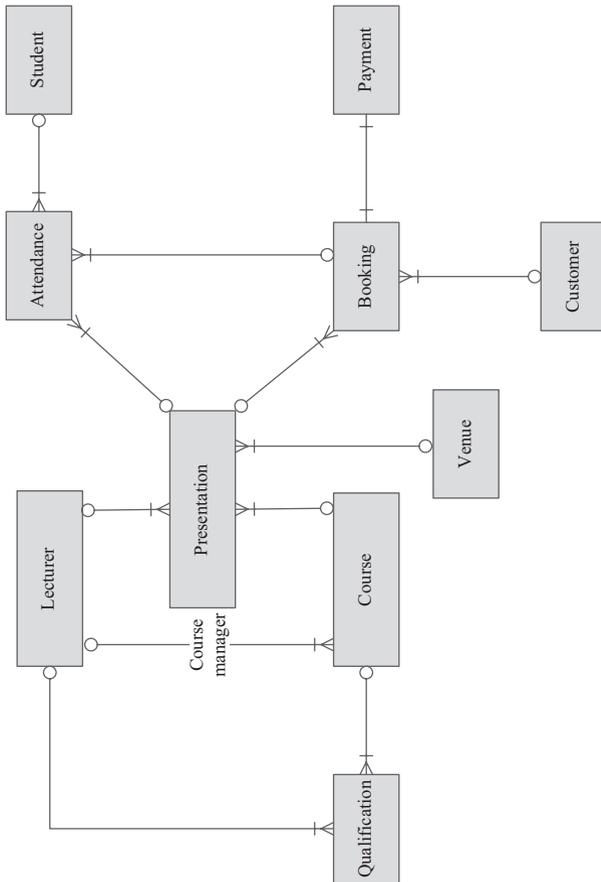
Fig. 17.6 An information model for the USC domain

Articulation

In terms of articulation the key question is *what do you represent about what you do and communicate?* This leads to sub-questions such as:

- WHAT communicative content is represented in records?
- HOW are data structures transformed?
- WHO transforms such data structures?
- WHERE is the data structure articulated?
- WHEN is the data structure articulated?

These questions can then be brought together in a data system model—which specifies inter-relationship between acts of articulation. A complete pattern of articulation for USC domain is presented as a pattern comic in Fig. 17.7.

In the case of USC this organisation makes records about activity such as course records and presentation records. It also makes records for communication with internal and external actors, such as attendance records and payment records. These records can be specified as data structures. For instance, a course record has a course name, expected number of days and so on. Such records get transformed in acts of articulation such as a course manager is the only person allowed to create the record for a new course.

You can also build a data model to express how the various data structures inter-relate as illustrated in Fig. 17.8 (Exercise 17.4).

3 Returning to the Design Game

We can demonstrate the coupling or entanglement of patterns of action by returning to the design game we first considered in Chap. 2. We set a key question for players of this game: *what do you think you are designing with this game*? In other words, *what design artefact are you attempting to produce*? In fact, what we are designing within this game is not solely a communicative artefact such as the whiteboard—we are designing a pattern of organisation which must include consideration of how the whiteboard is articulated, what various acts of articulation communicate to key actors and what this communication is used to do in the sense of initiating certain activities. This pattern of action is illustrated as a tabletop prototype in Fig. 17.9.

Moving various magnetic tokens on the whiteboard correspond to various acts of articulation. Hence, an actor might place a red token in a green quadrant. Acts of articulation communicate certain things to key actors. Hence, a green token in a red square directs the actor to move one unit from location red to location green in the next time-period. This communication triggers instrumental activity—the unit gets moved to the indicated location. This unit movement then has to be signalled by the whiteboard to further actors. Hence, an actor removes a red token from the green quadrant and replaces it with a green token. This asserts that the unit was moved in the last time-period.
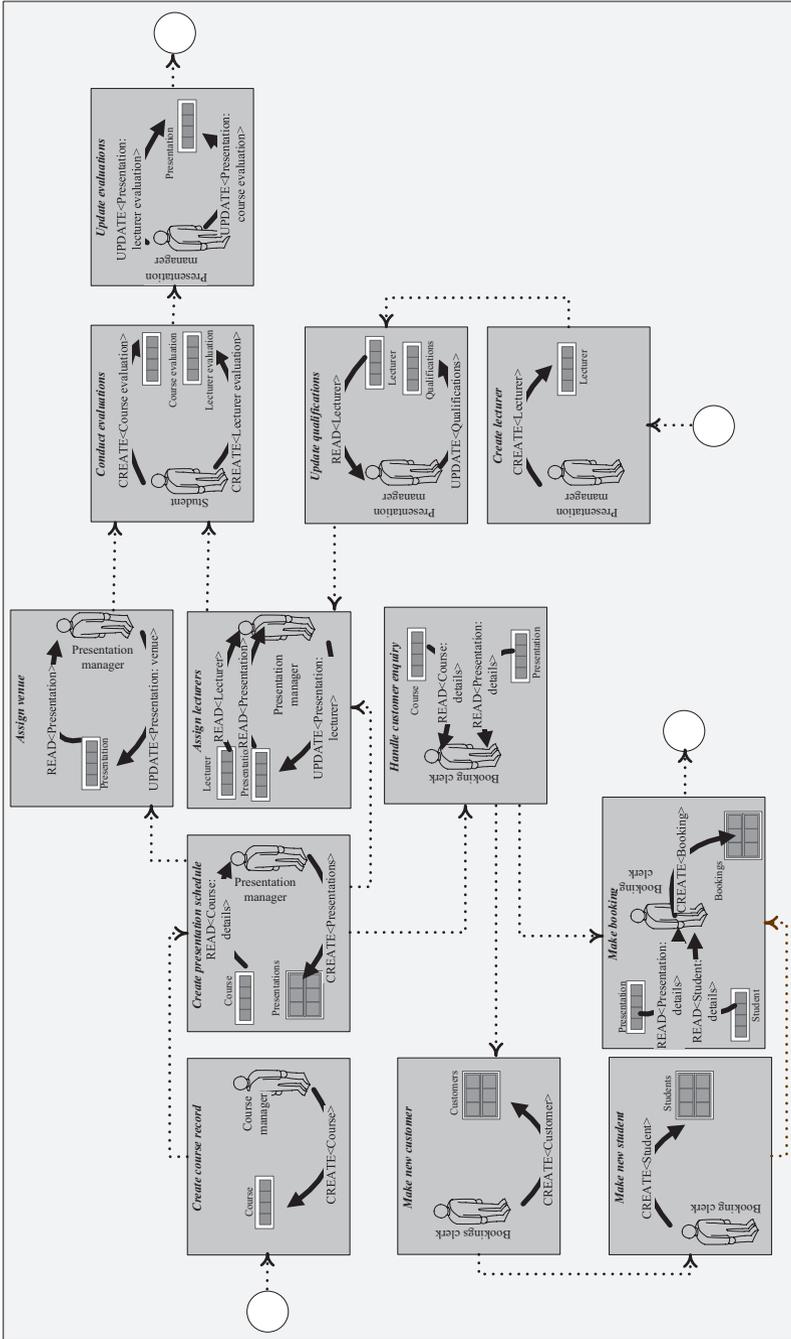
Fig. 17.7 The USC articulation domain

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			

Fig. 17.8 The USC data model

> **Exercise 17.4**
> Government agencies generate lots and lots of paper and electronic forms that they use to interact with citizens. Take one of these forms and attempt to unpack its purpose. What does the form tell you about the likely data structures, patterns and systems used by this government agency?

4   AS-IS, AS-IF and TO-BE

Patterns of socio-technical organisation are the central design artefacts considered in this book. Such patterns cut across the three interdependent layers of organisation as well as the activities of business analysis, business design and business implementation. We can also consider patterns in practice (scenarios) or patterns in principle (Table 17.1). Scenarios comprise observed action in practice. Patterns may also be abstractions—narratives of patterns in principle.

Herbert Simon (1996) defined design as '*courses of action aimed at changing existing situations into preferred ones*'. So, within business analysis and design we model not only existing situations but also preferred situations. 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 the system property 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
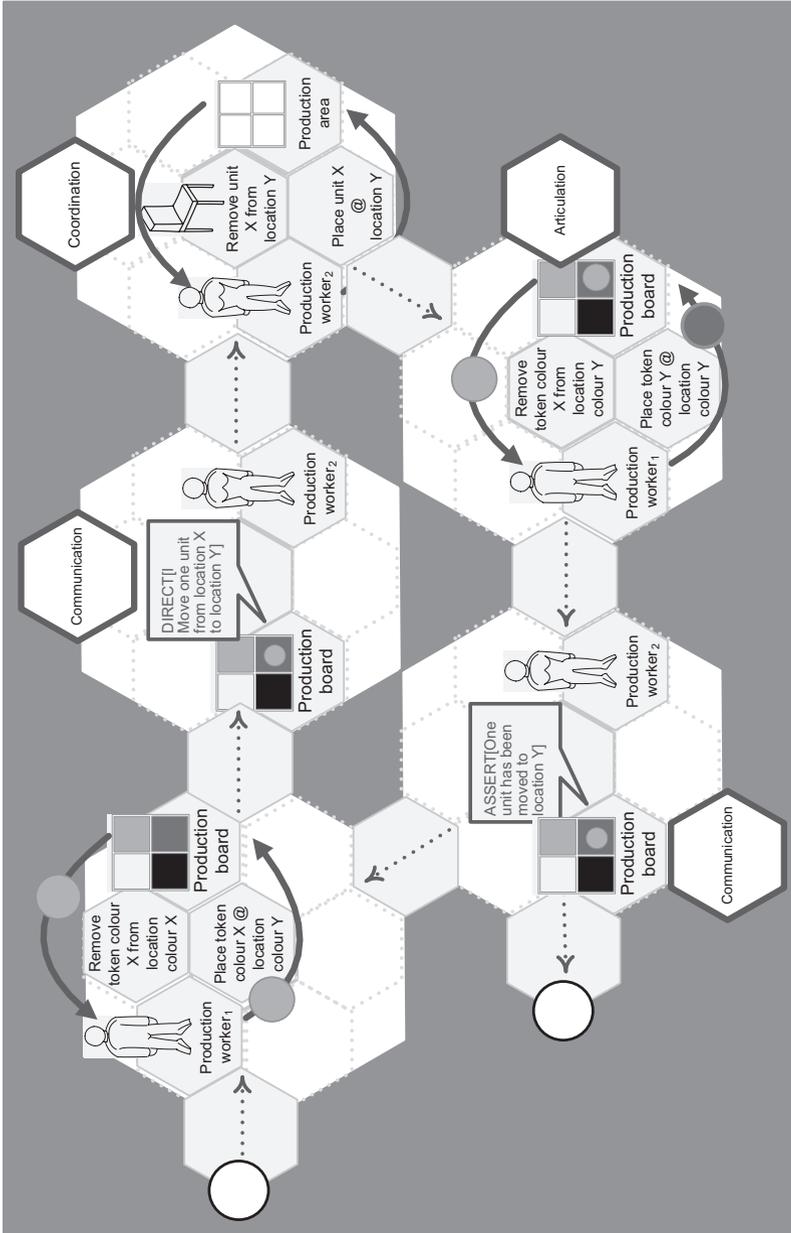
Fig. 17.9 The patterning of the design game

Table 17.1   The use of business patterns

Business analysis Pattern	**Analysis (*as-is*)**	**Design (*as-if*)**	**Implementation (*to-be*)**
Articulation	Practice/principle	Principle	Practice
Communication	Practice/principle	Principle	Practice
Coordination	Practice/principle	Principle	Practice

enact change, one of these *as-if* models must be chosen as a *to-be* model. This then becomes a design or a plan for a new domain of organisation that will hopefully be implemented in practice (Fig. 17.10).

Figure 17.10 also illustrates some of the distinctions made between business motivation, business model and business strategy, which we alluded to earlier 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 amongst as-if models and specifying courses of action to implement a new (to-be) business model for the chosen domain. We have also represented business evaluation upon the figure. After a to-be business model has been implemented and embedded into ways of organising we will wish to revisit the expressed motivation for change and see if it has been achieved or not.

5   Organisation as a Cycle of Action

Changes to organisation involve not only changes to what is done. Any change to what is done simulates the need to ask questions about how new ways of doing things are coordinated. Coordination, as we have seen, normally requires some form of communication. Communication amongst large groups of people typically involves different forms of representation, particularly the making of records.

Hence, to make sense of any domain of organisation we need to consider activity, communication and representation as an entangled whole. It is through the entanglement or coupling of articulation, communication and coordination that organisation is accomplished or enacted. This entanglement is illustrated for the domain of the emergency ambulance service in Fig. 17.11.

As we have seen, the purpose of the emergency ambulance service as a system of coordinated activity is to administer emergency healthcare at the point of incident. To achieve this direct purpose a whole range of inter-related activities have to be continually accomplished by a multitude of different actors. Resources have to be deployed, emergency calls handled and ambulances (as well as their care teams) have to be moved between incidents and points of healthcare.

But to engage in such coordinated performance actors have to communicate. For instance, call-takers have to determine the severity of an emergency incident. Ambulance drivers have to know where to go. Paramedics need to know something
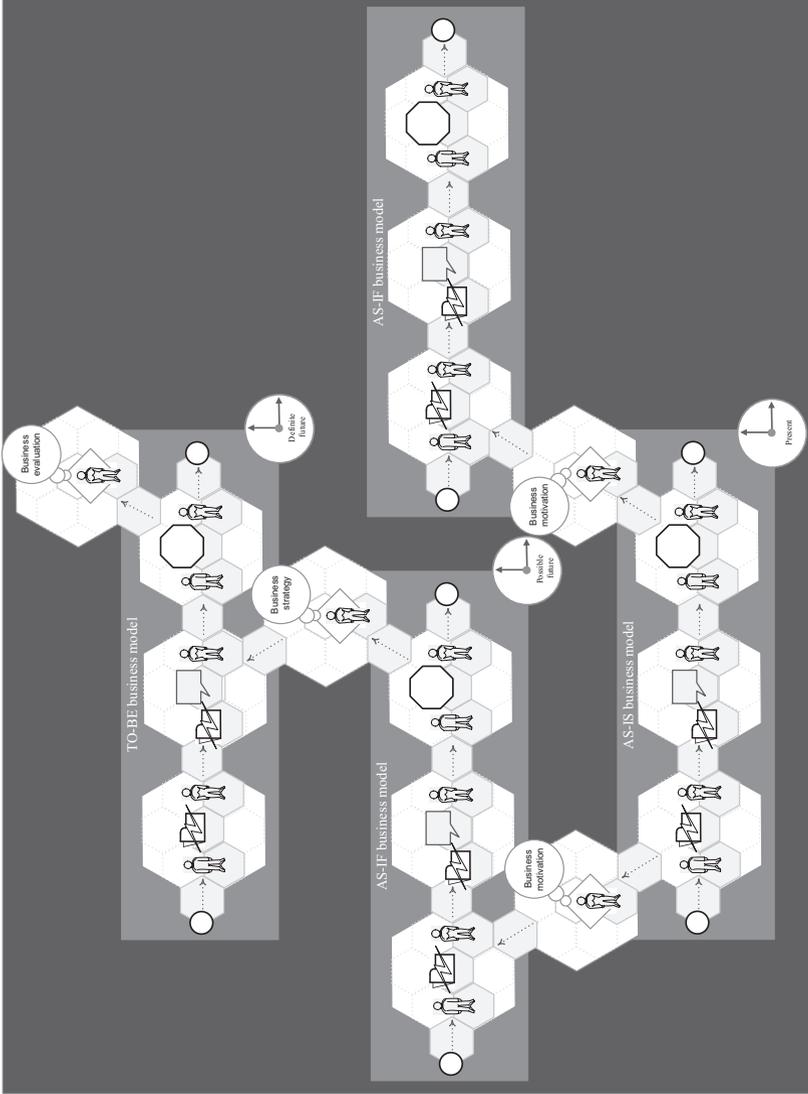
Fig. 17.10 AS-IS, AS-IF and TO-BE business models
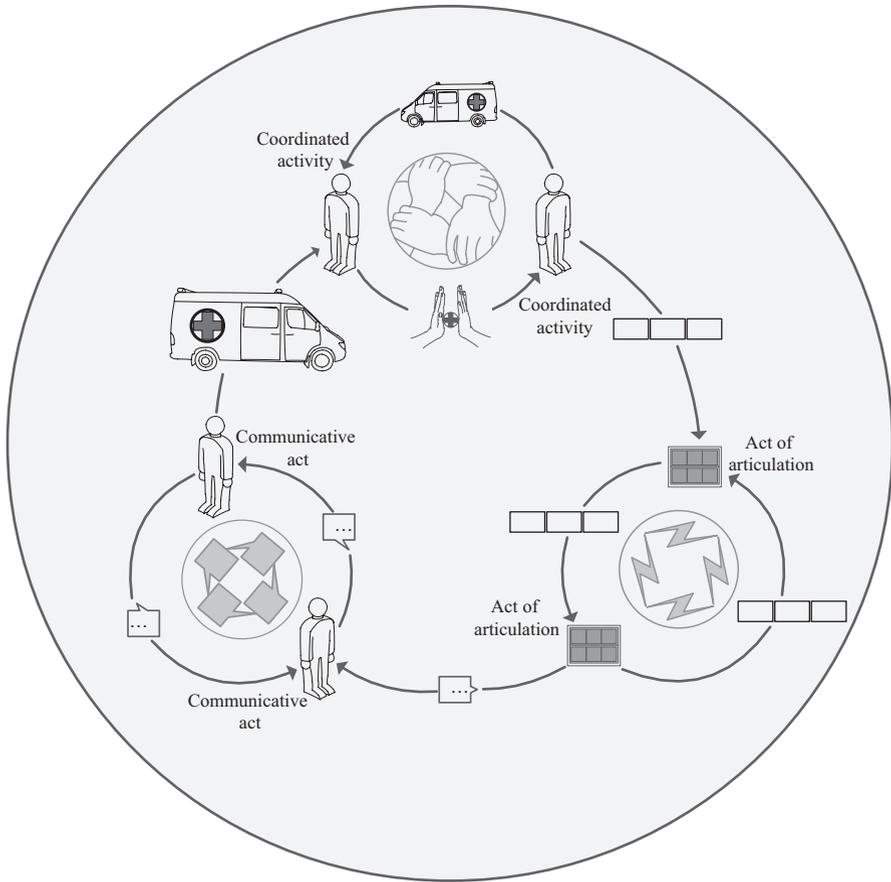
Fig. 17.11   The cycling of action within emergency response

of the condition of the patient. Dispatchers need to track the journeys of particular dispatched ambulances.

Much communication within this particular domain of organisation is still conducted through human speech—directly within the confines of a particular control room, ambulance or site of incident or indirectly and remotely using devices such as the fixed or mobile telephone or radio handset. But communication is also made persistent through records such as incident records, resource records and patient records. Much of what we know as communication in the modern organisation, such as that of the ambulance service, is conducted through the manipulation of records. Such manipulation involves both human and non-human actors, such as ICT systems.

In unpacking a domain of organisation in this manner one might think it somewhat contrived. But surely everything is action?—you might say. Why do we need this distinction between coordination, communication and articulation as action?

In reality, acts of coordination, communication and articulation are coupled, meaning that in practice acts of coordination as contained within a coherent activity pattern are closely coupled to a parallel stream of communication and articulation. Without such coupling, the effective coordination of the activity of a multitude of dispersed actors would not be feasible.

Hence, the activity of driving an ambulance to an incident will necessarily involve a range of communicative acts which in turn are likely to be reliant upon a series of data acts.

All the acts we consider as essential to the constitution of organisation are clearly and necessarily instrumental. Certain acts of performance are directed at the production of data structures and are intentionally informative to certain actors who may decide to further perform on the basis of such communication.

In the way we have necessarily discussed the three patterns of organisation within this work, one would tend perhaps to assume that the direction of influence between such patterns is linear: from data, through information to activity. In actuality, these three patterns form a cycle of influence: that activity enacts articulation which enacts information and in turn enacts activity.

In Chinese philosophies such as Taoism and Confucianism, the concept of yin-yang is significant. This describes how seemingly opposite or contrary forces are interconnected and interdependent—how they give rise to each other and how they inter-relate to one another. The relationship between coordination, communication and articulation might be seen to be entangled in a similar manner and is illustrated as a modified yin-yang symbol in Fig. 17.12. These symbols appear on the glass beads in the illustration in Fig. 17.1.
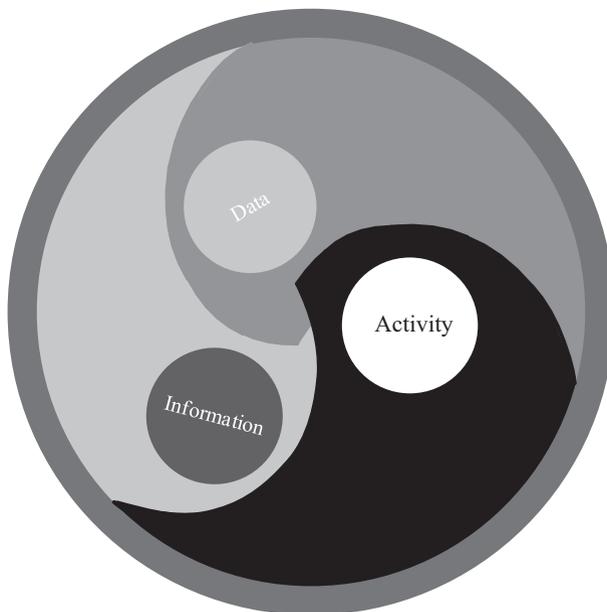
Fig. 17.12 The entanglement of data, information and activity

For instance, one act of performance may involve an actor speaking. This performative act is directed at the production of data. Hence, the actor's embodied performance here is also an act of articulation in that it involves creating some data structure such as a spoken sentence. Another actor engages in an act of 'reading' this spoken sentence and informing with it. On the basis of being informed this actor may decide to engage in another act of performance—perhaps replying as a spoken sentence.

The three acts may seem the same here. But note some differences. First, there is a difference in the actors enacting various acts. Any communication, for instance, must necessarily involve one actor creating data and another actor reading data. Second, there is a necessary time delay between the act of intending to speak, forming the spoken word, hearing the spoken word, interpreting the spoken word and deciding to further act upon it. Performing, forming and informing are necessarily distinct processes. Each such process may take a second, a minute, an hour, days or possibly even weeks. For instance, the act of creating a record may take place some weeks before this record may actually be read and acted upon, potentially also by a different actor than the one who created it.

6   Online Grocery

Let's use these ideas in considering a contemporary case of digital commerce (Beynon-Davies 2017). 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) e-commerce. 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 prior to the coronavirus pandemic constitutes something like 5% of grocery sales in the UK. During the coronavirus lockdown in the UK, this is estimated to have doubled and this doubling in the size of the market within the UK is expected to continue 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 and a growing elderly population mix. Many supermarket chains that held off from developing digital business strategy in this area have recently 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. Ocado is solely an online grocery business. The Coop is investigating getting into online grocery and

in developing strategy in this area is running a series of experiments using different delivery patterns. But online grocery is clearly not a priority for many food retailers. The low-cost retailers, Aldi and Lidl, have not currently invested in an online grocery arm.

A number of reasons appear to have persuaded supermarket chains like Sainsbury's 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 or activity pattern in Fig. 17.13. Within this type of pattern comic, the cells represent major events of coordinated, instrumental action pertinent to some domain of socio-technical organisation.

Online grocery has the potential to disrupt this common retail pattern. Not surprisingly, there are clear differences between digital business strategies amongst 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 digital commerce 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 needs only to operate delivery from large and strategically placed warehouses. This reduces base operating costs. A high-level coordination pattern for the digital business model stock from warehouse is provided in Fig. 17.14.

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
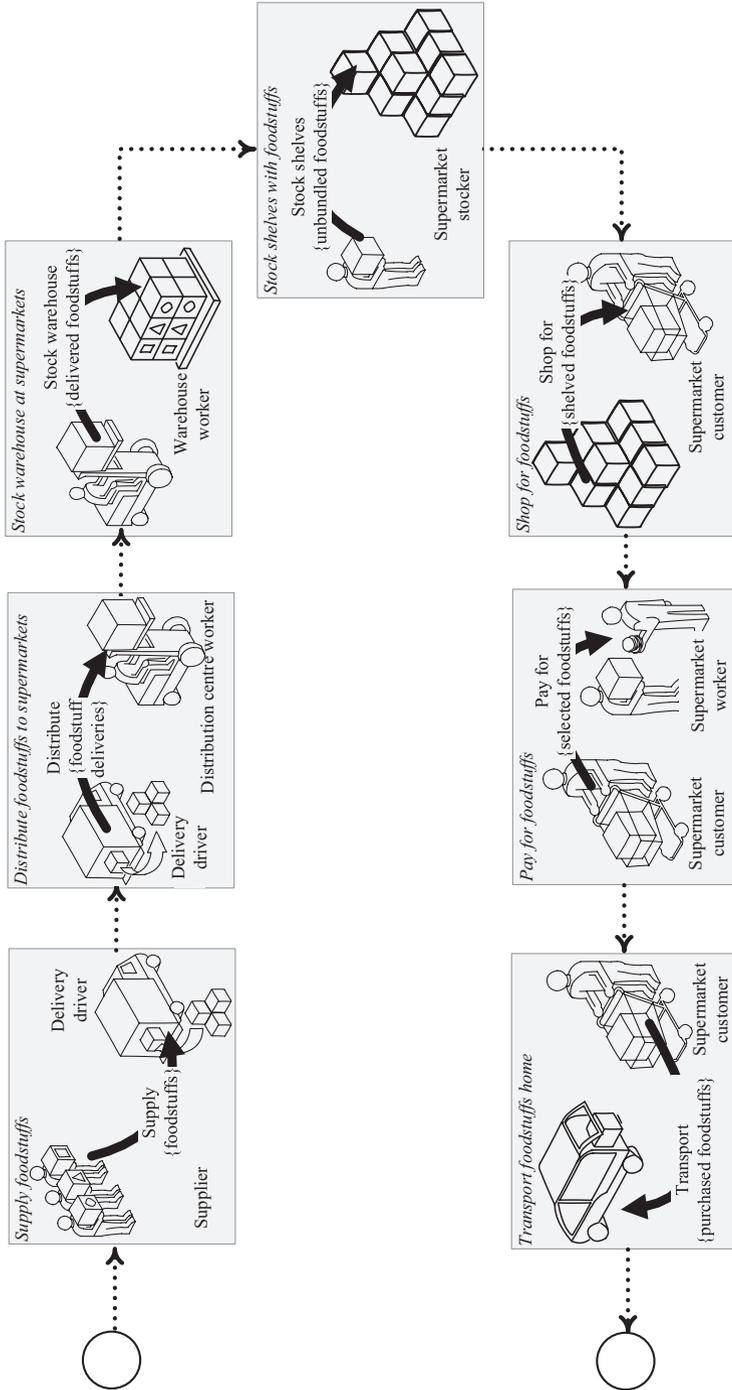
Fig. 17.13 Coordination pattern for traditional grocery retail
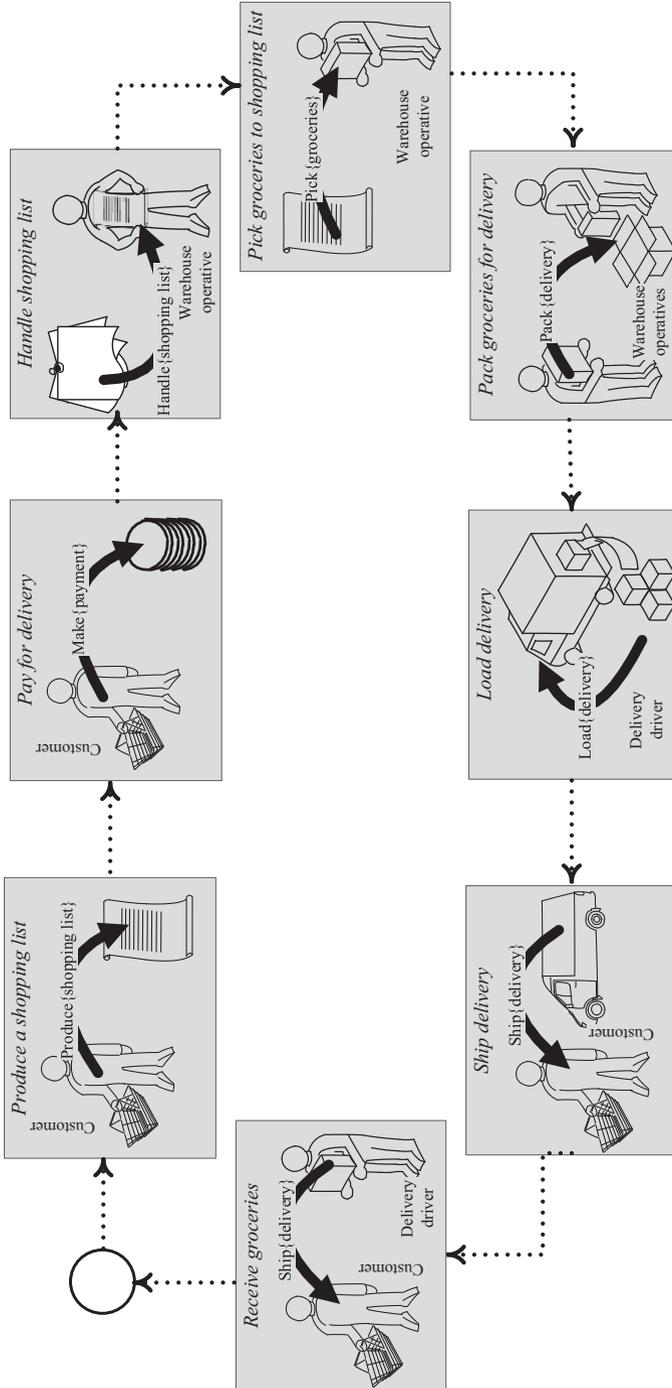
Fig. 17.14 Coordination pattern for stock from warehouse online grocery retail

business pattern in which a retail outlet or distribution centre operates exclusively for online shopping.

It is evident that the stock from warehouse coordination pattern or the related dark store pattern are likely to be coupled with a communication pattern not dissimilar to that illustrated earlier for online retail. The only significant differences probably lie in the picking and packaging events within the narrative of sociotechnical action. Likewise, the click and collect patterns for online grocery are unlikely to be that different from click and collect patterns for online grocery in general. Hence, the communication pattern for online grocery using a click and collect model will reuse many aspects of the online retail pattern.

7 Conclusion

Business analysis and design is an activity system that produces business models. We use the term business model in a straightforward sense as the core logic for creating value. Such logic is encapsulated in the nature of business organisation—how do we organise to create value? Business models are narratives that explain how organisation works. They are not motivation models which explain how some way of organising needs to change. A business model describes how things work, while a business strategy details how things will change.

Business organisation can be expressed in terms of three entangled layers or types of business system, which we have called a coordination, communication and articulation system. These systems are composed of business patterns that collectively, in interaction, produce value. Such patterns utilise 'material' from the structural dimension of a business model—described in an activity, information and data model.

8 Theory

Chapter 12 of *Significance* brings together the notion of domains of organisation which forms the centre of attention for business analysis. The notion of a business model is never discussed directly in this book, but Chap. 13 attempts to open up a debate about the disciplinary changes we need to make to make better sense of the complex, adaptive systems that act as the 'infrastructure' of the modern world.

9 Practice

The idea of a business model is largely a theoretical concept in the literature. When discussed, business models are normally practically implemented as business plans—which in turn primarily detail the financial model underlying some new business venture. We try to take a more complete vision of a business model in this book. The approach we take has some sympathy with the idea that a business model

expresses the logic of some enterprise as discussed and developed in the work of Osterwalder and Pigneur (Osterwalder and Pigneur 2002, 2010). Our approach to visualising business models also has some synergy with the approach taken by these authors.

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Business Motivation, Strategy and Evaluation

18

1 Introduction

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*' (Darwin 1998).

But why do we and our closest evolutionary relatives make faces? What states of mind are being expressed by such movements of the face? As Darwin intimated, facial expressions such as a smile are an important form of communication for not only humans but most of the great apes. Such signs relate to human sentiments or emotion and this communication of emotion relies upon not only the sensory capacities of individuals it also relies upon the critical ability to empathise: to assume the position of the other; '*to walk in another's shoes*' (Beynon-Davies 2013).

Emotion and its communication is a key motive force in most forms of human organisation. It is no accident that the terms emotion and motivation have the same English root. Goleman (Goleman 1996) argues that emotions are in essence impulses to action. The root of the English word emotion is the Latin verb *motere* which stands for to move—with the prefix e connoting something like to move away. This suggests that a tendency to act is implicit in any emotion—hence emotion is a key input into the control of behaviour or performance, not only on the individual level but also at the level of human organisation.

As we have seen in Chap. 16, the transition between business analysis and business design implies some interest in business change. But why should things change? Clearly change is only motivated when one or more stakeholders in the

domain of organisation under examination are unhappy with the current way of doing things. 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 and documented. This is mainly because the clear establishment of business motivation forms the context for the development of effective business models.

Within this chapter we utilise the idea that business motivation is best expressed in terms of ends and the means to achieve them. This allows us to better organise a number of related topics which are sometimes labelled with the acronym VMOST or sometimes MOST. VMOST stands for vision, mission, objectives, strategy and tactics. These elements of motivation form a related sequence. Vision defines future purpose or state. Mission establishes measures for achieving purpose. Objectives are specific goals that must be met to achieve a mission. Strategy is the plan of action for meeting objectives. Tactics are the specific set of actions needed to execute strategy. But where do you start in formulating vision? The typical place is with an analysis of the environment of the open system which is the domain of organisation under consideration.

In Chap. 16 we mentioned that our way of thinking about organisation in terms of design also gives us a clearer way of thinking about business change. Business motivation involves the need to document explicit reasons for changing an existing (as-is) business model. 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 amongst as-if business models and specifying courses of action to implement a new (to-be) business model.

2   Environmental Analysis

In previous chapters we portrayed an organisation as an open system—as a value-creating system positioned within a wider environment. By environment here we normally mean anything outside of the system of organisation with which the organisation interacts. This way of considering organisation and environment is familiar in a technique from business analysis known variously as PEST or PESTLE analysis. A PESTLE analysis is a high-level way of investigating in strategic terms the environment of some organisation. Such environmental analysis may offer critical insight as to why things should change. PESTLE should help the analyst structure the issues within the wider environment of some organisation that will require it to adapt. In other words, the organisation will need to change its patterns of action to meet with the state of the environment in the short, medium and long-term future (Exercise 18.1).

> **Exercise 18.1**
> Conduct a PEST or PESTLE analysis on some domain of organisation known to you such as a university, local authority or high street retailer.

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 five major inter-dependent systems: an economic system, social system, political system, technological 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 the actions of organisations.

The physical environment constitutes the eco-sphere surrounding organisational activity. In recent years growing concerns have been raised as to organisational impact on the physical environment, such as the negative effect CO_2 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 performative, informative and formative systems within organisations.

For instance, a PESTLE analysis conducted of an ambulance service might find that its social environment is undergoing change as an ageing 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 central UK government. This means that the financial resources of a particular ambulance service 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.

3   Ends

A PESTLE analysis might set the context for where we might want to be in terms of some domain of organisation. A convenient way of expressing desired future is in terms of endpoints or end-states–ends for short. Consider the information model in (Fig. 18.1). Here, an endpoint or an end is defined as an information class with two-subclasses. This means that ends can be typically expressed either as some business vision or as some expression of the results desired from this vision. In turn, a desired result is typically expressed either as a goal or as an objective. We distinguish more clearly between these terms in the section that follows.

Vision Statements

Future thinking is normally documented in an organisation's vision 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
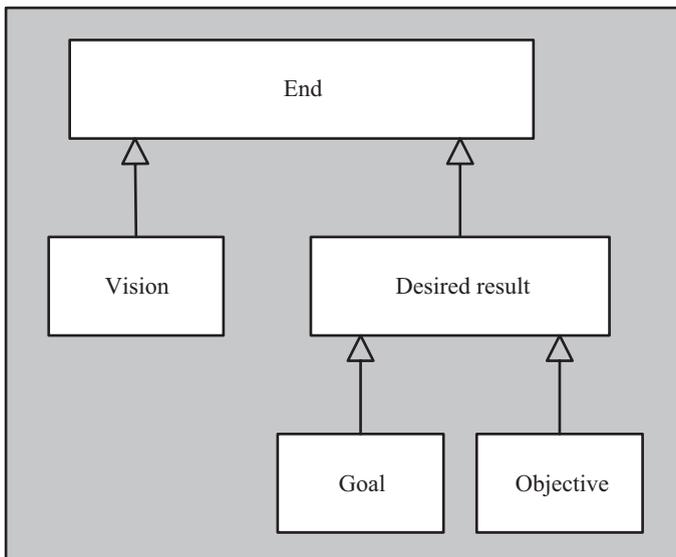
Fig. 18.1 Ends expressed as an information model

following terms: to be the lowest-cost pharmaceutical supplier with the best customer service (Exercise 18.2).

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 fourth quarter of the current year, no more than 1% of rentals need the car to be replaced because of mechanical breakdown (excluding accidents).

SMART Goals

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 (Exercise 18.3).

- 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.

Exercise 18.3

Identify which of the following objectives are SMART, and which are not. Explain why you placed the objective in each category.

- I aim to lose some weight this year.
- We will raise our profits.
- We expect to be able to better compete in our market over the next couple of years.
- The company will increase its production levels by 5% in the first quarter of 2015.

Critical Success Factors

One approach to identifying goals or objectives is to think of critical success factors 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 typically follow the Pareto rule discussed in Chap. 17—that only a few issues really count in terms of leveraging business change.

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 sub-contracted staff (Exercise 18.4).

Exercise 18.4

Identify some critical success factors for the following organisations:

- Goronwy galvanising
- USC
- Cwmni

SWOT Analysis

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 (Exercise 18.5):

- What do we do well?
- What do we do badly?
- What potential areas exist for expansion of our activity?
- What areas are particularly likely to damage us if we don't correct them?

Exercise 18.5
Imagine you were given responsibility for determining short-term planning for USC, a company that provides training for companies. Conduct a tentative SWOT analysis for this case.

GAP Analysis

Yet another way of determining areas for improvement or prioritising areas for change is through gap analysis. Gap analysis is the attempt to measure the difference between expectations and actuality. This idea can be used in a number of ways, such as:

- To identify a gap in some market that could be filled by a change in strategy
- To locate areas of perceived under-performance in a company
- To formulate expressed differences between what people are currently doing and what they might want to do in the future

Gap analysis often fits well with the idea of best practice benchmarking, particularly process benchmarking. If key patterns can be determined for some area of action which is regarded as best practice, then an organisation can determine the gap between its own patterns of action and those in the benchmark patterns.

4   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 the organisation has decided to do in order to become what it wants to be. Means can be organised in terms of a mission, courses of action and directives. This is illustrated as an information model in (Fig. 18.2).

A vision, as we have seen, 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. Alternatively, a consultancy might express part of its mission as being to provide management consultancy services to companies in North America.
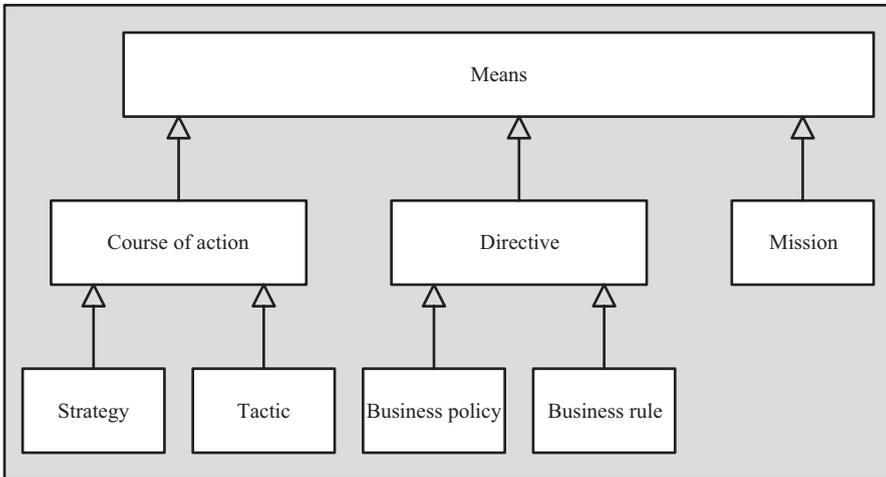
Fig. 18.2 Means expressed as an information model

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.

Strategy and Tactics

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, not surprisingly, 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. Strategy is not the same as tactics, which concerns the mechanical movement of bodies set in motion by strategy. Therefore, strategies are long-term courses 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 nation-wide 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 to be able to access central pricing and booking systems.

Ansoff (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 about the nature of the value-proposition for some domain of 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 defining critical issues concerned with the viability and sustainability of organisations (Exercise 18.6).

> **Exercise 18.6**
> If USC establishes the vision to become a major competitor in the provision of online training within three years, what might be aspects of its corresponding mission?

Directives as we saw in an earlier chapter are informative acts. They are types of communication which try to get other actors to do something. Typically, organisations issue directives to their members that are business policies or business rules. Business policies exist to govern strategy and tactics. A business rule is an actionable element of business policy.

Suppose that a company has established as part of its mission the goal to improve customer satisfaction. To achieve this, it institutes policy of measuring customer satisfaction at the end of every sale and some months following. It also issues a rule that all customer representatives must ask customers whether they wish to quickly participate in an online survey immediately following their dialogue with the customer.

5   Carrots and Sticks

There is clearly an inherent linkage between business motivation and business change. Business motivation expresses and documents the need for change in terms of both ends and means. Business policies and rules typically try to implement 'carrots' and 'sticks' in an attempt to habituate new patterns of action required by some 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, typically on an annual basis is awarded. A 'stick' is a punishment or more likely a threat of punishment. Performance appraisals within organisations typically are linked not only to career progression, they may be linked to career demotion. The ultimate sanction or stick would be losing one's job.

Many performance management systems are frequently, either implicitly or explicitly, based upon the ideas of 'carrots' and 'sticks'. However, one should beware of portraying individual motivation purely in terms of what we called a theory X model of management in a previous chapter. Taking a theory Y perspective, we may design jobs or roles to enable individuals to motivate themselves to do good work. It is possible for roles to provide many immaterial or intangible forms of value for individuals such as fulfilment of personal identity and self-actualisation.

The analyst should also not get into a mind-set that change is always necessary. As we have seen in an earlier chapter, change is notoriously difficult. Any planned change also inevitably introduces unforeseen and unexpected consequences. A classic example here is the introduction of rabbits into Australia as a food source 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 right across Western Australia. Eventually, the myxoma virus, which causes myxomatosis, was introduced into the rabbit population causing a severe impact upon population growth.

6   Evaluation

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 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 (Exercise 18.7).

> **Exercise 18.7**
> 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

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 materialises 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.

7   Types of Evaluation

Therefore, we generally wish to assess worth at various points in the life cycle of some business analysis projects. 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 in previous sections of this chapter. 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 considered in Chap. 16. 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 has 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 sub-type of summative evaluation particularly directed at analysing failures to organisational 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 Chap. 6.

Strategic Evaluation

Most organisations conduct some form of strategic evaluation of projects that aim to change socio-technical organisation. This type of evaluation involves assessing or appraising an investment in socio-technical 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 amongst 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 frequently 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.

For example, suppose we wish to implement a vital sign monitor into care for elderly at home within some region. Tangible costs would include not only the costs of the monitors themselves but also the costs of employing people to install monitors. Intangible costs would include costs of training elderly people in the use of this technology and maintaining this technology working effectively over a long period.

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.

It might be possible to produce estimates of certain tangible costs in the case of vital sign monitors in elderly care. Hence, we might estimate the amount of money saved to ambulance trusts by reduced number of callouts to elderly persons or more generally to the health service by reducing bed-blocking through earlier discharge of patients. But most of the costs may be intangible such as increased mental well-being amongst the group having such monitors.

Cost-Benefit Analysis

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 (RoI) and payback period.

The return on investment 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 return of investment. 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.

For example, assume we need to calculate the RoI on a new ICT system introduced into a university to manage student applications. Table 18.1 contains estimates as to the amount of income generated by the introduction of this system plotted against the costs associated with the development and maintenance of the system. We have assumed here that the complete socio-technical system will take two years to complete and implement and that the tangible costs associated with this will be of the order of £300,000. We also assume that the life of this project will be in the order of 12 years.

If we calculate the RoI for this project we arrive at an average (annual net income/ annual investment) as 32.

Table 18.1 An example of strategic evaluation

Year	Income	Investment	Income/investment
1	£0	£200,000	0
2	£0	£100,000	0
3	£50,000	£10,000	5
4	£300,000	£10,000	30
5	£500,000	£11,000	50
6	£600,000	£11,000	55
7	£600,000	£12,000	55
8	£600,000	£12,000	50
9	£600,000	£12,000	50
10	£500,000	£13,000	38
11	£400,000	£13,000	30
12	£300,000	£14,000	21

Formative Evaluation

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 (Chap. 5). 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 socio-technical organisation. In more linear approaches a project may be reconfigured or more resource may be deployed.

For example, if we were to introduce a programme of implementing vital sign monitors amongst an elderly population we would probably wish to set and work towards performance targets, such as the expected number of installations in a given month. Formative evaluation here would involve monitoring actual levels of implementation and comparing this against the target set. If we are clearly achieving more installations than expected then we do nothing. If however there is a lower than expected number of installations, for perhaps more than two months in succession, then we will need to change aspects of the installation planning to increase throughput.

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 (Exercise 18.8).

> **Exercise 18.8**
> Try to jot down some ideas for reducing the likelihood of project escalation occurring in a business analysis project.

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 socio-technical organisation?

Even if a project of business change reaches completion, it might fail in some sense when it is delivered or implemented. Therefore, at a suitable time after implementation 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 analysis and as such is likely to involve the use of various investigation techniques (Chap. 6) to determine actual (tangible) 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 has typically 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 Chap. 2. This approach is clearly adaptable to assessing satisfaction with new patterns of introduced action.

For instance, suppose we visit a sample of elderly persons after they have been using vital sign monitors for six months. We might get them to fill out a short questionnaire as illustrated in Fig. 18.3.

By placing a cross at some point along each scale the respondent to this questionnaire expresses his or her feelings towards some measurable aspect of the business model introduced by relating them to the appropriate emoticon (happy, neutral and sad). The entire collection of responses, expressed by a cross-section of these actors, can be aggregated to form an overall measure of the satisfaction with this feature of a business model, as well as suggesting areas for improvement.

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

Fig. 18.3 Examples of questions from a satisfaction questionnaire

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.

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 only to determine the reasons for failure, but to consider and suggest changes to organisational practice. This is known as post-mortem analysis.

It is important to recognise that success or failure is relative. This is because assessments of failure and success are frequently inter-subjective, 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 socio-technical 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 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 (Exercise 18.9).

> **Exercise 18.9**
> Can you ride a bicycle? If so, can you explain to someone else how to ride a bike? The difficulty in doing this is explained by the fact that the knowledge required to ride a bike is tacit.
>
> Think of some set of actions in organisational life that rely upon tacit knowledge? If it is difficult for workers to explain the elements of such tacit knowledge, how would you go about investigating such knowledge?

Suppose that we have to abandon our planned implementation of vital sign monitors because of a failure in perhaps piloting the socio-technical change amongst a delimited sample of the elderly population. It is likely that such abandonment will be triggered by feelings that the perceived benefits of such introduction are not as expected. Clearly a deep analysis will need to be established to determine not only what went wrong with this project but what lessons can be gleaned from it.

8   The Learning Organisation

We particularly evaluate things or unpack failed projects systematically because we wish to learn as business analysis professionals. But evaluation is also important to organisational learning.

The concept of organisational learning or the learning organisation, like many management concepts, is one that seems open to many different interpretations. In recent times it has become particularly associated with the work of Peter Senge at the MIT Centre for Organisational Learning (Senge 2006). In this section we particularly wish to utilise some of the concepts developed in the earlier work of Argyris and Schön (Argyris and Schön 1978) on organisational learning.

Argyris and Schön define organisational learning as occurring when '…*members of the organisation act as learning agents responding to changes in the internal and external environments of the organisation by detecting and correcting errors in organisational theory-in-use, and embedding the results of their inquiry in private images and shared maps of the organisation*'. Critical to this definition is the distinction made between espoused theories of action and theories-in-use. When someone is asked how she will behave under certain circumstances, the answer she usually gives is her espoused theory of action. However, the theory which actually governs her actions is theory in use, which may or may not be compatible with her espoused theory. Rules for collective decision and action in organisations often reflect an espoused theory that conflicts with the organisations' theory in use.

This has many similarities with Michael Polanyi's concept of tacit knowledge (Polanyi 1962). Tacit knowledge is the ability of human beings to perform skills without being able to articulate how they do them. In this context, tacit knowledge seems to be used mainly to mean the unexplicated knowledge involved in enabling individuals to orient their own work to those of others in a particular work setting.

Organisations learn in both a shallow and a deep manner. This is a distinction which lies in what Argyris and Schön call single-loop learning and double-loop learning. In single-loop learning, individuals respond to error by modifying strategies and assumptions within constant conventions of action. Such learning is directed at increasing organisational effectiveness. In double-loop learning, response to detected error takes the form of a joint inquiry into the conventions of action themselves. The purpose is to resolve the inconsistency between existing conventions and make a new set of conventions realisable. In both cases, organisational learning consists of restructuring organisational action.

This perspective on organisation is of course very compatible with the one adopted within this book. Organisations are not seen as static entities but as collections of individual actors that engage in the active process of organising. Individuals are continually engaged in the attempt to know the organisation, and to know themselves in the context of the organisation. The emphasis is on the process of organising not the entity of organisation. Organising is therefore essentially a continuous process of reflexive inquiry for the actors organising.

9   Action Research

One systematic way of conducting exercises in organisational learning is through action research (Avison, Lau, Myers et al. 1999). Action research first arose in the work of Kurt Lewin who maintained that complex social situations cannot be studied in laboratory settings. The method presumes that complex social systems such as the domains of organisation considered in this book are best studied by introducing changes into such systems and observing the effects of such changes. During action research, researchers, or in our case business investigators, not only observe phenomena, they intervene and participate in the domain under study.

An action research study is commonly described in terms of a five-phase cycle undertaken within the context of some client/system context. This context needs to be agreed upon and specified in terms of the authority the investigation team may utilise in specifying changes to patterns of action within the studied domain.

The first stage of action research is diagnosis. This corresponds to the identification of the primary problems that constitute the reasons for an organisation wishing to change. Diagnosis normally takes place in relation to some theoretical framework that guides the identification process. Hence, within an earlier chapter we emphasised the importance of identifying and specifying the problem situation. We have also provided a view of socio-technical organisation which helps guide the process of problem setting.

The second stage is action planning. A team of analysts and stakeholders collaborate in specifying a series of organisational actions that should relieve or eliminate organisational problems. Again, a theoretical framework will indicate the nature of some desired future state for the organisation as well as the changes which will achieve such a state. Within this book we have emphasised the importance of thinking about business change in terms of the transition between As-is, As-if and To-be business models.

The third stage, which is sometime called action-taking, involves implementation of planned actions. This means that the team of analysts and stakeholders actively intervenes in the target domain. In our terms they change an as-is business model into a to-be business model.

After the actions have been undertaken, the action research team undertakes an evaluation of the outcomes of given actions. Where the change in business model was successful, the evaluation must question whether the action inspired by theory was a substantial contributor to the success of the change. Where the change was unsuccessful, the theory must be corrected for the next iteration of the action research cycle. In our terms this is effectively a form of strategic or possibly postmortem evaluation.

At some stage, what has been learned from a particular intervention must be specified. This may inform the organisation itself, the theory being prepared for future intervention, or more generally it may inform the generation of theories for practitioners of business analysis.

10   Conclusion

Charlie Chaplin once wrote a beautiful song which started with the following lyrics: *Smile; Tho' your heart is aching…* Smiles as forms of facial expression communicate emotional state. Emotion is contagious and is a major source of individual motivation. But motivation is clearly both a collective as well as an individual issue. Within this chapter we have considered the issue of business motivation in terms of ends and the means to achieve them. Ends and means can be elaborated in terms of vision, mission, objectives, strategy and tactics (VMOST). Vision defines future purpose. Mission establishes measures for achieving purpose. Objectives are specific goals that must be met to achieve mission. Strategy is the plan of action for meeting objectives. Tactics are the specific set of actions needed to execute strategy.

Consider the hand gesture in Fig. 18.4. The origin of these gestures is obscure but their meaning, at least in the modern context, is clear. The upturned thumb is generally taken to stand for approval whereas the downturned thumb is generally taken to stand for disapproval. In informative terms these gestures express the feelings of the actor making them—they are particularly used as a signal that some evaluation has been undertaken. It is therefore no surprise to find images of these gestures now used widely, within both offline and online spheres. Within various social media, for instance, the up and down thumb is widely used to express whether a viewer likes or dislikes some digital content.

Evaluation involves assessing the worth of something. In terms of business analysis, we evaluate at various points in the life cycle of some project. First, we wish to establish whether we should change our current business model—strategic evaluation. Second, we wish to establish that the change we are enacting is going according to plan—formative evaluation. Third, we wish to establish whether change has been worth it—summative evaluation. Fourth, we particularly wish to evaluate why things go wrong—post-mortem evaluation.

The American philosopher John Dewey once said that '*we learn what we do*'. Evaluation is therefore not a one-off process; it is a continuous process of

Fig. 18.4   A hand gesture

organisational learning. It may be appropriate to conduct such learning systematically as an action research cycle. Within such a cycle planned interventions in organisation are systematically evaluated for the lessons learned.

11   Theory

Motivation is a key determinant of action. Motivation for business change is typically expressed as a business case or sometimes as a business plan. But how should a business case be devised? We have used the idea of a motivation model in this chapter to help express how any business case is in essence a representation of ends and means. This has allowed us to better structure what is normally a rather confusing area of business analysis.

There are clear linkages between the ideas of system, feedback and single-loop/ double-loop feedback which are described in chapter 5 of *Significance*. Argyris actually uses these ideas to express his difference between single-loop and double-loop organisational learning. Much of the impetus for action research and evaluation more generally is based on the importance placed upon organisations continually engaging in a process of learning.

There are also links of course between the notion of value or worth and evaluation. Organisations need to establish what they feel is of worth before approaching any evaluation. The concept of value is discussed in more detail both in my book *Business Information Systems* and in my book *eBusiness*.

12   Practice

In practice much of the material covered in this chapter would be referred to as enterprise analysis. It is also related to the techniques of VMOST and MOST analysis. The specific way of relating issues together in this chapter takes its inspiration from something known as the business motivation model.

The Business Motivation Model (BMM) is explicitly designed as a modelling approach for strategic planning. This framework is produced by the Object Management Group (OMG), a body attempting to standardise aspects of systems development practice, particularly notations for modelling systems of various kinds.

BMM essentially consists of a standardised vocabulary designed for expressing business plans, and a business plan is seen as a specification for a business model (Chap. 8). The declared aim of this modelling approach is to allow the clear tracking of the motivation or the reasons for the design of a particular business model. The aim is also to enable better alignment of business plans/models to ICT systems through the mediating concepts of business processes and rules.

Although evaluation is clearly of worth in itself, in practice organisations tend to take rather limited approaches to evaluation. Approaches that help guide strategic evaluation such as investment appraisal are commonplace. Techniques for formative

evaluation are exercised usually as part of systematic project management. Summative and particularly post-mortem evaluation are rarely conducted in any depth. Organisations prefer to bury their failures rather than learn from them. The Kolb learning cycle is sometimes used by analysts as a means of thinking about evaluation in the context of organisational learning. David Kolb argues that learning typically takes place in a cycle in which immediate or concrete experience provides the basis for observations and reflections. These observations and reflections are assimilated and distilled into abstract concepts, producing new implications for action which can be actively tested. The active experimentation is likely to generate new experiences to initiate another cycle of learning.

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Epilogue

The Organoscape

During the eighteenth and nineteenth centuries two types of painting dominated Western art: portraiture and landscape. Patrons of the arts wanted either flattering portraits of themselves or flattering depictions of the rural landscape. Within the UK captains of commerce also wanted depictions of the various seascapes of the World, control of which the might of the British Empire depended on.

We are all familiar with the terms landscape and seascape. Landscape is a term used to encapsulate the entirety of the physical terrain making up some area, while seascape is a comparable concept as applied to an area of ocean. Being distinct facets of the physical environment, the landscape and the seascape are relatively straightforward to represent in a visual if highly idealised form as painting.

However, in this book we have discussed a type of scape which is not so easy to 'paint' but which in many ways takes equal place with aspects of the physical environment. Indeed, it consists in large part of the ways in which we confront the modern physical environment, in the sense that it shapes or influences our contemporary human activity in relation to land, sea and sky. Given that we traced the root of the word organisation to the ancient Greek term organon, this rather difficult but critical 'terrain' we might refer to as the organoscape—the domain of socio-technical organisation.

In his classic book, *Ways of Seeing*, John Berger argues that images such as paintings are not straightforward representations of the World (Berger 1972): they are 'tools' through which we see the world. They embody distinct ways of viewing the world and can be understood on one level as a record or representation of how one actor, the artist, makes sense of some aspect of the world. Such images therefore also involve communication between one actor, the creator or producer of the image, and other actors, the consumers of the image. In a sense the forms of visualisation suggested within this book are ways of seeing the organoscape. They are tools to help make sense of the world of organisation—both as it is and how we want it to be.

Another way of thinking of the notion of the organoscape is in terms of memory. The psychologist and promoter of lateral thinking, Edward de Bono develops a

conception of memory in terms of a surface or landscape (DeBono 1969). For him, '*A memory is what is left when something happens and does not completely unhappen*'. Memory is thus similar to landscape. The contours of a landscape are traces of physical processes that have acted upon it, such as the rainwater that has fallen over long periods of time. Such rainfall develops rivulets, streams and rivers that sculpt patterns in the landscape. Such patterns then determine how water reacts with the landscape—it follows conventional courses and tends to make each of such watercourses deeper over time.

Rainfall does the sculpting of the landscape, but it is the response of the landscape to the rainfall that organises how the rainfall will continue its sculpting. The organoscape is thus similar to this notion of landscape as memory since it is continually re-constructed by our patterned action. But the existing organoscape also influences the patterned action that we can take. Over time, our organoscape becomes a memory surface through which we view and react to the world.

We began this book with a notion of creativity defined in De Bono's words as '*breaking out of established patterns in order to look at things in a different way*'. Within this work we have therefore attempted to 'paint' aspects of the modern organoscape not purely for the purposes of looking at such things in a different way, but with the objective of changing things when necessary. But to do so we have had to break down some of the established patterns with which you probably see the world: the worldviews you have applied to issues such as the nature of organisation, the role of management and the place of technology, particularly information technology, within work.

There is a Welsh phrase—'Da boch!'—which is typically used as a farewell greeting in conversation. This phrase can be translated either as 'be good' or perhaps 'live well'. In a way, this phrase sums up what we hope from business analysis and design. The business analyst and designer should have a toolkit of concepts that enables her to do good things in terms of analysing and designing organisation. We would also hope that business analysis provides a useful way for individuals, groups and institutions to continuously examine their actions and whether they could be better. But above all business analysis and design is a discipline that should foster the insight that organisation is a continual process of 'living', and that such 'living' should always be directed at making a difference.

A Compendium of Tricks

This book has presented an integrated, holistic approach to business analysis and design. Our aim has been to make what is traditionally a very technical subject palatable to a non-technical and particularly a business audience. But in doing this we have always had an important objective in mind: to make sure that the approaches we take to making sense of business are well-founded. For us this means that the approach is based on a view of the domain of socio-technical organisation which is well-supported by both existing theory and empirical evidence. For those interested

in such foundations I suggest looking at my companion book, *Significance* or my forthcoming book '*Data and Society*'.

This book has deliberately taken a new and innovative approach to doing business analysis and design. It has suggested new ways of conceptualising and visualising aspects of contemporary socio-technical organisation. But this does not mean we have ignored the vast array of techniques used by practising business analysts and listed in the Business Analysts Body of Knowledge (BABOK). Within the body of the text, many conventional business analysis techniques have been introduced by the 'back door'. These include activity systems modelling, information modelling, data modelling and motivation modelling amongst many others. However, many other techniques within the armoury of the business analyst have not been covered within the main body of the text, because we did not wish to disturb the logical progression of topics considered and over-complicate the narrative.

As a young child in the 1960s one of my most remembered Christmas presents was a compendium of magic tricks. Many happy hours were spent practising such tricks in the hope that I would be able to impress my peers. In a similar manner we present a compendium of business analysis and design techniques as an appendix to the book. Be warned: it takes much practice in the use of these techniques to impress. We have tried to provide some guidance within each description as to when the performance of each technique is likely to produce the best trick, for the best response from the audience.

References

Berger, J. (1972). Ways of Seeing. Penguin, Harmondsworth, Middx.
DeBono, E. (1969). The mechanism of mind. Penguin, Harmondsworth, Middx.

A Case Book

Within this part of the book we describe in more detail the domains of organisation used as material for many of the examples cited in the body of the text. We also include some other case material which might be used for exercises in analysis and design.

Case 1: Goronwy Galvanising

It is the mid-1980s. Goronwy Galvanising is a small company specialising in treating steel products, such as lintels (beams), crash barriers, and palisades (fence posts), produced by other manufacturers. Goronwy is a subsidiary of a large multinational company, Rito Metals, whose primary business includes the extraction and processing of base metals such as zinc as well as the production of various metal alloys. Rito Metals maintains ten galvanising plants on similar lines to Goronwy situated around Europe. Each plant is relatively autonomous in terms of managing its day-to-day business.

Galvanising, in very simplistic terms, involves dipping steel products into baths of molten zinc to provide a rustproof coating. Untreated steel products are referred to in the industry as being 'black'. Treated steel products are referred to as 'white'. Besides the obvious addition of a zinc coating, there is usually a slight gain in weight as a result of the galvanising process. Goronwy galvanises steel for a number of major steel manufacturers. However, as much as 80% of their current sales are conducted with Blackwalls steel, which places a regular set of orders with Goronwy. Other manufacturers order galvanised steel on an irregular basis. The staff at Goronwy consists of two layers of management: an overall plant manager who has reporting to him a production controller, an inbound logistics controller and an outbound logistics controller. The production controller is in charge of an office clerk, 3 shift foremen and 40 shop-floor workers. The inbound and outbound logistics controllers each have five operatives working for them. The plant remains open 24 hours per day, seven days a week. Therefore, most of the production workers, including the foremen, work shift patterns.

As mentioned, unfinished 'black' materials consist of steel fabricated products of various forms. This raw material is delivered to Goronwy on large trailers in bundles

referred to as batches. On arrival at the galvanising plant the black material is unpacked by an inbound logistics operative and checked for discrepancies such as material being 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 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 re-galvanised. Satisfactory (conforming) white material is then bundled back into batches, loaded onto trailers and eventually dispatched back to the customer (Fig. C1.1).

As we have seen in our description of the activity at Goronwy, each trailer arriving from a customer might be loaded with a number of different types of steel product. Each batch of such products was therefore labelled with a unique order number. As a whole, each trailer was given its own delivery advice note detailing all associated batches on the trailer.

Since Goronwy mainly processed steel products for Blackwalls, the delivery advice note supplied with Blackwalls products was identified by a delivery advice number specific to this manufacturer. Each batch was identified on the delivery advice note by an order number generated by Blackwalls. Figure C1.2 illustrates a
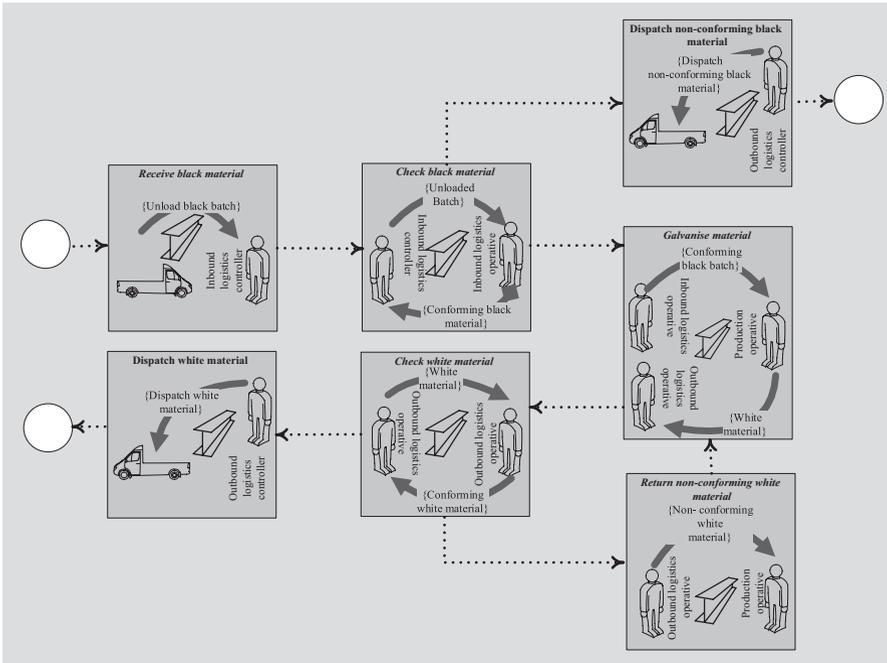
Fig. C1.1 Goronwy Galvanising activity system

Blackwalls steel products		Delivery advice			
Advice No.	**Date**	**Customer name**	**Instructions**		
A3137	20/01/1988	Goronwy Galvanising	Galvanise and return		

Order No.	**Description**	**Product code**	**Item length**	**Delivery Qty**	**Weight (Tonnes)**
13/1193G	Lintels	UL150	1500	20	145
44/2404G	Lintels	UL1500	15000	20	1450
70/2517P	Lintels	UL135	1350	20	130
23/2474P	Lintels	UL120	1200	16	80

Haulier	**Received in good order**
International 5	√

Fig. C1.2 Delivery note

typical delivery advice note received from this company detailing all the black material on a particular trailer.

The delivery advice note in Fig. C1.2 effectively acts as a record of particular batches arriving on a given trailer. Data about a particular batch upon this form was referred to as an order-line. Each order-line effectively served to communicate an assertion from a customer such as Blackwalls to a particular business actor such as the inbound logistics controller at Goronwy about the type of product, its quantity and its weight.

On arrival at the galvanising plant the black material was unpacked by an inbound logistics operative. It was then checked for discrepancies with the data supplied on the delivery advice note. Two major types of such discrepancy tended to occur on a regular basis:

- A *count discrepancy* occurred when the number of steel items actually found was less than or greater than the amount indicated on the delivery advice note.
- A *non-conforming black* discrepancy arose when some of the material was unsuitable for galvanising. For instance, a steel lintel might be bent, or the material might be of the wrong product type.

Both types of discrepancies were written as annotations within the appropriate box on the delivery advice note by the inbound logistics operative.

When all the material had been checked, the delivery advice note was then passed on to the production controller. He and the office clerk transcribed details by hand, including any discrepancies, from the advice note to a job sheet. A separate job sheet was filled in for each order-line on the delivery advice note, such as the one illustrated in Fig. C1.3.

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					

Fig. C1.3 Job sheet

The job sheet was next passed down to the shop floor of the factory where the shift foreman used it to record details of processing in the galvanising plant. Most jobs passed through the galvanising process smoothly. As mentioned, the steel items would be placed on racks, dipped in the zinc bath and left to cool. The site foreman would then check the condition of each completed job. If all items in a job galvanised properly, he would put a Y for yes in the galvanised box on the job sheet and pass it back to the production controller.

Occasionally, some of the items would not have galvanised properly. Such items would then be classed as non-conforming white and the number of such items placed in the appropriate box on the job sheet. Non-conforming white items would typically be re-galvanised at some later date.

When the shop floor had treated a series of jobs the production controller would issue a dispatch advice note and send it to the outbound logistics section. Workers in this section would then stack the white material on trailers according to the data represented on this document, ready to be returned to the appropriate manufacturer. Each trailer for dispatch would have an associated dispatch advice note detailing the white material on the trailer.

Because of discrepancies, partial dispatches might be made from one job. This meant that the trailer of white material need not correspond to the trailer of original black material supplied to Goronwy. Hence, the data on delivery advices did not need to correspond precisely with the data on dispatch advices. The production controller would therefore need to record separate dispatches associated with one particular job on the correct job sheet. A typical dispatch advice note is represented in Fig. C1.4—note that the final order, 23/2474P, has not yet been delivered in full.

Goronwy called in a business analyst to examine their existing way of organising work and to suggest improvements to such organisation. He started by drawing a diagram of the information system at Goronwy, as in Fig. C1.5.

In conducting this analysis, it became evident that major problems existed with the data system at Gorowny. It is evident from the visualisation of the information

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	UL150	1500	20	145	20	150	
44/2404G	Lintels	UL1500	15000	20	1450	20	1460	
70/2517P	Lintels	UL135	1350	20	130	20	135	
23/2474P	Lintels	UL120	1200	16	80	14	82	
Driver	**Received by**							

Fig. C1.4 Dispatch advice

system that the data needs to be shared among a number of people: for Goronwy. It includes inbound logistics operatives, production controllers, shift foremen and outbound logistics operatives. So, in the existing business operation manual copies of data are needed, and making manual copies is slow and therefore expensive. A lot of time was also taken transferring data from one type of form to another: for instance, from delivery advice notes to job sheets. Every stage of data transfer is an opportunity for human error to creep in, and this can lead directly to processing errors, which are costly and time-consuming to correct. Finally, it is difficult to analyse data held in manual records. Even if data 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 (Exercise C1.1).

> **Exercise C1.1**
> Draw a tentative data systems model based on the description and the visualisations in C1.1 and C1.4

As a result, Goronwy and its parent company looked at moving to an ICT-based system for basic administrative functions. Its managers with the help of a business analyst drew up a business case for a new ICT system which outlined many of the problems with the existing manual information system. They decided to keep the existing activity system much as it was, and to base the design of the associated ICT system closely on it. They chose this support option because there was a low risk of failure in the development effort. As part of the work required for expressing a new business model the business analyst produced the information model illustrated in Fig. C1.6 (Exercise C1.2).
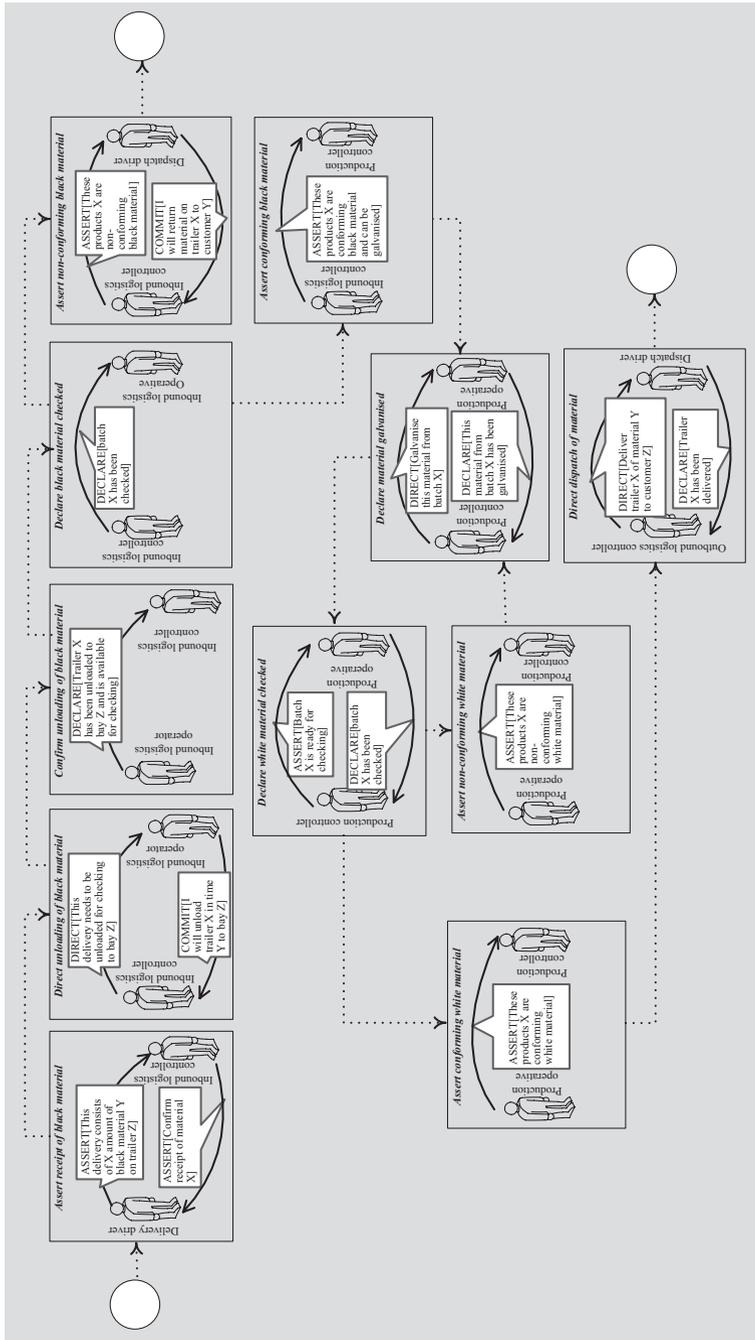
Fig. C1.5 Information system at Goronwy Galvanising
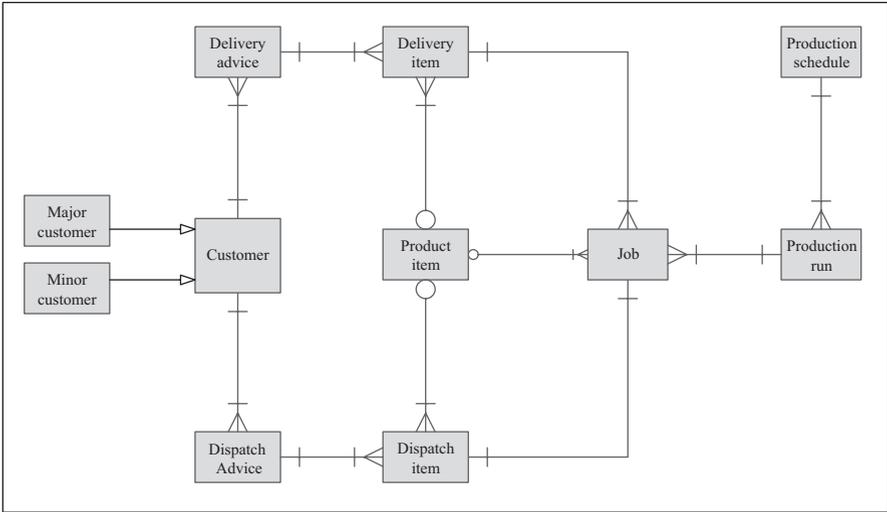
Fig. C1.6 Information model for Goronwy Galvanising

Exercise C1.2
Draw a tentative data model based on the information model in C1.5 and the illustrations of the manual forms in Figs. C1.2. C1.3 and C1.4.

The business analyst was called in to conduct an evaluation after Goronwy had introduced its new ICT system. It found that staff were identifying much more non-conforming black and white material because more quality checks could be made both at inbound logistics and after production. This initially caused problems with customers: they were getting more non-conforming material returned to them, and it took more time to return finished goods. However, after a few months customers began to comment favourably: they saw they were getting a better quality of service. Workers seemed to adapt to higher quality control standards, and over time production times started to decrease because there were fewer problems with both inbound and outbound material. Higher levels of customer satisfaction tend to lead to more orders, from the satisfied customers themselves or from their recommendations to others. Smoother throughput led to greater productivity. This enabled the plant to take on more business, and as a result it became the most profitable galvanising operation within the Rito Metals group for two years running (Exercises C1.3 and C1.4).

Exercise C1.3
What sort of evaluation was conducted in the preceding paragraph? Improved performance is evident from this description. Can you unpack this in terms of improvements in efficacy, efficiency and effectiveness?

Case 2: Emergency Ambulance Service

Within modern healthcare an effective system is required for responding to emergency health incidents. Most countries in the world rise to this challenge by establishing and maintaining specialist staff such as paramedics and specialist equipment such as ambulance vehicles to enable emergency response. Such service units are clearly called by different names across the globe. Ambulance services in the UK have the freedom and responsibility to establish their own forms of activity, communication and technology. This means that there is variation amongst activity systems, information systems and data systems within ambulance services in the UK. The description below is therefore based on a composite of the systems experienced amongst a number of such services. Let us describe the operation of this organisation in terms of the typical life cycle of an emergency incident.

Getting specialist ambulance staff in their vehicles to an incident in the shortest period of time is a key goal or purpose for such an ambulance service. This demands effective coordination and control of activity amongst multiple actors to ensure that the resources such as ambulances and paramedics are used most effectively and that the patients receive appropriate emergency healthcare as promptly as possible.

The service is first aware of an incident when telephone operators take an emergency call and identify the caller's area code or closest mobile phone from the call. The call is then routed to the ambulance control call centre. A call-taker matches the number calling with an address using a computerised place map of the area covered by the service and then asks a set series of questions prompted by a set of rules embedded in the ICT system. On the basis of answers to the questions supplied, the system suggests appropriate action.

It used to be the case that the ambulance service in the UK worked using a first-come, first-served basis in terms of their response to emergency calls. However, most ambulance services now institute a process of 'triage' to enable prioritisation of response to incidents. This means that decisions are made as to the medical importance of incidents and on this basis further decisions are made about the dispatch of ambulance crews to such incidents.

A dispatcher will have been listening to the call since the location was identified. If the call is category A (life threatening) or category B (serious) then a paramedic dispatcher may have been asked for assistance. Some ambulance services employ paramedics within the control room who can be consulted in case of any doubt as to the priority of the incident. The dispatcher assesses manually the nearest appropriate ambulance by using a number of computer screens: a screen indicating a plan

designed to maximise the efficient use of resources (known as the system status management or SSM plan), a screen listing the status of all current resources and a screen which plots the current location of ambulance resources against a computerised map and a touch-screen telephone. The SSM plan is an attempt to dynamically deploy vehicles around the area covered by the ambulance service according to demand patterns established for day and time, geographical area and clinical urgency. As part of the functionality of the ICT system the SSM plan is capable of prompting control room staff to shift resources such as ambulances on a continual basis to stay within plan.

Using this technology and her knowledge of the local area the dispatcher assigns an ambulance to the emergency incident. This means that the dispatcher does not always send the nearest ambulance in terms of distance to an incident. For example, it would be inappropriate to dispatch a spatially near ambulance if the incident is called in during rush hour and the ambulance would need to travel in the direction of the major traffic flow. In this case, it is preferable to send a slightly more distant ambulance that can travel against the primary traffic flow. Not surprisingly, many ambulance services institute a policy of recruiting control room staff from their pool of operational ambulance crews because of the critical importance of such domain knowledge to effective dispatch (Exercise C2.1).

Exercise C2.1
Develop an activity model for this case based upon both description of the case and the models provided in previous chapters.

During this process the call-taker will be giving pre-arrival advice to the caller prescribed both by the ICT system and their own training. While the call-taker continues with this interaction the dispatcher typically uses a radio message to alert the chosen ambulance crew that they are required to attend an incident. Details of the location of the incident (including a map grid reference) and the reported details of the patient's condition are also transmitted in this way. Some ambulance services also employ communication systems enabling control staff to page information as to incidents to ambulance crews.

Having received an incident alert from the control room, a member of ambulance crew presses a button on their communication set indicating the point at which they go mobile. Ambulances are fitted with global positioning system equipment that updates the dispatch system every 13 seconds with the location of ambulance crews. Crews are guided by satellite navigation to the incident location, supplemented by radio communication with the control room. When the crew arrive at the incident, they press an *arrive* button on the communication set. They then administer any immediate treatment required at the scene and eventually move the patient into the ambulance. When ready to leave the scene of the incident, they press a *leave scene* button and when they arrive at the general hospital, they press an *at hospital* button. Finally, they press a *clear* button when they are available to be allocated as a resource again (Exercise C2.2).

The activity, information and data system models for the emergency ambulance domain are provided in the main text.

Significant patterns are never fixed; they are in continuous flux. Consider, for instance, two ways in which the patterns within the organisation of emergency response are changing. For instance, in 2005 the UK government published a series of recommendations based upon a detailed analysis of the 'performance' of ambulance service. One of the key recommendations was that the targets set for responding to emergency calls should be measured consistently across the UK. It suggested that the clock should start ticking when an emergency call is connected to the control centre and not when the call-taker has completed the collection of key details from the caller and identified the location of the incident, which is what most UK ambulance services had been using as their point of measurement within systems of internal data collection. Following adoption of this subtle recommendation, UK ambulance services have spent a number of years re-configuring major aspects of not only their data systems but also changes to communication and activity because on average the difference between connecting a call and identifying an incident is as much as one minute (Exercise C2.3).

Statistics collected on the ambulance service reveal that while 30% of calls are categorised as life threatening by call-takers and ambulance-dispatchers only 10% of such incidents actually turn out to be life threatening in nature. Also, 77% of all emergency calls result in a journey to a local hospital but only 40% of these patients are eventually admitted for treatment to hospital. There are clearly a complex set of reasons for this situation.

Various ambulance units have attempted to make changes to such breakdowns in practice, in an attempt to meet the implicit intentions expressed in such measurement. For instance, some have begun to re-configure their data systems to collect a patient summary containing not only important medical data about the patient but also a history of interaction with the ambulance service. It is hoped that such records will not only allow call-takers to refine the success of their decision making but also better signal to ambulance crew what to expect at incidents and consequently how better to perform at point of incident (Exercise C2.4).

The emergency ambulance service is clearly part of the wider system of healthcare provision within the UK. The performance of the service is affected by a number of changes to the wider provision of healthcare. For instance, emergency healthcare is straining to deal with an increasing number of 999 calls. Some suspect this is due to changes to the out-of-hours service traditionally provided by general practitioners. Accident and emergency departments at general hospitals are also experiencing significant increases in admissions. At certain times lack of beds within the general hospital mean it is impossible to admit patients. There are hence increasing number of times when emergency ambulances are waiting outside of A and E departments with their patient on board (Exercise C2.5).

Case 3: University Short Courses

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 three to four 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 on the popularity of the course, a course might be presented by a number of 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.

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 less than four students registered for them. If less 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 the staff telephoned each booked student to confirm attendance. One week before each presentation, the 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.

The system models for the emergency ambulance domain are provided in the main text. The information model for this case is provided in Fig. C3.1.

As we have seen, in the early years of its administration USC used a paper-based records system. However, the company experienced a number of problems with this manual data system. For example, to ensure effective coordination of activity data needed to be communicated amongst a number of people such as venue operators, lecturers and a multitude of USC administrators. This meant that copies had to be made of documentation such as presentation schedules, consuming much-needed time and resource. A considerable amount of time was also spent in transferring data from manual records on to other documents such as course schedules. Administrators frequently made errors in entering the wrong data onto records or other forms of documentation. Further valuable time and effort was therefore expended in resolving such errors by administrative staff. Finally, it proved difficult to use the data stored in records for strategic as well as operational purposes. For example, it was difficult for managers to collate and analyse data to determine trends such as the popularity or otherwise of particular courses. To conduct such analyses meant a considerable investment of time and effort on the part of both administrative and managerial staff (Exercise C3.1).
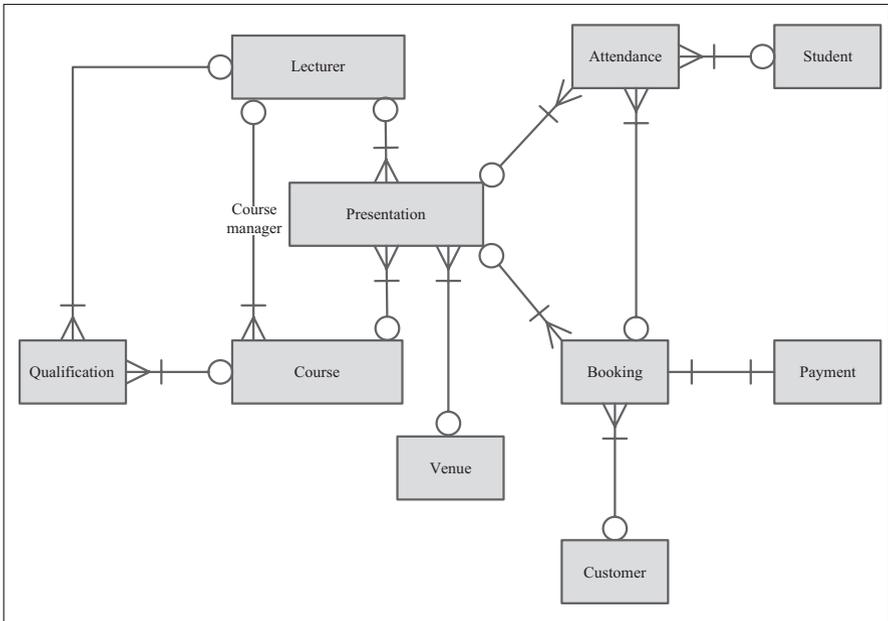
Fig. C3.1 Information model for USC

Exercise C3.1
The ICT system implemented a number of update functions such as *Create a new course record* or *Create a new booking* or *Assign a new lecturer to a course presentation*. See if you can flesh out one or two of such functions.

At the start of the 1990s, problems such as these persuaded USC to consider investing in the construction of an ICT system to handle basic administrative functions. Computing technology was also becoming much more affordable for the small and medium-sized enterprise during this period.

Since ICT systems are essentially data processing systems, they rely on a core repository for the data used within the system. This repository is normally referred to as a database and is controlled by the data management layer. 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 will be stored within the system and in what form (Exercise C3.2).

Exercise C3.2
Modify the information model for USC to accommodate this business change.

In terms of its suppliers the company initially built a long-term relationship with a limited range of suppliers. This relationship was managed by one USC administrator to ensure the steady flow of supplies into the company, effectively constituting a managerial hierarchy. In contrast, for most aspects of its customer-chain USC entered the market and competed with other companies to supply technical training to customers. However, USC managed to build a relationship with a limited range of customer organisations to deliver major aspects of their internal training programme. These contracts in repeat business were originally managed by a couple of dedicated USC administrators, but eventually with the growth in electronic communications it became possible for one administrator to manage this business.

Traditionally, the business model of USC has depended on the delivery of its courses at physical events—course presentations—to customers from various organisations. A smaller part of its revenue was derived from on-site physical presentations for partner organisations. More recently, USC has developed an online business model for a range of courses from its portfolio. Certain customers are able to take an entire course through electronic learning or eLearning. This enables the company to reach international as well as national customers with parts of its course portfolio (Exercise C3.3).

> **Exercise C3.3**
> Sketch some of the changes to the business model of USC.

Case 4: Cwmni

Cwmni, which means in Welsh both *company* and *our valley*, was established as a private enterprise in 2001 by the Welsh regional administration to offer advice and support within the areas of digital business and digital commerce to SMEs based within Wales.

Funding for the operations of Cwmni was provided jointly by the regional administration and the European Union. A number of 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. All advice and support was provided in face-to-face meetings between business advisors and SME managers or other employees at such visits.

There were a number of elements to the digital business support service provided by Cwmni. These included a digital business review, implementation support and a grant for digital business implementation.

- Digital business review. A network of business advisors were trained and accredited by Cwmni and provided the main point of contact with client firms. Approximately two days of an advisor's time was 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 review consisted of an eight- to ten-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 digital business 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 digital business advisor's recommendation became eligible for financial support from Cwmni. Up to £1750 of client aid was available based on a client spend of £5000 before VAT. 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 such as their first online catalogue or set up an email marketing campaign. A small daily fee was charged for this work. SMEs typically would take two or three days of implementation support.

The activity system at Cwmni is illustrated in Fig. C4.1.

After three years of operating in this manner an evaluation was conducted of this support organisation by an external consultant, who was tasked with not only investigating the level of satisfaction experienced by business organisations with the service provided by Cwmni but also providing 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 again 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 and so on. The work of the call centre was also re-configured 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
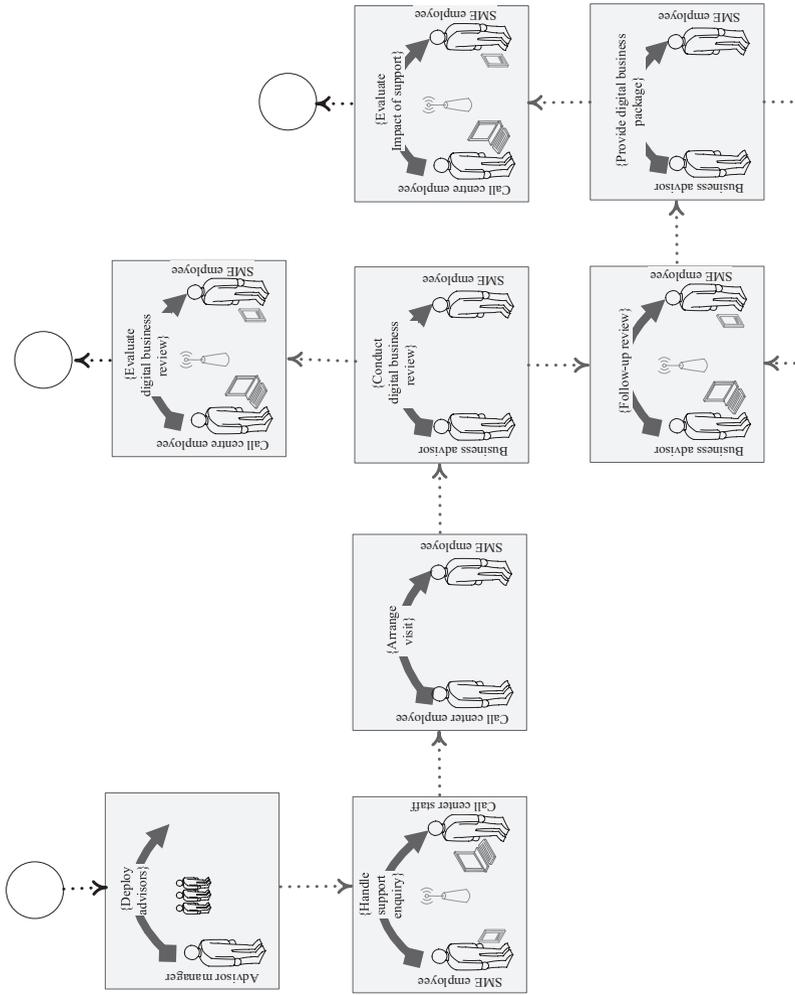
Fig. C4.1 Activity system at Cwmni

system now enabled the collection of issue-based data which was 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.

The information system supporting this change to business model is illustrated in Fig. C4.2.

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 digital commerce support to more general business support. Such environmental turbulence meant that Cwmni needed to radically re-design both its organisation and technology to meet the revised and increased range of objectives and targets (Exercises C4.1 and C4.2).

Exercise C4.1
Sketch out some of the details of the data system model that would accompany the information system model in C4.2.

Exercise C4.2
Sketch out some of the likely changes to the business model that the business change detailed above would require.

Case 5: Online Retail

A tipping point has been reached in retail over the last couple of years in countries such as the UK. 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. Most online retailers follow an established pattern for this sort of business. Figure C5.1 illustrates the information pattern underlying most forms of online retail.

Another associated business pattern has recently been implemented by many click and mortar companies. This is illustrated in Fig. C5.2 (Exercises C5.1, C5.2, and C5.3).
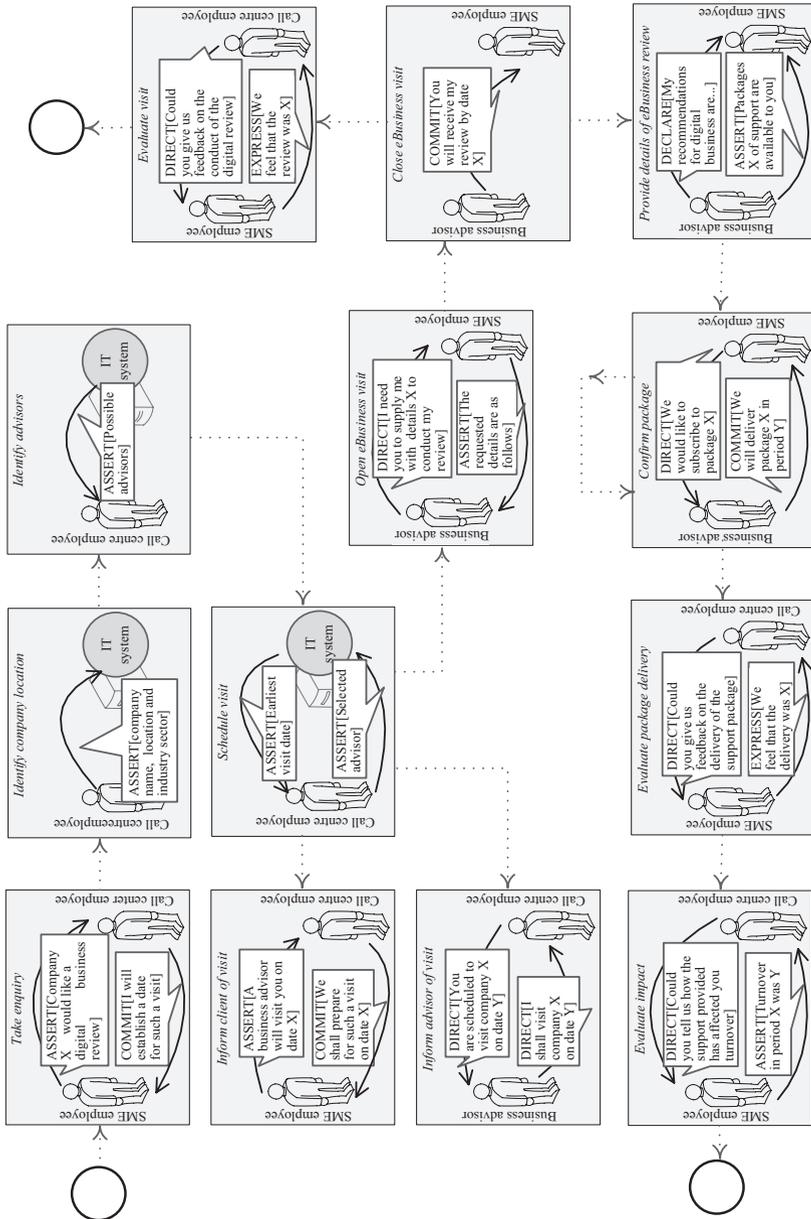
Fig. C4.2 Information system at Cwmni
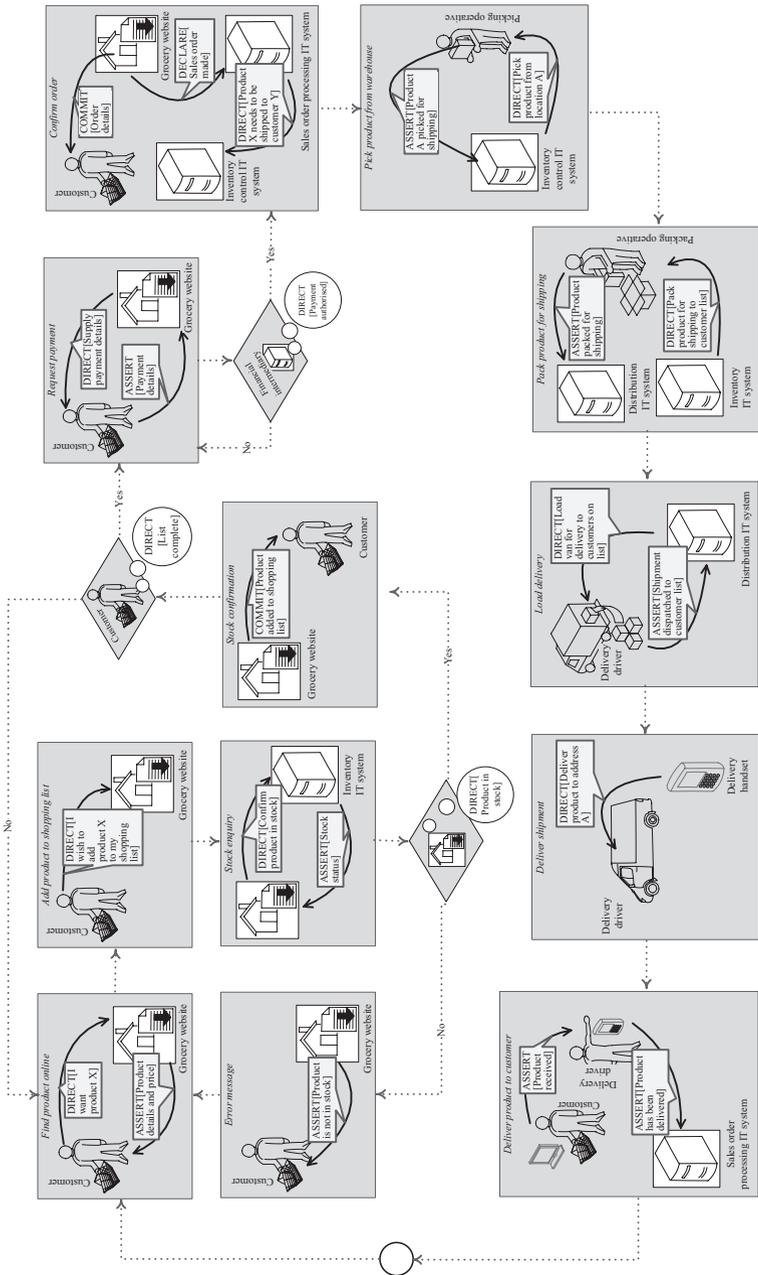
Fig. C5.1 Online retail information pattern
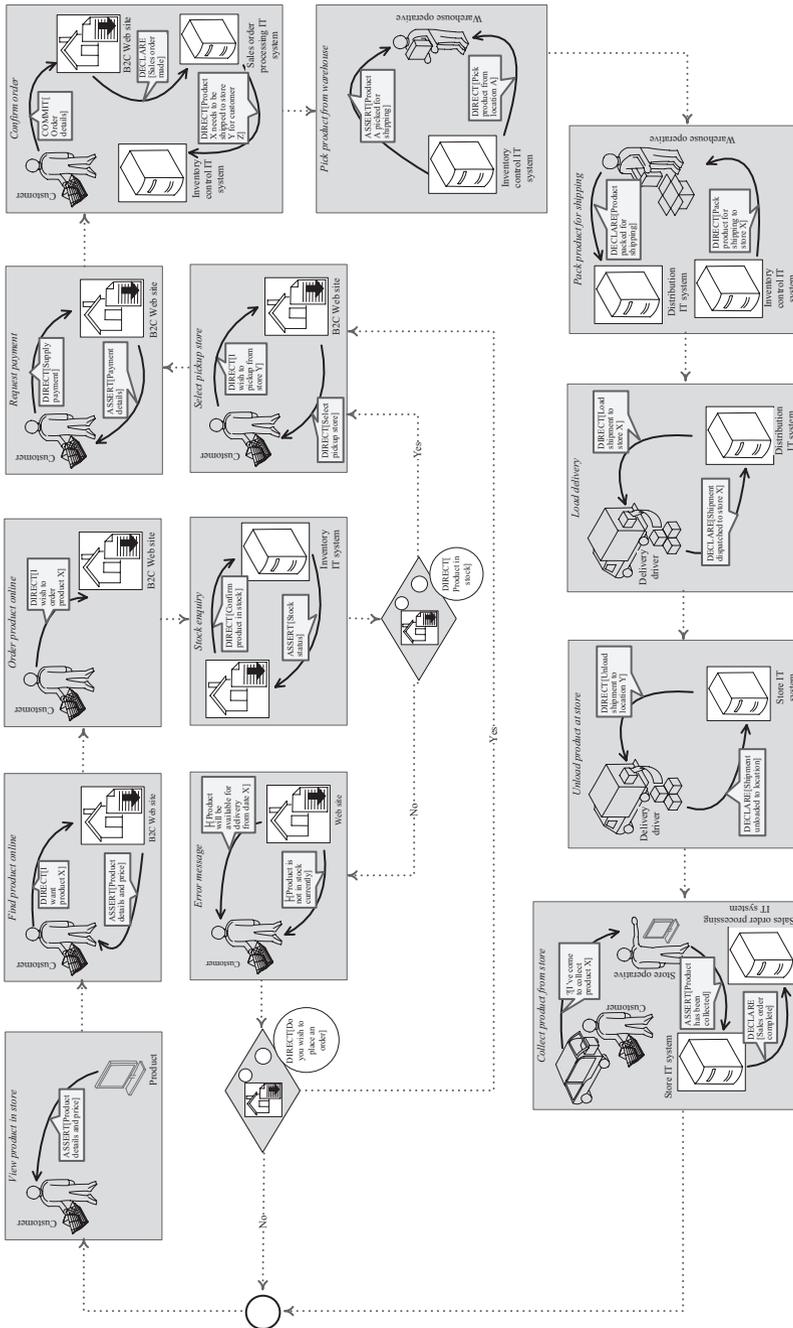
Fig. C5.2 Click and collect information pattern

Exercise C5.1

Returns are a significant cost to an online retail company. An evaluation of this situation suggests that a small percentage of customers are responsible for a high volume of returns. How would you develop strategy to deal with this problem? What changes might be required to the business model of online retail?

Exercise C5.2

Develop a scenario for each of the following forms of business—online grocery, online book retail, online electronics goods retail—and walk each through both the online retail and the click and collect pattern. Do any modifications need to be made to such patterns?

Exercise C5.3

Would the use of a different access device such as a mobile phone or tablet running an app change the patterns of communication in C5.1 and C5.2?

Case 6: Healthcare Appointments

Healthcare as an activity is normally organised as one or more events of intervention performed on a patient by some healthcare specialist. For this reason, a common pattern experienced within most forms of healthcare is that of booking appointments. Figure C6.1 provides a possible information pattern for booking an appointment with a general practitioner (Exercises C6.1 and C6.2).

Exercise C6.1

Produce a written description of your own experience of booking another type of healthcare appointment, such a booking a dental appointment. Try to write it as a scenario. How closely, or not, does it match with the pattern illustrated in Fig. C6.1?

Exercise C6.2

Consider three different types of healthcare such as general practice, outpatient treatment and dental treatment. Consider whether the same business pattern will suffice in each case for booking appointments. If not, sketch out some of the differences in the pattern for each domain.
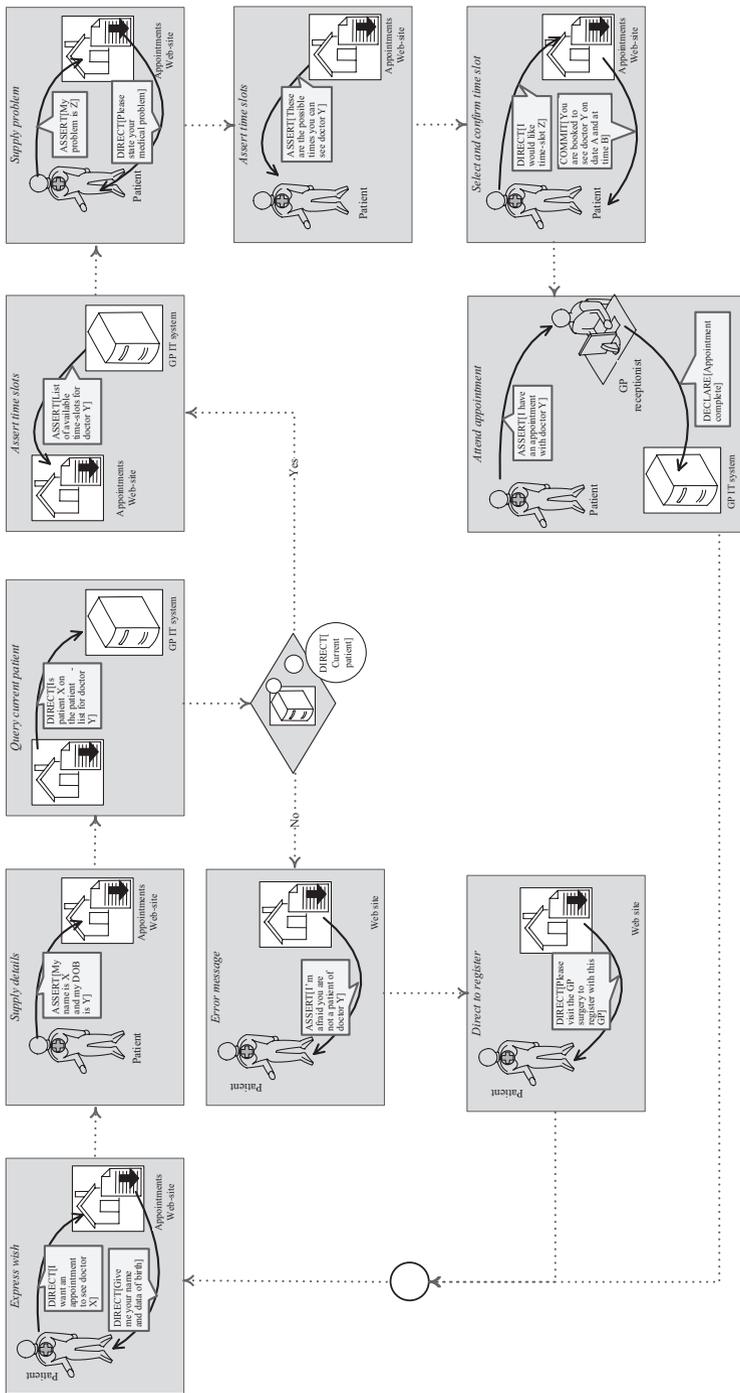
Fig. C6.1 Booking a healthcare appointment

Case 7: Online Healthcare

Many countries now attempt to manage the loading placed upon healthcare systems by providing certain aspects of healthcare as an online service. This has been given further impetus by the recent coronavirus pandemic in which the rules of social distancing have forced many healthcare practitioners to re-configure their way of providing healthcare. For instance, ill people may be able to access health advice from a website or speak to a trained health professional over the phone or using a voice or video over internet service. Communication with a healthcare professional through such a service may facilitate triage access to further healthcare. In other words, the service can act as a gatekeeper to face-to-face healthcare.

To be effective, online healthcare has to integrate its service with numerous other forms of offline healthcare. Many persons may decide not to go through such an online service to access healthcare. Some persons may not have access to technology to make online healthcare a possibility for them. What implications does the growing range of access devices to online content have for online healthcare?

Consider one way in which access to general practitioners might be re-organised through digital innovation. Patients would first be required to download an app. This app then uses a machine learning algorithm to ask a series of questions of the patient. Depending upon the answers to such questions the app might suggest that the complaint is minor and suggest self-care or self-prescription to the patient. There may even be a referral to a pharmacist. If the likely complaint demands intervention by a medical practitioner then the app communicates with the GP surgery of the patient and arranges an online appointment with the healthcare practitioner. Depending upon the outcome of the online consultation the patient might be requested to visit the surgery for further tests or investigations. A follow-on appointment is automatically made in the bookings system of the surgery (Exercises C7.1, C7.2, and C7.3).

Exercise C7.1
Develop a rich picture which sets the problem of online healthcare in context.

Exercise C7.2
How would you go about evaluating the success or otherwise of this domain of organisation?

Exercise C7.3
Develop a pattern comic which describes what you think goes on in the information pattern associated with the online delivery of healthcare. Use the description above as a starting point.

Case 8: Household Waste Collection

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.

As a pattern of organisation household waste collection can clearly be organised in a number of different ways. Consider one such pattern as illustrated in Fig. C8.1. First, a waste collection schedule is produced. This is sent to each householder in the local authority. Householders sort their waste into three categories (food, recyclable and non-recyclable) and place such waste in the appropriate bin. At a nominated time and in a nominated place they place the three waste bins out for collection. A waste collection team is dispatched to collect a particular type of waste.

The complete pattern is expressed as an integrated pattern comic in Figs. C8.1, C8.2, and C8.3. By this we mean that related acts of articulation, communication and coordination are shown on the same storyboard. The three panels of this comic are joined by labelled start and stop connectors (Exercises C8.1 and C8.2).

> **Exercise C8.1**
> Study the pattern closely and see if it corresponds to the way in waste collection is performed in your area. There are likely to be differences in the pattern. See if you can modify the pattern to document how it works for you.

> **Exercises C8.2**
> The recycling of household waste is a significant problem for nation-states. Develop a rich picture which establishes your understanding of the issues surrounding this problem situation.

Case 9: Track and Trace App

During the COVID-19 pandemic, a strategy designed to manage the infections from the virus was proposed and executed by many governments around the world. Within the UK this strategy became known as test, track and trace and was proposed in this country mainly as a means of helping to prevent a second outbreak of COVID-19. In other parts of the world, such as South Korea, this strategy was implemented much earlier on in the cycle of the pandemic and had some success in limiting the outbreak of the disease.

Test, track and trace is actually not a new strategy. This system has been part of the armoury of agencies of public health such as the World Health Organization for decades. Effectively, it amount to an activity system that involves testing people to
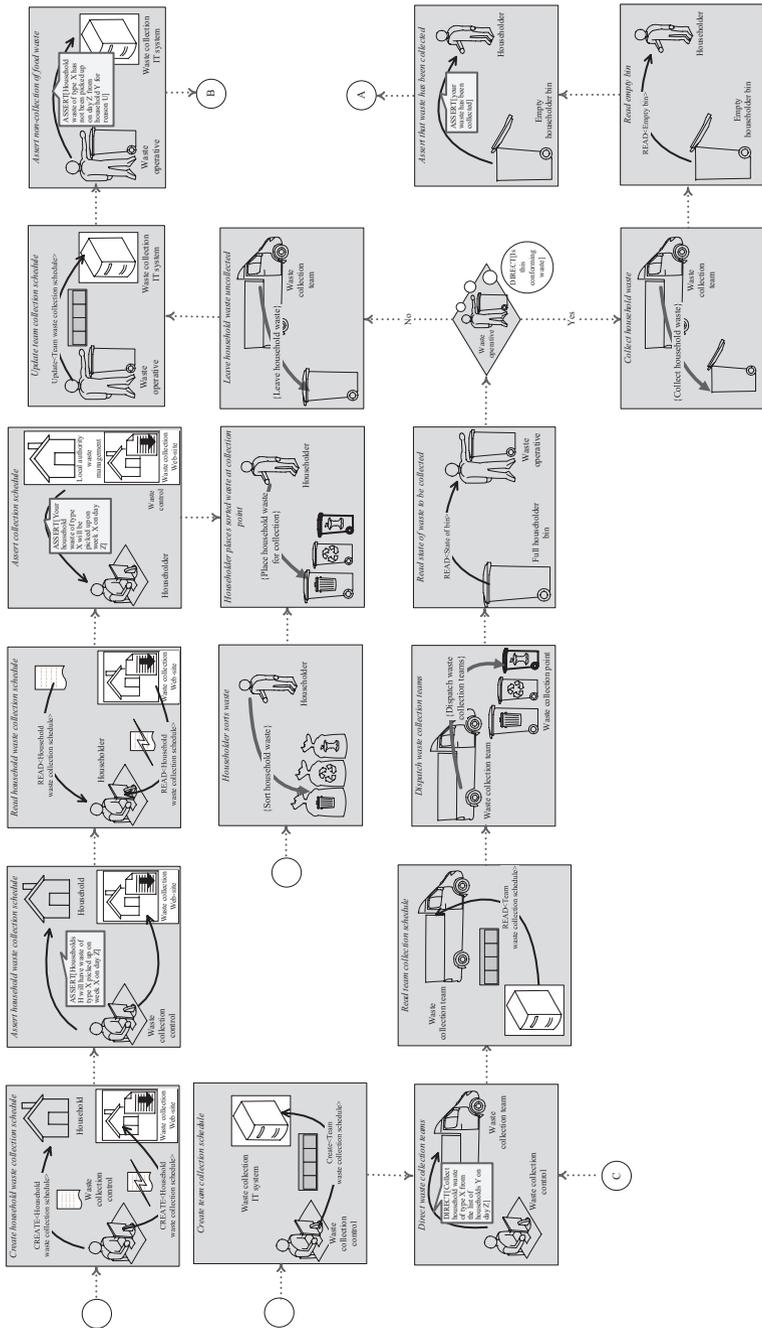
Fig. C8.1 Panel 1 of the integrated comic for household waste collection
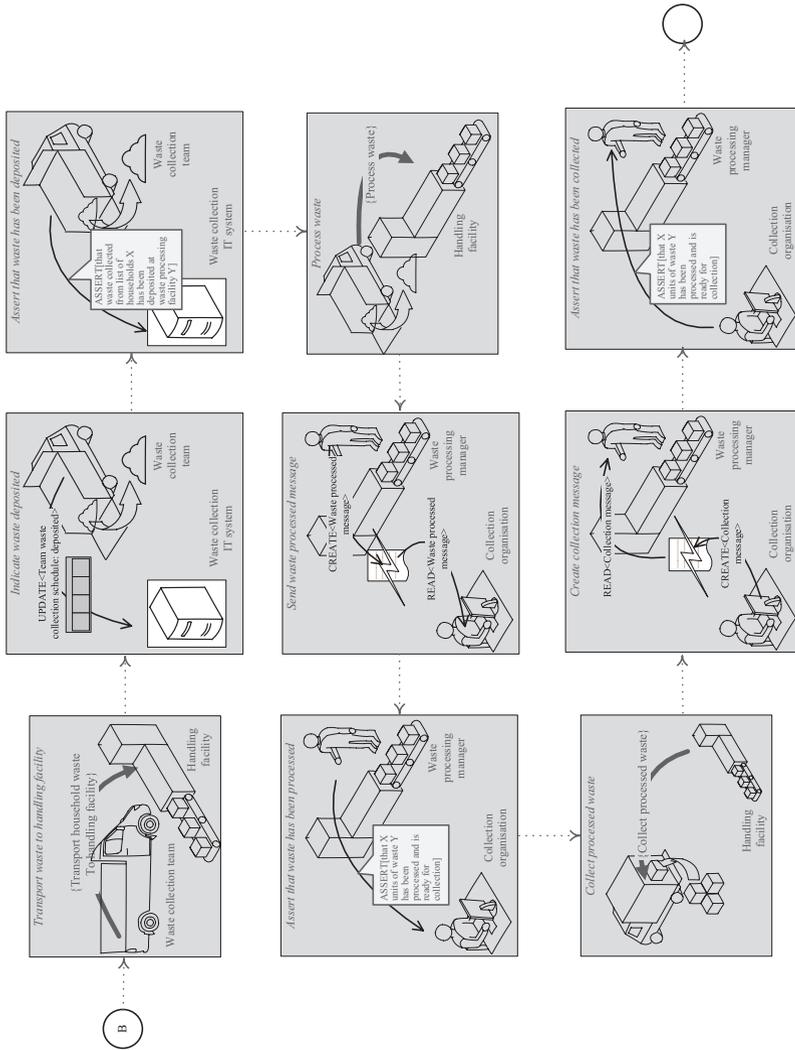
Fig. C8.2 Panel 2 of the integrated comic for household waste collection
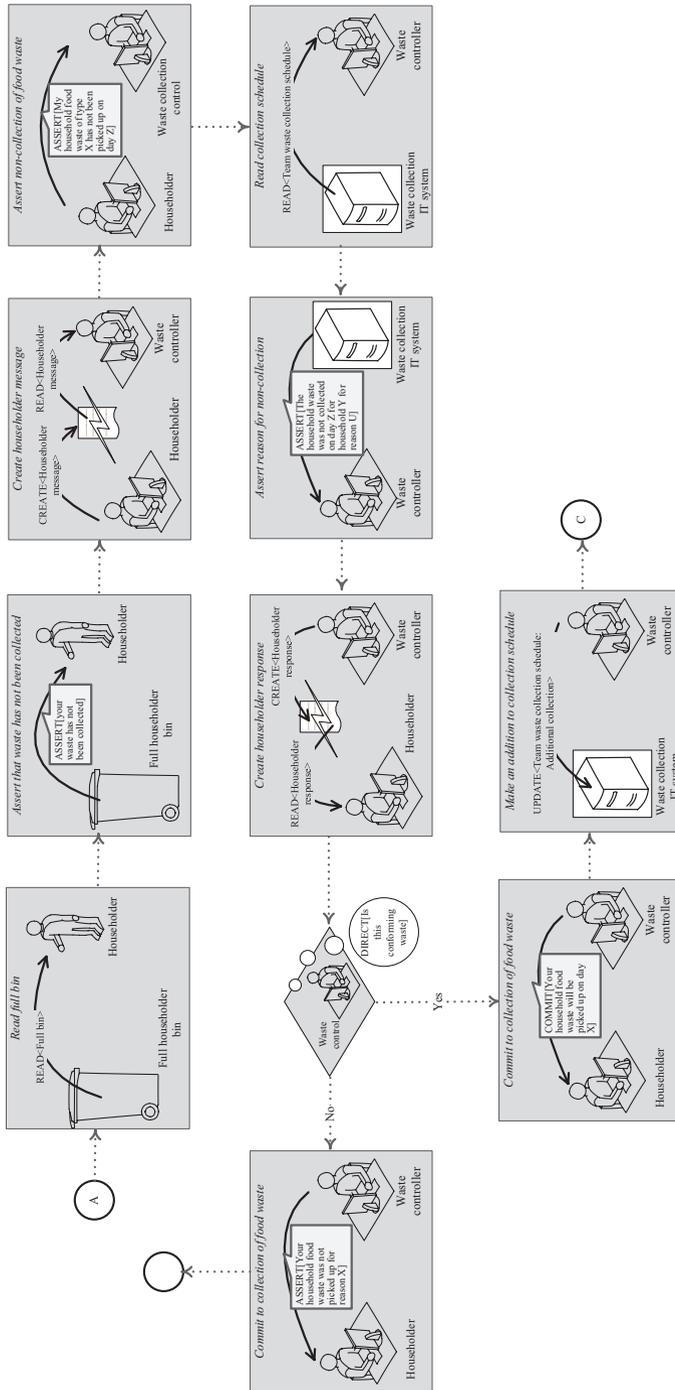
Fig. C8.3 Panel 3 of the integrated comic for household waste collection

determine who has the virus, tracking the spread of the disease amongst a population and tracing those people who are likely to be infected. But this activity system touches upon many of the issues surrounding data and data structures discussed in this book. The development of mobile apps to aid in this process is also illustrative of not only the potentialities of such technology for articulating data but also the limitations of such technology in scaffolding activity.

Test, track and trace is a clear example of the way in which data is critical to action. Consider how this public health activity is traditionally done in a manual manner. A person shows symptoms of COVID-19, so they book a test online and from this a data structure is created with certain details recorded about the person such as his/her name, address, telephone number, age and whether he/she has any underlying health conditions. The person is either sent a home test kit or goes to a designated test centre to take a covid test. In either case, a new data structure is created which records details of the testing. After a couple of days this data structure is updated with the results of the test. This record asserts to a member of the testing service whether or not the test is positive. If a positive result is recorded then that person is referred on to the tracing service which is given access to this data structure. This data structure is used to initiate an interview by a contact tracer to find out who they have been in close contact with (someone they have been in close proximity with for 15 minutes or more in the last 48 hours). The contact details of such persons are then recorded in a further data structure. The tracer then works her way down through this list contacting each person in turn by phone. High-risk contacts are asked to self-isolate for 14 days. This data therefore effectively acts as a prohibition to such persons, namely, that they must self-isolate for a period of time to prevent further infections. If symptoms develop in this person then he/she in turn is required to book a covid test.

But note a key assumption of this activity system, namely that the person tested positive can remember all the persons they have been in close contact with over the last 48 hours. This might be easy in the cases of friends and relatives. But, what if they have taken a long train journey and been in close contact with a number of strangers.

Even if they know those with which they have been in contact, the system assumes that the person testing positive is willing to hand over details of persons. They may not wish to do so because of the potential for stigmatisation or loss of earnings to such persons.

For such reasons, many countries put faith in the development of mobile apps to help support this manual activity system of testing, tracing and tracking infection. Many such apps have been developed and the functionality of each is different. However two core designs emerged quite quickly in various parts of the world: one is based on a centralised model of data organisation; the other on a decentralised model.

The core functionality of such an app works in the following manner. When person A and person B meet, their mobile phones exchange a key code over a Bluetooth connection. When A becomes infected he updates his status in the app. In a centralised model the phone provides its own anonymised ID plus codes gathered from

other phones to a centralised database. The centralised system uses this database to do contact matching and risk analysis plus send alerts to the mobile phones of those contacted. In a de-centralised model the phone provides only the anonymised ID to the centralised database. The phone downloads data it needs, does contact matching and risk analysis and sends alerts to contacts itself.

Various version of such an app also include other functionality. Some apps include an alert function which informs them of the coronavirus risk level of an entered postcode area or an area in which the mobile is currently located. A QR scanner can be used to check in when they visit a venue and be told if others there later tested positive. A symptom-checking tool allows users to book a free test and get the results via app. A countdown function comes into effect if they are told to self-isolate, so users can keep track of how long to stay at home (Exercise C9.1).

Exercise C9.1
Develop an activity pattern from the description of test, track and trace. Identify in this pattern any potential areas of breakdown.

The key advantage of a de-centralised model is that it preserves the privacy of both the mobile phone user and all the contacts. On the downside, no aggregate data is gathered for use by health scientists and epidemiologists. This is useful in plotting the spread of the virus across the population. It is also impossible to learn from this system anything about the success of the app in the sense that no analysis can be made of the contribution the app makes to tracking and tracing of individuals (Exercise C9.2).

Exercise C9.2
Making assumptions about its core functionality, develop a communication pattern for a de-centralised model of the track and trace app. Then produce a pattern for a centralised model. Compare the two patterns and try to indicate upon the visualisations the advantages and disadvantages of each.

A Compendium of Business Analysis and Design Techniques

A compendium of magic tricks contained not only artefacts needed to conduct the tricks themselves. It also contained detailed instructions as to how to perform each trick. In much the same vein we present a compendium of the 'tricks of the trade' associated with the contemporary practices of business analysis and business design. The techniques are presented in alphabetical order with a brief description of what each technique involves. Each technique is also tagged in terms of whether it is covered in the book and in the International Institute of Business Analysis' *A Guide to the Business Analysis Body of Knowledge* (2005).

IIBA (2015). A guide to the business analysis body of knowledge. Toronto, Canada, International Institute of Business Analysis.

Techniques		IIBA	Book
A			
Action research	Action research is an approach to systematically evaluating interventions in some domain of organisation. Problems are identified, changes planned, the intervention made, and the intervention evaluated in terms of lessons not only for the organisation itself but for business analysis more generally.		■
Affinity mapping	This technique is particularly useful within problem setting and involves first identifying a range of issues that relate to a problem situation. The issues are then grouped or clustered together in terms of their affinity.		■
Ansoff's box	*See Ansoff's matrix.*		
Ansoff's matrix	Used as a tool for strategic analysis, this matrix plots existing and new products produced by an organisation against existing markets and new markets for these products. This helps Ansoff define four different growth strategies. Market penetration is where the firm seeks to increase its market share by selling more of its existing products in its current market. Market development involves targeting existing		

	products in new markets. Product development means creating new products for existing markets. Diversification involves creating new products for potential new markets.		

B

Balanced scorecard	This technique is particularly used to help define and manage performance within organisations. It suggests viewing an organisation from at least four different perspectives. The business process perspective focuses on internal processes and whether these are meeting targets set from the organisation mission. The customer perspective focuses on determining whether products and services as well as after-sale service produces satisfied customers. The financial perspective is the typical way of assessing performance in terms of profit and loss. Finally, the learning and growth perspective focuses on the potential of human capital to solve organisational problems.		
Benchmarking	Benchmarking is normally conducted to compare the strengths and weaknesses of some unit of organisation against some other comparable unit. For instance, a given production process might be analysed and compared to that used by a competitor.		
Benefits management	Benefits management, sometimes called benefits realisation or benefits realisation management is based upon the assumption that an investment in some change is only successful if the benefits stakeholders were hoping to get are actually realised. A benefit in this philosophy is a measurable change (an outcome) that has a positive impact upon some domain. Approaches to benefits management typically emphasise defining outcomes and how they are to be measured. Change is then planned on the basis of achieving outcomes. Once the change is implemented then it is reviewed against benefit measures.		
Boston box	A tool for strategic analysis, the Boston box is a matrix which on one dimension distinguishes		

	between high and low market share of and on the other dimension distinguishes between low and high rates of market growth. This matrix can be used to think about an organisation's business units, activities or products. For instance, a product would be considered as star if it is likely to command a high market share in a fast-growing market. A cash cow is a product which commands a high market share in a slow-growing market. A 'question mark' is a product that has a low-market share but in a fast-growing market. Finally, a 'dog' is a product which has a low market share in a slow-growing market.		
Brainstorming	Brainstorming is a technique applied on an individual or group level to find a solution to a specified problem. Creativity is encouraged through generating ideas in an open, spontaneous and free-form manner. Judgements about the relative value of ideas are deferred until after the brainstorming session is completed.		
Business event analysis	A process is typically seen as triggered by an event. Events may be external such customer orders a product or internal such as stock level reaching reorder level. Analysing the typical events that affect some process through techniques such as entity-life histories or use cases is therefore important.		
Business motivation model	The Business Motivation Model a modelling approach for strategic planning. This framework is produced by the Object Management Group (OMG) and essentially consists of a standardised vocabulary designed for expressing business plans (specifications for business models). A business plan is a specification for a business model. The declared aim of this modelling approach is to allow the clear tracking of the motivation or the reasons for the design of a particular business model. The aim is also to enable better alignment of business plans/models to ICT systems through the mediating concepts of business processes and rules.		

Business process modelling	Process modelling is the activity of specifying, usually visually the workings of some activity system. A popular technique is Business Process Modelling Notation (BPMN), which was developed by the Business Process Management Initiative and is now maintained by the Object Management Group. Its aim is to provide a standard notation that is readily understandable by a variety of business stakeholders, including business analysts who create and refine business processes, technical developers responsible for implementing the ICT systems they need, and business managers who manage and control them.
Business rules analysis	Business rules make up a substantial amount of the functionality of a commercial ICT system. Business rules implement a decision strategy within some process. Typically, such rules ensure that the data system remains an accurate reflection of its information system and activity system. Such rules are normally expressed as conditional expressions such as IF THEN rules.

C

Cashboxing	A cashbox is a variant of a timebox. Whereas a timebox defines a critical time-period for the development of products a cashbox defines a finite set of resources required for the development of products.
CATWOE	A way of defining Root definitions within the Soft Systems Method. Peter Checkland has suggested that most useful root definitions consist of six elements which make up the acronym CATWOE: Customers: the victims or beneficiaries of the transformation. Actors: those who would do the transformation. Transformation: the conversion of input to output. Worldview: the worldview which makes the transformation meaningful. Owners: those that could stop the

	transformation.		
	Environmental constraints: elements outside the system which it takes as given.		
Change lever	A key place within the organisation of a complex system where a small shift in one thing can produce big changes in every other thing making up the system. A small change in such a key part of some complex system may leverage a large effect on the performance of this system.		
Class diagram	Class diagrams are ways of visualising information models. UML adopts a standard notion for the drawing of classes, relationships and attributes.		
Clean rooms	The term clean room refers to a setting for a business analysis event such as an analysis workshop which is free from normal work distractions. As such, workshops are held at sites remote from the normal work environment.		
Constraints analysis	A constraint is something that imposes a limit or restriction on some aspect of the behaviour of a system. Analysing the set of constraints appropriate to some system can be a variant of business rules analysis.		
Context diagram	A context diagram is a top-level representation of some system using some techniques such as data-flow diagramming. It typically is used to express the central transformation of the system and its key inputs and outputs.		
Cost-benefit analysis	If an investment can be defined in terms of the costs incurred and the benefits accrued, then cost-benefit analysis is used to assess whether or not an investment is worth-while.		
Critical success factors	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.		
CRUD matrix	A CRUD matrix is typically used in association with other techniques such as a class diagram		

	and use case diagram. Classes from some domain are listed along one axis of the matrix while use cases are listed along the other axis. Each intersection on the matrix is then classified as Create, Read, Update or Delete.		
Cultural analysis	Cultural analysis is a way of thinking about an organisation's dominant culture. A culture is the set of behaviours expected in a social group. Some categorisation of the nature of culture is typically used for the purpose of cultural analysis such as Charles Handy's distinction between power, role, task or person cultures. Another approach is to think of culture as having a number of facets and classifying a particular organisation culture as lying somewhere along a number of dimensions which represent such facets. For instance, Hofstedte builds a number of cultural facets including individualism/collectivism, risk-taking/risk aversion, masculinity/femininity and equality/inequality.		
Customer journey mapping	See Journey mapping		
Customer resource life cycle	The customer resource life cycle is a sequence of 13 stages based around the customer's interaction with a 'resource'. A resource in this sense is a product and/or service delivered by an organisation: The customer establishes requirements, in the sense of how much of a resource is required. The customer details the attributes of the required resource. An appropriate supplier for the resource is selected. A quantity of the resource is ordered from the supplier. The customer authorises and pays for the resource; authority for the expenditure must be obtained and payment made. The customer acquires or takes possession of the resource. The customer verifies the acceptability of the resource before putting it to use. The resource is added to an existing inventory. The customer monitors to ensure that the resource remains acceptable while in inventory. If requirements change, it may be necessary to upgrade resources. It may prove necessary to maintain or repair a resource. The customer may transfer		

	or dispose of a resource. The customer accounts for the resource in the sense of monitoring where and how money is spent on resources.		

D

Data dictionary	A data dictionary is either a way of representing the elements of some information model or a way of representing elements of some data model. Rather than visualising such elements it represents each as a record within a data system.		
Data flow diagrams	A data flow diagram is a visualisation of an information system or ICT system in terms of sources or sinks which interact with the system, data flows which travel through the system, data stores which collect data and data process which transform data.		
Decision table/decision tree	A decision table or decision tree is a way of expressing a decision strategy. Decision tables lay the conditions of business rules along one axis and the actions along the other. Decision trees represent conditions as the branching nodes of a tree and actions as the leaf nodes of the tree.		
Desktop walkthrough			
Determinancy/ dependency diagram	A determinancy or dependency diagram is a way of visualising the functional dependencies between data items making up some data set. It is particularly used to help design data structures that can be shown to be free of maintenance anomalies.		
Document analysis	Using documents such as designs, reports, memos etc. as a useful resource for business investigation.		

E

Entity life history	Entity life histories are a way of thinking about		

	the sequence of events that impact upon a given entity or class. Such life histories are typically expressed as a decomposition of standard CRUD pattern – an entity is created once, read and updated many times and finally deleted.		
Entity-relationship diagram	Entity-relationship or Entity-relationship-attribute diagrams are ways of visualising information models. Typically, an E-R diagram differs from a class diagram in not using abstraction relationships such as generalisation and aggregation.		■
Estimation	Estimation involves measuring the likely cost or effort associated with a particular pattern of action. Estimation is particularly used to assess the likely costs associated with the whole of or a part of a new business model.		■
Ethnography	Ethnography is considered more a style of social investigation rather than a technique of business investigation. Much used particularly in anthropological research it typically involves intense periods of participation in the domain being investigated and recording of observations in detailed field notes.		

F

Feasibility analysis	A feasibility analysis or study is an attempt to determine whether the introduction of a new business model is achievable given organisational resources and constraints.		
Fishbone diagram	A fishbone diagram (sometimes known as an Ishikawa or cause-and-effect diagram) is used to organise the causes generated in some *root cause analysis*. The problem or effect under consideration is drawn as a box at the far right of the page. A horizontal arrow is then drawn across the page meeting with this box. This forms the central spine of the fishbone. Various categories of potential causes are then drawn as additional boxes linked to this central spine by diagonal lines. In terms of each category of cause the analyst may draw a series of primary, secondary and tertiary causes.		

Focus group	A focus group is a form of 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 are 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 to generating consensus views of something or some situation.		
Force-field analysis	Originally developed by Kurt Lewin, force-field analysis involves thinking through the forces or factors that influence some situation. Such forces may be either helping forces or hindering forces. Helping forces drive movement towards some goal whereas hindering forces block or constrain movement towards the goal.		
Formative evaluation	Formative evaluation involves assessing the shape of a business model within the process of business change itself		
Four-view model	A typical conception of where change is likely to need to be applied is in terms of organisation structure (roles, responsibilities and resources), processes, people and technology.		
Functional decomposition diagram	*See Process decomposition diagram*		
Functional requirements analysis	Functional requirements are expected features of some system. These may be established in a number of ways such as MoSCoW prioritisation.		

G

Gap analysis	Gap analysis is a variant of means – end analysis. The gap between some current situation and some desired situation is first determined. Then some plan is formulated, usually as a series of steps, to move an organisation from where ii is now to where it would like to be.		

H

Hothousing	Hothousing is an approach to problem-solving which involves an intensive period of study, analysis and design.

I

Impact analysis	Impact analysis is a systematic approach to assessing likely impacts of proposed changes to some domain of organisation. Any change is typically analysed in terms of intended consequences such impacts upon organisation structure or working practices. But change frequently generates unintended consequences such as changes to worker motivation or changes to relationships with external stakeholders.
Interviews	Interviews are probably the most used technique for business investigation and involve systematic conversations with stakeholders.
Investment appraisal	Investment appraisal is the process of formally assessing the worth of some investment. Typical investment appraisal techniques are payback period and return on investment.

J

Job analysis	When designing a new mode of organisation key decisions have to be made about what people should be doing and what machines should be doing. Decisions about what people should be doing are typically referred to as job or task analysis. This activity will involve thinking about the level of specialisation both in tasks and decision-making associated with a particular job and devising distinct strategies of rotation, enlargement, enrichment and group working.

Joint application development workshops	Joint application development workshops were developed as critical events in a philosophy known as participatory design. JAD is a team-based information gathering and analysis technique in which business users and developers come together in one or more facilitated workshops to focus on a particular problem.		
Joint requirements planning workshops	The conduct of a JAD meeting will change at different points in the lifecycle of a development. Early on in the lifecycle, JAD meetings deal with higher-level issues such as defining objectives, decomposing the domain under consideration into smaller units, defining boundaries and scope. In these meetings, participants begin to compile lists of assumptions, constraints, and issues. They also begin to target specific resources for the task such as people and equipment and construct timelines for the project. All this information is documented on flipchart paper which is then displayed around the walls of the meeting room. This form of JAD is frequently referred to as Joint Requirements Planning (JRP).		
Journey maps	A customer journey map is a timeline of key touchpoints, in which a touchpoint is a moment of interaction between the organisation and its customer. So, a touchpoint might involve face-to-face communication in a physical shop, chat via an online website or perhaps a mobile phone call. Although the term customer is used, normally the designer would consider key types of customer and develop personas of such types. Sometimes the satisfaction of each persona with a touchpoint will also be modelled.		■

K

Key performance indicators	A key performance indicator is a critical aspect of some performance management system. A KPI is typically a quantifiable measure used to compare actual performance against desired performance.		■

Kolb cycle	David Kolb argues that learning typically takes place in a four-stage cycle. Immediate or concrete experience (stage 1) provides the basis for observations and reflections (stage 2). These observations and reflections are assimilated and distilled into abstract concepts (stage 3) producing new implications for action which can be actively tested (stage 4). The active experimentation is likely to generate new experiences to initiate another cycle of learning.		

L

Learning cycle	*See Kolb cycle*		
Lessons learned process	This is a business analysis event such as a meeting or workshop called to compile and to document lessons 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. As such this process can be seen to be important to summative evaluation, or possibly even post-mortem evaluation.		
Levers of change	*See change lever*		
Lewin's change model	Kurt Lewin proposes that change management involves three phases of activity. The first stage involves breaking down or 'unfreezing' patterns of habitual action. The second phase involves designing new patterns of action. The third phase involves freezing or implementing new patterns of action into some domain.		

M

McKinsey's 7-S	Developed in the 1980s by Tom Peters and Robert Waterman who were working for McKinsey consulting at the time this models assumes that there are seven internal aspects of		

	any organisation that need to be aligned if it is to be successful. The three 'hard' elements are strategy, structure and systems. These are elements that are relatively easy to define and influence. Alongside, are four 'soft' elements comprising: shared values, skills, style and staff. Such elements are less easy to define and are influenced by culture.		
Mind maps	A mind map is a diagram which is used to represent the association between ideas relevant		
MoSCoW prioritisation	Such prioritisation is a way of dynamically managing the scope of a timebox or cashbox. Each product within such a 'container' is defined to be one of four possible types of product - Must haves, Should haves, Could haves and Won't haves. Must haves are products that satisfy the critical success factors for the project. Should haves are products that will directly benefit the business in a cost-effective way. Could haves are products that will not directly benefit the organisation but would be nice to have. Finally, won't haves are products that the organisation would like to have, but probably will not have.		
MOST analysis	MOST is an acronym which stands for mission, objectives, strategy and tactics. Mission establishes measures for achieving purpose. Objectives are specific goals that must be met to achieve mission. Strategy is the plan of action for meeting objectives. Tactics are the specific set of actions needed to execute strategy.		

N

Non-functional requirements analysis	Non-functional requirements are constraints set on the project. Determining such requirements is important to determining the feasibility of introducing a new business model.		

O

Observation	A technique of business investigation in which the business analyst records the patterns of action observed in actual situations.
Options identification	Options identification involves exploring the number of possible routes for addressing some business problem or issue. A shortlist of options may be generated by applying some other technique such as SWOT or PESTLE analysis.
Organisation chart	An organisation chart is typically used to illustrate the structure of roles, responsibilities and lines of reporting or communication in some domain of organisation.

P

Participation	A number of benefits arise from participation of representatives of stakeholder groups within a business analysis project. The major difference between stakeholder involvement and stakeholder participation relates to decision-making power. In stakeholder involvement representatives of stakeholder groups are typically consulted about the shape of the current business model or the design for a new business model but the final decision on the shape of such models is left in the hands of the business analyst. In stakeholder participation power is placed in the hands of the stakeholders themselves to make decisions about the direction analysis should take as well as the design of a new business model.
Pattern comics	This is a way of visualising patterns of action as storyboards and can be used as a means of communicating patterns both to design teams and to actors more generally.
Payback period	Payback is calculated on the basis of: Payback = Investment - cumulative benefit (cash inflow). It thus corresponds to the number of years it takes to pay off an initial investment.
Personas	A persona can be seen as a type of role defined by the designer to encapsulate the way in which a group of persons is likely to interact with an

	ICT system or react to a product. Personas are often considered characters in a story and have attitudes, goals and concerns which help define their motivations for taking particular actions in relation to artefacts.		██
PESTLE analysis	PESTLE analysis considers the environment of some system 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).		██
Porter's five forces	A framework for assessing competitive advantage which argues that a successful firm		
framework	shapes the structure of competition by influencing five primary forces that define the relationship between an organisation and economic actors.		
	Competitive structure of the industry. This really defines the relative power of competitors to determine things like the pricing policy in the economic environment.		
	Bargaining power of buyers. This highlights the degree to which customers have control over issues like pricing and quality of products and services.		
	Bargaining power of suppliers. This highlights the important position that suppliers play in in influencing organisational strategy.		
	Threat of new entrants. This refers to the ease with which new competitors may establish themselves within a particular market sector. From an alternative point of view, strategists frequently refer to the barriers of entry to a particular market, meaning the factors that have to be taken into account when breaking into particular market. For instance, the state of technological deployment in a particular market sector may make it difficult for new competitors to establish themselves.		
	Likelihood of substitutes. This refers to the degree of availability of alternative products and services in a particular market.		

Post-mortem evaluation	Assessing the reasons for some perceived failure in business change.		
Power/Impact grid	A variant of the power/interest grid which is used particularly to help inform change management. Impact here is usually defined in terms of the impact of change upon the work of the stakeholder group in question.		
Power/Interest grid	A technique for stakeholder management which attempts to place a particular stakeholder group in a 2 by 2 matrix. On one axis stakeholder are classed as having high or low power in relation to their ability to influence change in some domain. On the other axis such stakeholders are classed as having high or low interest in the results of some business analysis project. Those in the high power/ high interest grid need to be managed actively and will need to participate in decision-making. Those in the high power/low interest will need to be kept satisfied and those in the low power/high interest grid will need to be informed and possibly be consulted on developments. Those in the low power/interest grid can be ignored.		
Process decomposition diagram	A way of visually representing the principles of system hierarchy in terms of some particular process. In other words, we decompose a process into its constituent activities. For each activity we decompose it into its constituent tasks.		
Prototyping	The use of the word prototype tends to suggest the tentative nature of this artefact. It is early, unfinished or a model of something. Frequently to gain some idea of what is required it is better to build something and get a reaction rather than investigating using techniques such as interviews or observation. Prototypes may be low-technology mock-ups such as models drawn on flipcharts. They may also be high-technology early realisations of systems.		

R

RACI matrix	Sometimes referred to as a *responsibility assignment matrix*, this technique is used particularly to think about the ways in which stakeholders need to participate or be involved in some business analysis project. Stakeholders are thought of as having one of four different types of responsibility in relation to the action evident in some domain. A stakeholder is *responsible* (R) for the performance of some activity if the stakeholder has to engage in work to complete the activity. A stakeholder is *accountable* (A) if it is ultimately answerable for the correct and thorough completion of the specified activity. A stakeholder is *consulted* (C) if it is necessary to seek its opinion on the exercise of some activity. In other words, two-way communication needs to occur with people fulfilling this type of role. Finally, a role is *informed* (I) if he or she needs to be kept informed of the progress or performance of some activity.		■
Record sampling/analysis	The records maintained by some existing data system are sometimes a good resource for investigation. Often a sample of such records is taken for inspection and analysis.		■
Report analysis	The reports generated by the existing ICT systems within some domain are often a good resource for business investigation.		■
Requirements management	A term frequently used to refer to both requirements elicitation and requirements representation.		
Requirements traceability matrix	This is an instrument used to establish clear linkages between initial established requirements and the products of some business analysis project.		
Requirements validation	The process of validating requirements represented for some domain with influential stakeholders.		
Rich pictures	A rich picture is a visualisation of some problem situation. They are deliberately loose or informal. There is no standard notation for rich pictures: it is up to the modeller. Instead,		■

	such visualisations attempt to capture the essence of a complex situation within which some stakeholders perceive a problem, and some form of business analysis work needs to take place.		■
Risk analysis	Risk is involved in all business analysis projects and can be defined as the probability of some negative outcome occurring. Risk analysis involves: Risk identification: generating a checklist of risks for a particular project. Risk estimation: assessing the likelihood or probability of a risk occurring and determining its likely impact. Risk assessment: prioritising risks and planning how to avoid or monitor them.		
Role analysis Role mapping	A series of activities involved in analysing and documenting the set of requirements for the new roles associated with a new business model.		■
Role playing			■
Root definition	A root definition expresses the ideas that stakeholders hold of a particular activity system. A root definition expresses the core purpose of an activity system, in terms of the classic input–process–output model of a system.		■
Root cause analysis	Root cause analysis is an attempt to both identify and usually to visualise the underlying causes of a particular problem. The results of root cause analysis are typically represented using a fishbone diagram.		

S

SARAH modelling	SARAH is an acronym used to describe the series of stages people typically go through when experiencing change. The acronym stands for Shock, Anger, Rejection, Acceptance and Hope.		

Scenario	Scenarios normally consist of key situations or episodes in the activity of people working with ICT systems. The emphasis in a scenario is on concrete representation of use rather than abstraction of use. The focus is on specific instances of use in a particular work context.		■
Serious play			■
Service blueprints			■
Shadowing	Shadowing is an approach to either observation or participation in which the analyst either follows around and observes a worker performing a set of tasks or actually participates in those tasks.		■
Stakeholder analysis	Stakeholder analysis involves analysing the types of and impact of stakeholders on exercises in business analysis.		■
Stakeholder map/ping	A stakeholder map is a tool utilised within stakeholder management. It lists for each stakeholder the relevant details needed to inform the conduct of a business analysis project such as the name of the group, it's power or influence, it's level of interest in the work of some business analysis project, it's likely attitudes to change, etc.		■
Stakeholder nomination/selection	Identifying a group of people which should be involved or participate in a business analysis project.		■
Stakeholder wheel	The stakeholder wheel is a way of categorising different types of stakeholders that may influence the trajectory of a business analysis project. Types on the wheel include customers, partners, suppliers, regulators, employees, managers, owners and competitors.		■
State transition diagram	A state transition diagram models the sequence of states that some object moves through during its life. The paths between states are known as transitions.	■	
STEEPLE analysis	An extended form of PESTLE analysis which adds ethics to the consideration.		■

Storyboarding	Storyboarding is a technique which attempts to visualise in a free-form way the pattern of action necessary to conduct some task such as navigating through a website.		■
Strategic evaluation	This type of evaluation involves assessing or appraising an investment in socio-technical change.		■
STROBE	STROBE stands for Structured Observation of Behaviour. The idea is to approach observation in a structured manner by using a pre-established checklist to look for particular behaviours.		
Structured walkthroughs	The idea here is to sit down with some stakeholder and run through the steps required to achieve some task. This may be an existing pattern of action or an envisaged package of action.		■
Summative evaluation	Summative evaluation involves returning to the costs and benefits established in strategic evaluation after a period of use.		■
Survey	A survey in an investigation technique in which some instrument such as a questionnaire is administered to a sample of people.	■	
Swimlane diagrams	A swim lane is a visual element of a diagram such as a process flow diagram which highlights a particular collection of activities as a group.	■	
SWOT analysis	This is a technique for environmental analysis which requires the analyst to think of the strengths, weaknesses, opportunities and threats associated with some problem situation.	■	■

T

Tabletop prototyping	A tabletop prototype involves positioning various icons on a tabletop to represent various patterns of action. A tabletop prototype involves positioning various icons on a tabletop to represent various patterns of action. It can be used as a means of documenting analysis of existing patterns of action or specifying the design for a new system of action.		

Thomas-Kilman Conflict modelling	A technique for resolving conflict, particularly in the workplace. It allows individuals to classify themselves in terms of the likely style they take to conflict situations. Individuals are classed as competitive, collaborative, compromising, accommodating, or avoiding. Knowing a person's likely conflict stance will help in determining the best approach to resolve conflict.		
Three-view model	*See Four-view model.*		
Timeboxing	A deliverable is a part of some business analysis project that the team agree to demonstrate to representatives of relevant stakeholder groups at a review session. A deliverable is normally expressed in terms of what the new business model will do. A timebox is an agreed period of time for the production of a deliverable and is normally expressed as a fixed deadline. The timebox is never changed once established but the definition of the deliverable may be adjusted within a particular timebox.		
TOWS analysis	A variant on a SWOT analysis in which Threats and Opportunities are examined first.		

U

Use case diagram	A use case model provides a high-level description of major user interactions with an ICT system. It is normally expressed as a diagram and uses two constructs, actors and use cases. An actor within this technique is any person, organisation or system that interacts with an information system. A use case is a delimited set of activities that collectively form an important element of the functionality of the system.		

V

Value-chain analysis	This is a technique which requires the analyst to think of the internal activities that are involved in creating value and how these inter-relate.		

Value-network analysis	Value-network analysis is an extension of value-chain analysis which focuses on 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.		
Value-proposition analysis	A value-proposition is a customer perspective on some domain of organisation. Value-proposition analysis is an attempt to summarise why customers use certain organisations or why they consume the value generated by competitors.		
Value-stream mapping	A technique particularly utilised within lean thinking. The value-stream is a sequence of activities required to design, produce and provide a specific good or service to a customer. The objective of lean thinking is to identify within this value-stream those activities which add value and eliminate those activities which generate waste in terms of measures such as the time and effort to do things.		
Vendor assessment	The process of systematically assessing some provider of a product or service in terms of criteria such as knowledge, expertise, reputation, terms of provision and stability.		
VMOST analysis	VMOST is an acronym which stands for vision, mission, objectives, strategy and tactics. Vision defines an organisation's purpose. Mission establishes measures for achieving purpose. Objectives are specific goals that must be met to achieve mission. Strategy is the plan of action for meeting objectives. Tactics are the specific set of actions needed to execute strategy.		
VOCATE	A variant on the idea of CATWOE as a means of defining a Root definition. VOCATE is an acronym which stands for Viewpoint, Owner, Customer, Actor, Transformation and Environment.		

W

Washup sessions	Within intensive agile projects, a meeting is usually scheduled for the end of each working day and to which all team members must attend - referred to as a 'wash-up'. The purpose is to ensure that all team members are aware of progress against the plan. The meeting can also be used to schedule the next day's activities and to document any new requirements that have arisen in the course of the days' work.
Work analysis	In the design sense this can be seen as a variant of job or role analysis. Rather than starting from individual actors and working towards a specification of what they should do, work analysis uses some idea of what actions are required and then seeks to assign these actions to particular human or machine actors. In the analysis sense, work analysis frequently means some attempt to assess the performance of a specific collection of existing tasks.
Workshops	A workshop is a business analysis event in which analysts and representatives of stakeholder groups gather together in a period of intensive work to work through a particular problem or issue.
Workflow diagram	Workflow has many similarities with the ideas of process and activity system. A workflow diagram is a form of flowchart which depicts the flow of tasks from one person to another in some domain of organisation.

Glossary

A

Act of articulation An act of manipulating some data structure, data element or data item.

Action perspective The perspective on organisation that considers it as a collection of actors undertaking action.

Activity system An inter-related set of patterns of coordinated activity.

Actor Any human, animal or machine that can act.

Aggregation An aggregation relationship occurs between a whole and its parts. An aggregation is an abstraction in which a relationship between objects is considered a higher level object.

Appreciative system An interconnected set of largely tacit standards of judgement by which we both order and value our experience.

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.

Assertive *Assertives* are communicative acts that explain how things are in some domain being communicated about.

Association Two classes are associated if some instances of one class are related to certain instances of the other class.

Attribute A property of an information class. *See data item*.

Attribution Attribution is the process of defining a class in terms of its attributes.

B

Business analysis The activity of making sense of some existing or proposed domain of organisation.

Business analyst The person conducting business analysis.

Business design The activity of specifying change to some existing domain of organisation or specifying new ways of organising.

Business domain *See domain of organisation*.

Business model A business model is a way of expressing the core design for some value-creating system. A business model expresses the coupling of articulation, communication and coordination within domain of organisation.

Business modelling The process of building a business model of some domain

Business sign Some thing that stands to somebody for some other thing. A thing of significance to actors within some domain of organisation.

Business significance The process of sign-use (semiosis) within some business domain.

C

Category A category is a chunking of the world, similar to the notion of a *class* or information class.

Class Also known as an information class. A description of the properties of a thing of interest to some domain or organisation. Classes make up the content of communicative acts.

Classification The process of defining instances of some information class.

Clay token A type of data structure used in ancient Sumeria consisting of a small piece of shaped baked clay, sometimes incised with markings.

Coding The proces of using modulation to construct symbols of some message.

Comics A verbal and pictorial representation genre consisting of a panel of visualisation cells.

Commissive *Commissives* are communicative acts that commit the sender of some message to some future course of action.

Communication The process of enacting communicative or informative acts.

Communicative act An act of communication between two or more actors. A communicative act is undertaken with some intent and aims to transmit some content.

Complex adaptive system A system of organised complexity which is open to its environment and continuously must adapt to its environment.

Concept That part of the sign representing the idea of significance.

Consumption The process of using some value.

Control The process by which a system sustains itself and adapts to its environment.

Convention A pattern of action which continues to be undertaken purely because of the weight of precedent.

Coordination The process by which multiple actors achieve joint action in fulfilment of some goal.

Coordination problem A problem of achieving coordinated action.

Coupling The way in which various types of actions are bound together. Acts of articulation are coupled to acts of communication which in turn are coupled to acts of communication.

D

Data A set of differences made in some substance.
Data element Part of some data structure.
Data item Part of some data element.
Data pattern A coherent set of acts of articulation, including sequences and cycles.
Data structure A form for organising data.
Data system An inter-related set of patterns of articulation.
Decision-making The act of choosing between alternative courses of action.
Declarative *Declaratives* are communicative acts that aim to change aspects of or the state of some domain through the communication itself.
Design comic *See Pattern comic.*
Directive *Directives* are communicative acts that represent the senders' attempt to get the receiver of a message to perform or take some action.
Distribution The movement of value from one actor to another.
Domain of organisation Some delimited segment of socio-technical organisation being focussed upon by a particular business analysis and design exercise.
Dramaturgical perspective A perspective within sociology which exploits the analogy between human social behaviour and drama, or more precisely dramatic performance.

E

Effectiveness Measuring the contribution some pattern of action is making to the wider system of organisation.
Efficacy Measuring whether a system does what it is designed to do.
Efficiency Measuring whether a system does something with the minimum use of resource.
Emergence The idea that the properties of the whole of the system arise from the interaction of its parts. In terms of domains of organisation that the structure of a socio-technical system emerges from the continuous action of this system.
Entanglement The way in which articulation, communication and coordination are coupled in practice.
Entity *See class.*
Evaluation The process of assessing the worth of something.
Expressive *Expressives* are communicative acts that represent the speakers' psychological state, feelings or emotions.

G

Generalisation Generalisation is the process of extracting common features from a group of object classes and suppressing the detailed differences between object classes. Generalisation allows us to declare certain object classes as sub-classes of other object classes.

I

Information pattern An inter-related sequence of acts of communication.
Information system An inter-related set of information patterns.
Informative system *See information system.*
Instantiation When we value a class with an instance we instantiate the class.
Institutional perspective That perspective on organisation which considers organisations as entities independent of the humans participating within them.
Intension *See concept.*
Intention The aboutness of some action. Every act is undertaken with some intention in mind.

K

Khipu An Inkan artefact consisting of an assemblage of knotted string.
Khipucamyuq The keeper of the khipus—a specialist creator and reader of the khipus.

M

Model An abstraction of some domain.
Modelling The process of building abstractions to aid understanding and communication.
Modulation The process of introducing variety (differences) into some signal.
Motivation model A documented set of reasons for moving from one business model to another.

O

Ontology An organised and symbolic representation of some domain.
Organisation The patterned order evident in some domain of human and machine action.
Organisational routine Similar in nature to an activity pattern or system. A repetitive pattern of coordinated action.

P

Pattern A repeating occurrence of some phenomena.
Pattern comic A representation using comics for analysis and design purposes.
Performance As a verb it denotes the process of undertaking acts. As a noun it denotes the measurement of some pattern or system in terms of defined goals.
Problem situation A term used to describe a domain of organisation that is considered problematic in some way and hence ripe for change.
Production The creation of value.
Project A project is an activity system established for a finite period to achieve a specified series of goals.
Purpose The goal of some system.

R

Referent The real-world thing referred to by the sign.
Relationship A link between two information classes.
Role A package of expectations as to the action appropriate to some type of actor. A resource used by actors to guide action.
Routine *See organisational routine*.

S

Semiotics The study of signs.
Sign A sign is some thing that stands to somebody for some other thing.
Significant pattern A pattern treated as significant within some domain such as an activity, information or data pattern.
Sign-system An organised collection of signs.

Socio-technical 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).

Specialisation The opposite of *generalisation* is specialisation. Specialisation is the process of creating a new information class by introducing additional detail to the description of an existing class.

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.

Structuration The process by which organisation is constituted through action and acts as a resource for action.

Symbol Another term for a data item.

System An entity of patterned order.

Systemics The study of systems. Sometimes referred to as systems theory.

T

Tacit knowledge Tacit knowledge is the ability of human beings to perform skills without being able to articulate how they do them.

To-be model A model of how things will be within some domain of organisation. An as-if model selected for implementation as a new business model.

V

Value Any material or immaterial thing treated as of worth by some community of actors.

Value-chain The inter-related set of activities of the produce value for the customer of some organisation.

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

Value-network The wider network of actors with which the organisation interacts.

Value-stream A sequence of activities required to design, produce and provide a specific good or service to a customer.

Variety The term *variety* is used by systems theorists to refer to the maximum number of possible states a system may be in.

Vision statement A short list of statements as to future intention.

W

Worldview A particular perspective held about some business domain by a particular group of actors, sometimes referred to as stakeholders.

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