Part I

Introduction

Chapter 1

The Management of Construction Projects

1.1 Introduction

'Between the idea
And the reality....
Between the conception
And the creation....
Falls the Shadow'

One of the principal ways in which modern societies generate new value is through projects which create physical assets that can then be exploited to achieve social and economic ends – factories for manufacturing goods, offices and shops for delivering services, hospitals for health care, and tunnels for transport. Societies even create assets that are exploited for largely symbolic purposes, such as opera houses and cathedrals. In a typical modern society, around half of all physical asset creation (fixed capital formation) is the responsibility of the construction industry, thereby generating around 10% of national wealth (gross domestic product). These figures are much higher for rapidly developing countries. The creation of these assets is the principal force in the dynamics of cities and change in the built environment and, therefore, one of the major sources of social and economic change. This book is about how such assets are created effectively and efficiently so that they meet the needs of the clients which make the investments, thereby providing a net gain to the economy and society for which they are created.

The creation of new values is not an easy mission – as the liberties taken with T.S. Eliot's *The Hollow Men* in the epigraph above are intended to capture. Many problems have to be solved between the initial idea for a new asset, through its realisation on site, to the client starting to exploit it. This book covers the whole of this process as a progressive reduction of uncertainty through time. In other words, it argues that the problem of managing con-

struction projects is principally a problem in the management of information and its progressive embodiment in a physical asset. As one director of a leading European construction corporation put it, 'HBG's core competence is the generation and management of information'[1]. The book will, thereby, shine a penetrating light into the shadow between the conception of a constructed asset and its physical creation.

The book is not aimed at any particular professional group within the construction industry, rather it is aimed at all those whose working life is committed to the creation of constructed assets – at all professional groups. These include the representatives of the clients who provide the capital; the designers who turn ideas into specifications; the constructors who turn specifications into reality on site; as well as those who manage and regulate that process overall on behalf of the client and society. Creating new value through construction projects is an inherently collaborative process, and all have their specialist skills to deploy. The central premise of this book is that those specialisms can be deployed more effectively in the context of an understanding of the process as a whole. Thus, one of the most important measures of the success of this book will be the extent to which it helps in the creation of a common language for discussing the management of construction projects between different professional groups. While the perspectives and terminology used in this book may be a little unfamiliar at times, this is because the book is deliberately written from a perspective of the total process, rather than the contribution of any one professional group to it.

More specifically, the objectives of this book are:

- To provide a total project perspective on the management of construction projects from inception to completion;
- To apply business process analysis to the management of projects;
- To define basic principles of construction project management which will allow readers to apply those principles to their particular management problems;
- To review and synthesise the large number of different tools and techniques proposed for improving construction performance, from risk management and value management, through to supply chain management and quality assurance;
- To place the use of information and communication technologies (ICTs) at the heart of the construction project management process.

In achieving these objectives, the book will provide a holistic perspective that will allow practitioners and more advanced students to place their particular specialisms – be it risk management, design management or site management – in the broader context of the project process as a whole. The sheer variety of

proposed ways of improving the performance of the construction process can be daunting, even for the most enthusiastic practitioner. By placing all these different initiatives in the context of the total project process, and by articulating basic principles of good management rather than the latest fads, this book will provide help in sorting good practice from fashionable practice.

1.2 Projects as the creation of new value

All modern societies and economies are dynamic – the only certainty is change. Many of these changes are the result of unforeseen interactions of complex forces, but societies also change through deliberate action, and one of the most important forms of deliberate action is to invest in physical assets which can then be exploited to provide the goods, services and symbols that society needs. Governments invest in schools to provide education services, and bridges to provide transport services; firms invest in shops to provide retail services and houses to provide homes. Investments are also made in polluted and derelict industrial land to provide symbols of the future, as with the Millennium Dome and Village in London, and former free-fire zones to provide symbols of post-cold war reunification as with the Potzdammerplatz in Berlin. Cities change as shops are refurbished and new metros are built. Increasingly, these investments are made by partnerships of the public and private sectors. What all these investments have in common – whether directly for profit or not – is that they create something where there was nothing, create new assets to be exploited for private benefit and public good. It is in this sense that construction projects are about the creation of new value in society.

This dynamic is illustrated in Fig. 1.1. The fundamental inputs to the process are capital and human resources – capital resources to cover the costs of investment; human resources to transform ideas into reality. The return on capital from the process is the profits taken out of the process by the partici-

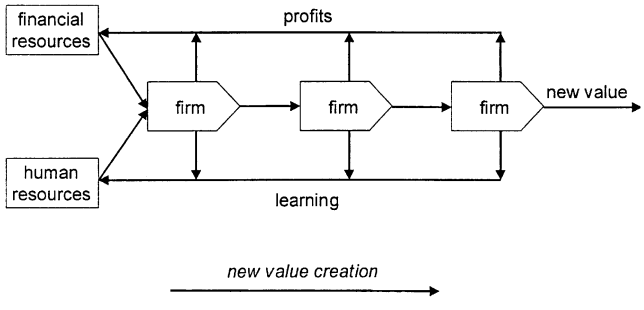

Fig. 1.1 Construction projects as the creation of new value.

pating firms. The return on human resources is the learning that takes place as problems are solved through the project life cycle. The effective achievement of both of these returns on the resources deployed in the creation of constructed assets is problematic – construction firms have low profitability compared to other sectors, and learning often stays with the individual, rather than being captured by the firm. As will be explored in Part IV, these two problems are linked.

1.3 The project as an information processing system

All organisations are, in essence, information processing systems[2]. In order to function they must monitor their environment, take decisions, communicate their intentions, and ensure that what they intended to happen does happen. In manufacturing organisations, these information flows generate and control flows of materials as well, but many service organisations are purely devoted to managing flows of information. Information flows are the heart of the business process in all organisations. These information flows are directed and enabled by the structure of the organisation, and the problem of management is the problem of continually shaping processes by manipulating the structure – what has been called the tectonic approach to organisation[3].

The analogy of a river is useful here. What is of interest in a river is the flow of water, which irrigates crops, provides a transport route, enables the generation of hydroelectric power and is a source of leisure and repose. Yet it is through altering the banks that we shape the flow – dams and weirs create lakes and power; dykes and canals control direction; docks and locks facilitate transport; bridges and tunnels mitigate the downside of the river as a barrier. The process – the flow of water – cannot be directly managed, we have to manage the context in which it flows. The same, I suggest, applies to organisations and their flows of information, and much of this book will be about how we manage the project process through managing the organisational context of projects.

The fundamental problem in the management of information is uncertainty; in other words, the lack of all the information required to take a decision at a given time. Figure 1.2 illustrates Jay Galbraith's definition of uncertainty as the difference between the information required for a decision, and the information available.

This uncertainty has two sources:

- *Complexity*, or the condition where the information is in principle available, but it is too costly or time-consuming to collect and analyse;

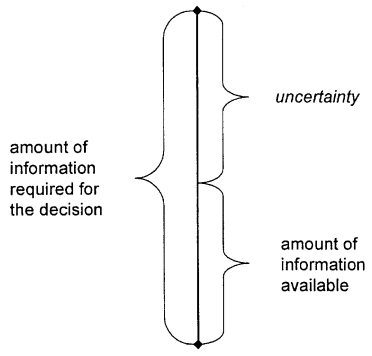

Fig. 1.2 The definition of uncertainty (Source: Galbraith (1977) Fig. 3.1).

- *Predictability*, or the condition where the past is not a reliable guide to the future – the future is, by definition, unknowable, but past experience is a valuable, if not infallible, guide to the future in many situations.

Where enough data are available to assign meaningful probabilities to the information required, then we can talk of risk rather than uncertainty.

At the inception stages of a construction project, uncertainty is very high – the asset of the future is little more than an idea and possibly a few sketches. How high depends upon a number of factors such as the extent to which the asset is a copy of ones existing; the extent to which standardised components and solutions can be used; and the extent of the requirement for new technologies to solve the particular problems posed by the project. This may be thought of as the level of *mission uncertainty* inherent in the project. As the project moves through the life cycle, uncertainty is reduced as more information becomes available – ambiguities in design are resolved; geotechnic surveys are completed; regulatory approval is obtained; component suppliers provide their shop drawings; and contractors successfully complete their tasks. The level of uncertainty at a particular point in the project life cycle relative to earlier and later points in the project life cycle may be thought of as the level of *dynamic uncertainty* on the project. This framework is illustrated in Fig. 1.3, which shows how uncertainty is progressively reduced through time until all the information required for the project is available at completion and embodied in the asset created. The area to the left of the s-curve represents information still to be acquired, i.e. uncertainty; that to the right represents what is known, i.e. certainty.

1.4 Project management and the management of projects

Construction projects have been 'managed' since time immemorial. Traditionally this was the responsibility of the 'master of the works' – a concept

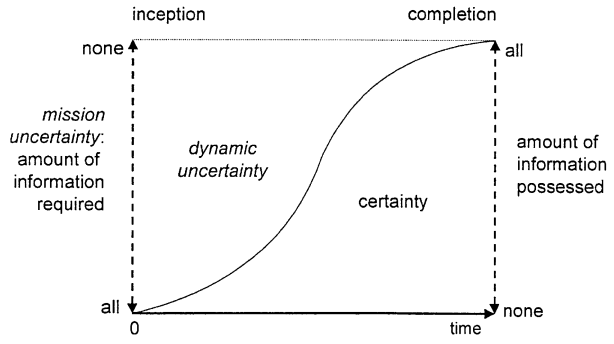

Fig. 1.3 The project process as the dynamic reduction of uncertainty through time.

retained in the modern French *maître d'œuvre* – but the emergence of a concept of 'project management' is a phenomenon of the twentieth century. It emerged as industrial societies started to build complex systems such as rail and power networks. It was adopted by the US aircraft industry in the 1920s, came to maturity in the US defence programme in the 1950s and gained international attention with the space programme in the 1960s. Project management is essentially an organisational innovation – the identification of a person or small team responsible for ensuring the effective delivery of the project mission for the client. However, it has become associated with a particular set of tools and techniques – most notably critical path analysis – which has stunted its development. As the concepts of project management diffused to the construction industry from the 1960s onwards, it was this toolbox, rather than the broader management concept, which was adopted[4].

Peter Morris argues strongly that project management is about the total process, not just about realising a specification to time, cost and quality. For this reason he distinguishes the 'management of projects' as a strategic approach from 'project management' as a toolbox approach to delivering the project mission. This book adopts Morris' perspective and argues for a holistic approach to managing the construction project. Effective management tools are vital – and will be discussed in detail in Part IV – but they are no substitute for a strategic overview of the process of realising a constructed asset, and skills in managing the disparate stakeholders in the project. However, this book is not just about the activities of the designated project management team, but about all those who are responsible for ensuring that the project mission is achieved – including project architects, site supervisors and contracts managers as well as client representatives. To be effective, the principles of the management of projects need to infuse the project process – construction project

managers cannot operate effectively as an external add-on harrying those responsible for actually adding value.

1.5 Projects and resource bases

Construction projects mobilise capital and human resources. The capital that finances the process comes from the client and its financiers. The human resources that enable the progressive reduction of uncertainty through time are supplied by the firms on the supply side of the construction industry, which act as skill containers for those resources. Resources of equipment are also typically supplied by firms in the construction industry. Components and materials are usually supplied by firms outside the construction industry, although some construction firms are vertically integrated backwards into frequently used sources of components such as pre-fabricated concrete elements, and materials such as aggregates. Our focus here will be on the mobilisation of human resources and specialist equipment.

Firms are different from projects – projects are temporary organisations with no autonomous capability. They rely entirely on mobilising the resources supplied by clients and the firms in the construction industry for their existence. Each project requires a large number of different types of human and equipment resources which are held by the firms on the supply side; we can think of these as the *resource bases* of the construction industry. It is with these resource bases that the continuing capacity to create constructed assets lies. These groupings of resource bases are often called the project team. However, as will be explored in Part V, the numbers of people involved are, in practice, too large to be meaningfully called a team. Moreover, as will become clear – particularly in Parts II and III – all these different resource bases have different interests. We can more usefully think of these groupings of resource bases mobilised on the project as the *project coalition* which comes together around shared objectives so that each member can meet its individual objectives. One of the main reasons why interests differ is that most resources bases will be supplying resources to more than one project at once, and can find themselves juggling resources between projects. We can, therefore, most usefully think of projects as coalitions of resource bases, indicated by the vertical dimension in Fig. 1.4, and firms as participating in portfolios of projects, indicated by the horizontal dimension.

1.6 The five generic project processes

Business process analysis (BPA) has become increasingly influential in a number of industries – both in the re-engineering of business processes to maximise the benefits of ICT systems, and in the diffusion of lean thinking. Conceptually, there are important links between the notion of the management of projects as

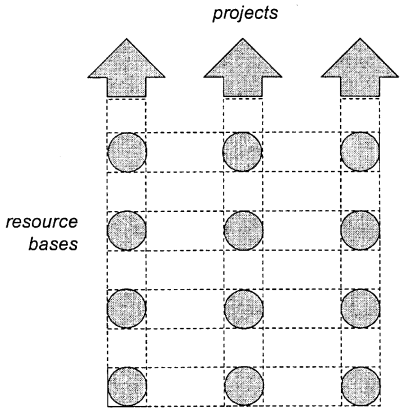

Fig. 1.4 Project organisation as a coalition of resources bases and a portfolio of projects (Source: developed from Fellows *et al.* (1983) Fig. 1.1).

the management of the total project life cycle and the development of BPA. This is clear from Thomas Davenport's formulation of a business process as 'a specific ordering of work activities across time and place, with a beginning, and end, and clearly identified inputs and outputs: a structure for action', and James Womack and Dan Jones' argument that the emergence of project management foreshadowed their own concepts of lean thinking. The concepts behind BPA and lean thinking are central to the agenda for change set out in the UK Construction Task Force's report, on *Rethinking Construction* – colloquially known as the Egan Report.

The approach adopted here to identifying the principal project process is that of BT[7] which identified five first order processes (Manage the Business; Manage People and Work; Serve the Customer; Run the Network; and Support the Business). Within these five, some 15 second-order business processes were identified. The structure of this book will draw upon a review of the body of empirical studies on the management of projects across the full range of project-orientated industries which identified five first order project processes[8] – defining the project mission; mobilising the resource base; riding the project life cycle; leading the project coalition; and maintaining the resource base. Within these five, a larger number of more focused business processes such as risk management, supply chain management and quality management will then be explored.

1.7 The plan of the book

Chapter 2 assesses the role of the socio-economic context of construction projects for their effective management. Different national construction

industries are organised to solve common problems in different ways. These differences have evolved over centuries, and have a profound effect on the ways in which projects are managed. While the principles explored in this book remain valid for all advanced societies, the details of their application will need to be adapted for specific national contexts. This chapter indicates some of the main points of variation. In conclusion, Chapter 17 explores the prospects for the development of the management of construction projects – suggesting how we might learn from other project-orientated sectors to mitigate our weaknesses, and how they might learn from our strengths.

The central chapters of the book follow the structure defined by the five generic project processes. Part II investigates the definition of the project mission – how do clients decide what they want, and how can members of the project coalition most effectively advise them on the full range of possibilities open to them? What tools are available for rapidly providing visualisations of the possibilities? How can all the different stakeholders be managed, some of which may be totally opposed to the project in principle? The outcome of this process defines the project mission, which allows the identification and mobilisation of the resource bases required for its realisation, discussed in Part III. How can such resources bases be selected and motivated, both those in direct contract with the client and those mobilised as sub-contractors?

Once the resources are in place, they have to be managed through time as they deliver on their commitments to the project. Thus Part IV covers the core tools and techniques of the management of construction projects, while placing them in a broader, strategic perspective. Part V switches attention to the more social aspects of the management of construction projects, exploring differences in the organisation of the project management function, and the importance of effective leadership and teamwork.

Readers may be puzzled as to why there is no explicit reference to ICT in this overview. This is because ICT is central to the information processing approach to organisations, not an optional extra. Discussions of the role of ICT are embedded in the discussions of the business processes on which it is deployed, although of course, at the present state of the art, ICT is of more use for a process such as information management than it is for stakeholder management, so the amount of discussion will vary. However, some specific issues around ICT are addressed in Chapter 14.

1.8 Relationship to the project management bodies of knowledge

The idea of the management of projects as an integrative approach to the creation of new value is rapidly diffusing. This is facilitated by the role organisations such as the International Project Management Association (IPMA),

and the Project Management Institute (PMI) are playing in the identification of the contribution that effective management of projects can make to business success, and the development of the competencies of project managers. As the basis for this development of these competencies, both the PMI and the (UK) Association for Project Management (APM), which is a member of IPMA, have developed bodies of knowledge, defining the areas in which a project manager should be competent. Table 1.1 shows how the contents of this book match the PMI Body of Knowledge (2001), while Table 1.2 a similar comparison for the APM Body of Knowledge (2000)[9].

Table 1.1 PMI Relationship to the PMBoK.

PMI PMBoK (2001) Area	Coverage in this book
Project Management Framework	Parts I and V
Project Management Context	Parts I, II and V
Project Management Process	Parts I and IV
Project Integration Management	Parts III and IV
Project Scope Management	Parts II and IV
Project Time Management	Part IV
Project Cost Management	Part IV
Project Quality Management	Part IV
Project Human Resource Management	Part V
Project Communications Management	Parts II and IV
Project Risk Management	Part IV
Project Procurement Management	Part III

Table 1.2 APM Relationship to the PMBoK.

APM PMBoK (2000) Area	Coverage in this book
General Project Management	Parts I and V
Strategic Project Management	Part II
Control Project Management	Part IV
Technical Project Management	Part IV
Commercial Project Management	Part II
Organisational Project Management	Part IV
People Project Management	Part IV

1.9 Summary

This chapter has laid out the information processing approach to the management of construction projects as the principal source of the creation of new value in modern societies that will be developed in this book. In order to give an early taste of how it fits together, Case 1 applies it to the construction of the Channel fixed link. However, before we move to developing the perspective

in detail, Chapter 2 sets out the factors in the context of construction projects which influence the ways in which they are managed.

Case 1
The Channel Fixed Link

The fixed link under the Channel/La Manche is one of the most challenging construction projects completed in the twentieth century. The range of challenges its project managers faced well illustrate the importance of taking a holistic approach to the management of construction projects. While the performance of the project on the traditional criteria of programme, budget and conformance to specification is superior to the majority of mega-projects (>US$ 500m), it was widely seen at the time of its opening in 1994 as a failure. However, the first six years of operation have convincingly demonstrated how successful the project was and is.

Defining the project mission was fraught. The completed project was the third attempt that had actually started tunnelling; the other two had been abandoned as key stakeholders lost commitment to the project due to economic and political pressures. The fear among the Eurotunnel project management team that this would happen again should Labour win the 1987 election led them to commence tunnelling – thereby sinking capital – before the design had been adequately developed, leading to some expensive design changes. Although the technical solution implemented had been developed in the 1950s, this focus on the technology led to serious errors in the definition of the project mission. Throughout the early phases, the mission was defined in terms of providing a tunnel as a challenging, but relatively well-defined, civil engineering problem. It was only around 1990 that it became clear that the true project mission was to provide an integrated transport system – a much more challenging systems engineering problem using many innovative technologies. This failure to define the mission properly led to inadequate attention being paid to the design of the mechanical and electrical services, procurement of the rolling stock and the commissioning of the system as a whole.

The *mobilisation of the resource base* also created serious – indeed show-stopping – management problems. The main problem was that the constructors – who formed the Transmanche-Link (TML) consortium – were also the promoters of the project. As a result, the construction contract was signed when their representatives were also on the client side. This generated enormous suspicion on the part of other stakeholders – most notably among the global banking consortia that were providing the capital – that the contract was biased towards the interests of TML. As a result Eurotunnel's project management team were obliged to play tough publicly with TML, and its chief executive

gained a ferocious reputation among TML managers. A related problem was the use of inappropriate contracts for different parts of the works. Only the tunnelling contract was incentive based; the contract of the rolling stock was a cost-plus one, and the fit-out and termini were on a lump sum. As might have been predicted, the cost-plus contract witnessed by far the largest percentage cost overruns, while the lump-sum contract was the focus of most of the crippling arguments between the stakeholders, which diverted attention away from actually delivering the project mission.

Against this context, *riding the project life cycle* was extremely difficult. Although sophisticated programme and budgetary management systems were in place, they could not be meaningfully used as management tools because of the continuing negotiations between TML and Eurotunnel. All was open to negotiation as the project coalition moved from one crisis to another. Programmes and budgets were typically set as the result of tense negotiations to justify outcomes, not to plan project realisation. Tools and techniques can only be effective for project management where appropriate organisational contexts exist for their implementation. Despite this, the project achieved outcomes that compare favourably with other major civil and petrochemical engineering projects around the world. Indeed, in one respect, the project performed better than the benchmarks – it worked. A high proportion of very large petrochemical facilities fail to meet their planned performance criteria, and the track record of the IT sector in delivering large systems is appalling. On the criteria of fitness for purpose and conformance to specification, the fixed link is a great success.

Leading the project coalition was extremely difficult, and overwhelmed more than one senior executive. Senior executives lost their jobs, marriages and nerves. On site, there were particular management problems in the early stages of the tunnelling on the British side as the TML member firms responsible failed to work together in a co-ordinated manner. This breakdown of managerial control led to lost lives, as well as to problems with the programme. Perhaps surprisingly, there were few intercultural problems between the British and the French. The relatively bureaucratic British approach with heavy reliance on systems and procedures contrasted with the more action-orientated French approach, but this did not appear to cause problems. What is most remarkable about the human resources deployed on the project is the extremely high level of commitment to the project, even as it entered its final commissioning stages.

The project also revealed some interesting differences in the French and British approaches to *maintaining the resource base*. Many have commented on the differences in style between the technocratic French engineers – the cream of the *grandes écoles* – and the much more pragmatic British engineers, which led to very different approaches to the management of the process, with the French

concerned to automate as much as possible. The French also used the project to train local workers in the skills required, and thereby inject resources into the local economy, while the British relied on traditional navvies recruited from far and wide, with no thought to developing the skill-base in the local economy, which was to suffer the loss of ferry-related employment.

The construction of the Channel fixed link was a remarkable adventure, mobilising massive resources and capturing the imagination of the world. On most criteria it was a very successful project, outperforming on budget and programme most other projects of a similar scale, and working almost perfectly once opened. Many of the management problems encountered were generated very early on during the definition of the project mission – the lack of clarity regarding the roles of different stakeholders led to mistrust; the inappropriate definition of the mission as a civil engineering project rather than an integrated transport system project led to lack of management attention to key elements of the mission; these problems in definition were compounded by errors in the mobilisation of the resources bases, and in combination, these made riding the project life cycle very difficult. Leading the project mission in this context became intense – too intense for some. The project also revealed very different approaches to maintaining the resource bases in the two countries involved.

Sources: Fetherston (1997); Winch (1996b); Winch (2000b); Winch *et al.* (2000).

Notes

1 Seminar, TU Delft, May 2000.
2 This is the central thrust of the major contributions to organisation theory of James March (Cyert and March 1963/1992; March and Simon 1958/1993), Herbert Simon (1947/1976), and, more recently, Jay Galbraith (1977). See Mintzberg (1979) for the broader context of this body of organisation theory.
3 See Winch (1994a) which reports on the co-ordination of the engineering/manufacturing interface in 15 UK engineering firms.
4 This critique is developed in Morris (1994); see also Giard and Midler (1993).
5 Davenport (1993, p. 5).
6 Womack and Jones (1995, p. 156).
7 Cited in Davenport (1993, chap. 2).
8 Winch (2000a).
9 See Morris (2001) for an overview of the development of these two bodies of knowledge.