1 Introduction

Between firms and markets

PROJECTS are becoming key to the growth, profitability and survival of the firm in an increasingly competitive and global business environment. Consultancy organisations, film makers, defence contractors, civil engineering companies, oil and gas producers, advertising agencies, and manufacturers of trains, aerospace and telecoms systems are all project businesses. They use projects to handle most of their internal needs as well as customer-facing activities such as product or process innovation, delivering major capital projects, promoting organisational renewal, and exploring new technology and market opportunities.

Today, firms in all types of industries are finding that traditional organisations, including functional departments, business units and divisions, are stifling innovation. Set up as permanent or semi-permanent structures, these organisational forms are suited to maintaining high-volume throughputs of standardised products and services and to making repetitive decisions in a relatively stable technological and market environment. But in a rapidly changing, uncertain and often turbulent environment, firms face many one-off opportunities and unique problems that cannot be dealt with easily by permanent or semi-permanent organisations. They are discovering that a one-off temporary problem or opportunity requires a one-off or temporary project organisation to resolve it.[1]

In contrast to the hierarchical and mechanistic management structures used in functional organisations, a project brings people together in an organic, adaptive and flatter structure (Bennis, 1966; Bennis and

[1] As Toffler pointed out, 'It is obviously inefficient to build a full, permanent structure to deal with a problem that will not be there after a fixed interval of time' (Toffler, 1985: 120). Indeed, as we show in this book, the project is able to counter the anti-innovation bias of the typical large firm departmental structure.

Slater, 1968) – or adhocracy, a term popularised by Alvin Toffler (1970) – that is able to innovate around specific customer needs in fast-changing conditions.[2] Whereas functional organisations focus inwardly on increasing performance by perfecting standardised processes and outputs, project structures focus outwardly on solving customer problems and encouraging innovation. Mintzberg (1983) recognised that the project form is used to organise new product development in consumer goods and appears repeatedly in the low-volume and highly customised production systems: 'A number of organisations are drawn to adhocracy because of the dynamic conditions that result from very frequent product change. The extreme case is the *unit producer*, the manufacturing firm that custom-makes each of its products to order, as in the case of the engineering company that produces prototypes ... [E]ach customer order constitutes a new project' (Mintzberg, 1983: 270, original emphasis). Building on the work of these early studies that drew attention to this new species of organisation (including Lawrence and Lorsch, 1967; Galbraith, 1973; Mintzberg, 1979 and 1983),[3] this book provides the first in-depth examination of the ways in which project businesses survive, compete, grow and transform themselves in today's dynamically changing technology and market conditions.

As the pace of change accelerates, some argue that the project is becoming 'the wave of the future in global business' (Pinto and Kharbanda, 1995). Project management and project modes of organising are used to cope with ever-increasing flows of new and more complex business opportunities and problems, rapid technological obsolescence, shortening product life cycles, and cross-functional

[2] Mintzberg (1983) showed that adhocracies refer to a whole spectrum of organisations, including space agencies, film companies, manufacturers of complex products, consultancy businesses, petrochemical producers, research-based organisations and non-commercial organisations like UNICEF.

[3] Although they do not specifically discuss project organisations, Burns and Stalker (1961) acknowledge that mechanistic forms of management used in functional organisations are appropriate for stable conditions, but emphasise that organic forms of management are better adapted to rapidly changing technology or commercial conditions. Following Mintzberg (1979 and 1983), many studies now use the term organic to describe the adaptive and responsive features of project structures. Woodward's (1965) classification of production systems is also used by Mintzberg and others to emphasise the importance of project-based activities in low-volume unit and small batch production.

product development.[4] The trend in recent years for large, vertically integrated firms to focus on their core business and to outsource non-core activities is creating opportunities for suppliers to provide individual solutions to each customer's outsourcing needs based on projects. Changes in government procurement policies, such as the UK's Private Finance Initiative (PFI) and Public–Private Partnership (PPP), are encouraging firms to take on the risks and responsibilities for performing long-term public projects, ranging from schools to large infrastructure projects like the Channel Tunnel. The result of all these various changes has been a proliferation in the number of projects and the range of project types. These include single- and multi-firm projects and programmes, national and international consortia and many other kinds of temporary problem-solving organisations. These are typically assembled for the time it takes to complete a particular episodic activity which can extend to several decades in the case of complex military weapons systems.

Internally, large firms are breaking themselves down into less bureaucratic, more adaptable and fluid project-based units (Lindkvist, 2004). They use projects in different ways to achieve organisational change, explore new market opportunities, develop whole new categories of product and solve complex or novel problems such as how to accelerate new product development and shorten times to market. When deployed effectively, projects provide a flexible, efficient and dynamic way of organising a firm's internal resources and capabilities around the needs and priorities of individual customers.

Increasingly, projects extend beyond the boundaries of the individual firm (Gann and Salter, 1998 and 2000; Grabher, 2002a). They include many organisations – such as systems integrators, customers, subsystem and component suppliers, software houses and consultants – working together in temporary coalitions or networks of firms, including strategic partnerships and alliances. Sometimes, large multi-firm projects are established for the sole purpose of delivering the entire range of technologies, products and services required to meet a single customer's business need. When the project ends, the organisation disbands. In this expanding middle ground between firms and markets, '*the actual operating unit becomes the business project enacted by a*

[4] The term cross-functional simply means combining different types of engineers, managers and marketing staff (and sometimes clients), usually to respond to fast-changing technologies and new customer needs.

network, rather than individual companies or formal groupings of companies' (Castells, 1996: 177, original emphasis).

The project business

There are many studies of project management as a technical and managerial discipline, specific types of projects (e.g. research and development) and project activities in particular sectors (e.g. information technology, cars, pharmaceuticals and construction).[5] However, as yet, there has been no book which deals with the *business* of projects. This book is the first to explore systematically the ways in which businesses use projects to drive business strategy and innovation. It goes beyond the traditional domain of project management to place projects centre stage in product and process innovation, strategy formulation and implementation, capability building and learning, organisational structure and design, and systems integration (the capability to combine diverse knowledge bases and physical components into a functioning system, such as an aircraft engine or a major e-commerce system).

The absence of a book on the business of projects is surprising. Although the evidence suggests that projects are becoming larger, more complex and increasingly widespread (Miller and Lessard, 2000; Flyvbjerg et al., 2003), they are not a new phenomenon. Many industries, such as aerospace, defence and business computing, have been organised along project lines since the 1940s and 1950s and the competitiveness of some of the world's largest global corporations – such as IBM, General Electric, HP, AT&T, Siemens and ABB – has long depended on their ability to conceive and execute major projects.

This book derives lessons for innovation and strategy from firms and industries that have been organised along project lines for several decades, namely high-value capital goods, which we call complex products and systems (CoPS), such as aircraft, defence systems, flight simulators, information technology (IT) systems, high-speed trains and telecoms networks. CoPS are designed and produced as one-offs or in

[5] These range from the early work of Baumgartner (1963) to Buttrick (2000). Also see Morris (1994) for a path-breaking book on why project management as a technical discipline is often inadequate in the real world of complex and changing circumstances. Clark and Wheelright (1992) and Clark and Fujimoto (1991) examine new product development teams in car manufacturing. For a theoretical approach see Stinchcombe and Heimer (1983).

small tailored batches to meet the requirements of large business or government customers. This vital category of low-volume and highly customised business-to-business activity has always been organised on a project basis. Indeed, early innovations in the project form and project management techniques were pioneered by the US defence industry in the middle of the twentieth century (Hughes, 1998). During the 1960s, such project innovations began to diffuse from the US military into the other industries (Gaddis, 1960; Middleton, 1967), such as telecoms and construction, and beyond into public-sector and other spheres of society (Morris, 1994).

Much can be learned from the histories of these pioneering firms and the experiences of today's CoPS suppliers by all types of firms that seek to master the challenge of managing innovation and achieving strategic advantage through projects. Many other firms and industries, such as consumer goods and services, are undertaking projects as a growing part of their research and development activities although their primary productive activity is volume-based or operations-oriented (Keegan and Turner, 2002). In some project-based firms and industries, such as professional services, film making, advertising and construction, the majority of the products and services produced are organised in projects (Gann and Salter, 1998 and 2000; DeFillippi and Arthur, 1998; Grabher, 2001).

In this book we use the term project business to refer to organisations – which may be entire firms or units within firms – that deploy projects to achieve major business objectives, including all firms which design and produce CoPS. These project businesses consist of a variety of organisational forms ranging from small projects conducted within a firm to large multi-firm alliances (e.g. the Channel Tunnel Rail Link consortium). The activities of a firm may be entirely project-based such as Bechtel and Arup in construction and Accenture and McKinsey in management consulting. But in many cases project businesses are individual departments, business units or divisions set up to supply CoPS within large diversified firms – such as General Electric, IBM and Nokia – which may also provide a range of mass-produced consumer goods and services.

The aim of this book

The aim of this book is to show how major international firms make a business out of projects. It does this by analysing concrete examples of innovation and business strategy in CoPS. The evidence presented is of

value to a wide business and academic audience and draws extensively from the field of innovation and technology management. This field is an increasingly important area of multi-disciplinary research and teaching which overlaps with business strategy, management and organisational studies as well as economic history and technology policy. Using detailed case study evidence, the book shows how and why the nature and dynamics of innovation in CoPS differ from non-project-based industries, especially standardised consumer goods and services produced in volume for mass consumption. It provides systematic guidance on business strategy and innovation management by explaining how firms deploy projects as part of an integrated corporate strategy to meet today's increasingly complex business problems and opportunities. The book introduces new concepts, frameworks and management tools, supported by empirical evidence, which account for successes and failures in project business practices. The aim is to show how firms can:

- respond strategically to opportunities to diversify into new technology and market positions through a process of project capability building, both within and beyond the firm's boundaries;
- improve company efficiency and effectiveness by capturing the learning and usable experience about successes and failures from one project and transferring them to subsequent projects and to the wider business organisation;
- select the appropriate project organisational form – which varies widely from pure project to matrix structures – to match the complexity, scale and novelty of the problem or opportunity;
- manage the wider business challenges and opportunities of developing software-intensive products and systems, performing systems integration and implementing strategies to move base into high-value service-intensive solutions.

What are complex products and systems?

CoPS are high-technology, high-value capital goods.[6] They are defined as high-cost, engineering- and software-intensive goods, systems,

[6] We use the term CoPS because the more conventional term capital goods fails to capture or convey the specific characteristics, diversity and importance of these products to modern economies. We recognise that while not all capital goods are complex, all of the products and systems discussed under the term CoPS in this book are capital goods. Throughout the book we use the term CoPS to distinguish

networks, infrastructure and engineering constructs and services, many of which are vital to industrial growth and the modern economy. Table 1.1 provides a list of CoPS produced in the UK and in other industrially advanced nations. As major items of fixed capital, CoPS underpin both the 'old' and 'new' economy and form the critical infrastructures that allow the flow of goods, services, energy, transportation, information and knowledge in both advanced and developing economies.

Our research shows that CoPS produced in the UK account for around 21 per cent of gross value added of manufacturing and construction, approximately £133 billion in output, and roughly 1.4 million in employment (Acha et al., 2004). Although many are produced within the economy for domestic consumption, CoPS consistently account for around 15 per cent of international trade over the past 30 years or more (Hobday and Laursen, 2003). These project-based CoPS businesses represent a significant proportion of the gross value added of all advanced industrialised countries and they are a major source of competitive advantage. However, the competitive advantage enjoyed by the advanced OECD (Organisation for Economic Cooperation and Development) countries over other parts of the world, including the rapidly developing East and South East Asian economies, cannot be taken for granted. Japan, Korea, China and others are making huge efforts to master the development and production of high-technology CoPS such as high-speed trains, intelligent buildings, aircraft and third-generation mobile communications because they are essential to their future growth.

In the UK, recent changes in government policy (e.g. PFI, PPP and smart procurement) have raised awareness of the importance of large capital projects and the CoPS which underpin them. However, recent high-profile project failures – such as the Swanwick air traffic control centre, the Channel Tunnel Rail Link, the UK passport issuing office, the London Ambulance Service, the London Stock Exchange and high-profile government IT and military projects – illustrate the difficulties involved in successfully managing project businesses and reveal the lack of business understanding and effective management tools in this area.

complex high-technology capital goods from standard, mass-produced consumer goods and routinely produced and low-technology capital goods.

*Table 1.1: Examples of complex products and systems**

Air-traffic control systems
Aircraft carriers
Aircraft engines
Armoured fighting vehicles
Avionics equipment
Baggage-handling systems
Banking automation systems
Base stations for mobile comms
Battleships
Bridges
Bulk carriers (ships)
Business information networks
Chemical plant
Clean rooms for semiconductors
Combined-cycle gas turbines
Cruise liners
Dams
Docks and harbours
Electricity network control systems
Electronic commerce systems (e.g. internet systems)
Electronic retail networks
Flexible manufacturing systems
Flight simulators
Frigates
Ground to air missile control units
Helicopters
High-speed trains
Hovercraft
Integrated mail-processing systems
Integrated tram systems
Intelligent buildings
Intelligent warehouses
Jet fighters
Mainframe computers
Maritime communication systems
Mine hunters (and other large military ships)
Missile systems
Nuclear decommissioning systems
Nuclear fusion research facilities
Nuclear power plant
Nuclear waste storage facilities
Ocean-drilling vessels
Offshore oil production platforms
Oil-refining equipment
Oil tankers
Passenger aircraft
Port loading/unloading systems
Process control systems for oil refining
Production systems (automated)
Racing cars (e.g. Formula 1)
Racing power boats
Radio towers (large)
Rail signalling/control systems
Rail transit systems
Refuelling aircraft and systems
Remote nuclear decommissioning units
Road systems/flyovers
Road traffic management systems
Robotics equipment
Rollercoaster equipment
Runways for aircraft
Satellite systems
Semiconductor fabrication equipment
Sewage treatment plant
Software packages
Space launch vehicles
Space observatories
Space stations
Strategic bombers
Submarines
Supercomputers
Superserver networks
Synchrotron particle accelerators

Tank communication systems (battlefield and tactical)	Telecommunications repeater systems
Tanks (e.g. main battle)	Training jets
Telecommunications exchanges	Water filtration/purification plant
Telecommunications network management systems	Water supply systems
	Wide area networks
	Yachts (e.g. 12-metre racing)

* These products include various kinds of capital goods, networks, systems, subsystems, and engineering constructs (e.g. intelligent buildings).
Source: Hobday (1998: 697).

Why industry differences matter

Although almost all major firms now use projects to drive parts of their business, firms and managers have to differentiate between strategies and practices appropriate for large-scale, standardised activities (e.g. volume manufacturing) and those which are project-based and customised (e.g. CoPS). These differences are all important in strategy formulation, day-to-day management and, ultimately, business success. The evidence from CoPS firms and industries provides rich insights into the challenges facing project business in general and the differences between project and volume business operations.

One of the key differences is that, in contrast to consumer goods, CoPS are never mass produced for final consumers. Instead, they are designed and produced on a project basis as one-offs or sometimes in small tailored batches for large professional business, government and institutional customers. Unlike the final consumer, these intermediate customers are usually intimately involved in the innovation process throughout the life cycle of the project. Indeed, the innovation idea often originates with the customer. Increasingly, as this book shows, complex services, such as consultancy, finance and training, are now also an essential part of the successful project business, as clients demand complete solutions to their business needs.

In some respects, today's producers of high-volume consumer goods face similar project business challenges. They have to rapidly deploy major capital goods in new interconnected plants around the globe to supply new products. They too need to execute major projects to develop the new product designs and prototypes essential for future business success. Like capital goods producers, consumer goods firms – such as

personal computers, consumer electronics and car manufacturers – are quickly learning that there are more sustainable revenue streams from intangible service-based activities than from the supply of physical products. Increasingly, consumer goods suppliers need to involve customers in new designs in order to keep abreast of their changing needs. Even in volume-based manufacturing, many firms have developed extensive in-house project management capabilities to meet their on-going internal needs for major capital equipment, such as assembly plant and IT systems. Perhaps most importantly, new business projects are essential to the revitalisation of mature businesses and especially the efforts of firms to move out of low-margin, low-growth businesses into higher value-added, more profitable activities.

Such inter-industry differences matter also because many leading US and European firms, including General Electric, IBM, LogicaCMG, BT, BAE Systems, Ericsson and Rolls-Royce, across diverse CoPS industries, have maintained or increased their dominance during the recent phase of intensified global competition. As this book shows, a core capability and source of competitive advantage for these firms is their ability to organise a growing proportion of their internal and external activities on a project basis.

Suppliers of consumer goods, by contrast, experienced an onslaught of Asian competition during the 1980s and 1990s. Consumer products, such as household appliances and consumer electronics, are becoming commoditised, offering low margins in slow-growth markets. Even in fast-growing areas such as personal computers and mobile handsets, US and European firms that previously enjoyed leadership positions can no longer match the competitive advantages of high-volume Asian manufacturers such as Samsung, LG and Sony. However, US and European firms retain an impressive lead in project business and supply a large proportion of the complex high-value capital goods needed by the Asian economies. As mentioned above, without a continuous and deliberate improvement in the management of innovation in project business, this lead is likely to slip away in the next decade or two.

Rethinking innovation management

A central theme of this book is that firms managing projects must rethink traditional management processes and best practices that typically have originated from the volume-produced consumer goods