Procurement of Built Assets

Duncan Cartlidge

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Elsevier Butterworth-Heinemann
Linacre House, Jordan Hill, Oxford OX2 8DP
200 Wheeler Road, Burlington, MA 01803

First published 2004

British Library Cataloguing in Publication Data
Cartlidge, Duncan P.
Procurement of built assets
1. Construction industry – Management 2. Industrial procurement 3. Risk management
I. Title
624′.0687

ISBN 07506 58193

Library of Congress Cataloging in Publication Data
Cartlidge, Duncan P.
Procurement of built assets / Duncan Cartlidge.
p. cm.
Includes index.
ISBN 0-7506-5819-3
1. Construction industry. 2. Industrial procurement.
I. Title.

HD9715.A2C355 2004
624′.068′7–dc22 2003049434

For information on all Elsevier Butterworth-Heinemann publications visit our website at www.bh.com

Typeset by Charon Tec Pvt. Ltd., Chennai, India
Printed and bound in Great Britain

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Foreword

It is only in the last three decades or so that procurement has been regarded by business as a strategic issue, rather than as an incidental activity to the real processes of production and marketing. Within organizations purchasing tended to be where you put people who had no professional qualifications, or the juniors in the organization. After all, anybody can buy; we do it every day!

All this changed in the 1970s and 1980s, when the Japanese in particular, showed how integrating the procurement function into the supply chain paid handsome dividends in controlling quality, production processes, and whole life costs. The introduction of just-in-time techniques into manufacturing and retail industries made project managers, and Financial Directors, identify and assess the true costs of holding stock, inefficient site control, and sub-optimal assembly programmes. The relatively high profitability of UK retailing during the 1990s gave ample evidence of the benefits resulting. Procurement, as a strategic discipline in the UK economy, had arrived.

Unfortunately, the UK construction industry was somewhat tardy in receiving the new gospel. On the supply side there seemed to be a conviction, sometimes verging on complacency, that, since most of the technical expertise rested with them, the customer would be well advised to take the product they offered and be thankful. At least Henry Ford assured the consumer they could have any colour they liked as long as it was black; the supply side of the construction industry seemed to offer any colour the supply side liked, immaterial of the customer desire. Clients, on the other hand, seemed to think that the new procurement techniques that they used to benefit their core business had no relevance when it came to acquiring

their construction needs. Or at least that's the advice they received from construction professionals.

Unfair? Perhaps so; but it was this uneasy feeling that the construction client, whether in the public or the private sector, was not getting a fair deal that has led to the unprecedented self-examination that the industry has undertaken over the last few years. Governments of both political persuasions recognized that, if they were to meet the aspirations of society for better services and higher living standards, a reconstruction of the obsolete infrastructure and provision of an improved built environment had to be provided. Private industry too recognized the need to meet changing technologies and the concentration in the developed world on the service industries. This in turn generated major construction programmes of new office building and adaptation, and relocation of existing production capacity. By 1998, home demand on the UK construction industry accounted for some £58 billions annually (including DIY), or nearly 5 per cent of UK GDP. So, when the Government inspired examinations of the industry, first by Sir Michael Latham and then by Sir John Egan, confirmed that there was scope for a potential 30 per cent improvement in the industry's productivity, there was a strong incentive to break from the outdated and inefficient methods, and from the long-established positions based on the preservation of special interests.

I have been fortunate enough to be involved in what has been regarded as an internally directed revolution in the industry, both from the suppliers' and the clients' points of view. The strongest impression that has been left with me is how markedly the language and culture of the industry is changing towards the acceptance of a fully integrated team approach in identifying clients' construction needs and satisfying them in ways which add value to their core business. This collaborative approach, the recognized basis for procurement strategies in other industries, has been the key element in the recommendations for making the industry truly effective in providing construction solutions for clients' business requirements. It is concerned with obtaining best value for money over the whole life of the project, and has been promulgated through the industry's strategic machinery, now being carried forward in the industry's Strategic Forum, which seeks to bring together all participants in the process, including the clients. It would be wrong to depict this changing business

environment in construction as being insufficiently 'hard-nosed' when seen in the historic context of the industry's confrontational way of doing business. The fact is that other industrial sectors in the UK economy have accepted for a long time that better solutions emerge from the collaborative input of all the specialists involved in the production process and including the end users. Rather than from an arrogant assumption that the customer is unable to articulate what their true requirements are, and will therefore have to accept what their suppliers decide to give them. We are now seeing from the industry schemes, which incorporate genuinely valuable contributions towards the resolution of complex technical problems not only from designers and contractors, but also from specialist suppliers, installers and manufacturers, as well as from the users of the project, themselves. It is of course the client who pays the bills for the project, not just in terms of the capital costs of the works, but also the costs of operation and maintenance of the project that they need in order to be able to undertake their business. The input to the process, and the understanding of it on the part of their suppliers, of the definition of the client's total requirements should lead to the provision of a facility which enhances the client's position and gives them a genuine asset which adds value to their core business. By concentrating on the integration of the process encourages, I believe, a genuinely holistic approach to solving the client's business problems. This in turn recognizes that corporate social responsibility, environmental protection and enhancement, and sustainability are intrinsically bound up in the final project. Construction projects, more than most other economic products, are comparatively long lasting and have an immediately discernible effect on a wider public than those for whom they are specifically provided. The best construction projects today incorporate quantified assessments of whole life performance and costs, as well as sensitivity in the choice of materials and design, giving due importance to the availability and use of renewable resources, and the retention of valuable professional and craft skills.

It will be readily recognized from what I have said above, that one of the most important contributions that can be made towards the achievement of the 'modern way' in construction is the adoption of a truly integrated procurement process, utilizing the various skills, including those of the client, in a genuine

partnership with shared aims and rewards. This book emphasizes precisely that, and illustrates how important it is to give up once and for all the old adversarialism, particularly when problems arise.

I am happy to commend this book to a wide representation of the industry.

Zara Lamont OBE

Preface

Almost 30 years ago I sat down to write my first book; it was called *Cost Planning and Building Economics* and included by way of a dedication, the following quotation, attributed to the Egyptian King, Cheops, at the commencement of the building of the Great Pyramid of Khufu in 2589 BC,

> *I don't care how much it costs or how long it takes.*

It seemed appropriate at the time to include these words as a sort of wake-up call to the UK construction industry, who had the unenviable reputation of delivering the majority of its products, over budget and over time. Thirty years, five books and several centuries later than Cheops's quote, yet another obelisk was being constructed; the home of the newly devolved Scottish Parliament in Edinburgh, Scotland. This particular project is referred to several times within the book, and while I would not wish readers to conclude that I am conducting a personal vendetta against this project – it is something of a horror story! Imagine going into your local car dealer to collect your new car to be told; sorry but the price has increased by over 90 per cent and it will not be ready for at least another year. Here is the deal – take it or leave it!

Utilizing management contracting and heavily criticized because of costs that have escalated from the original estimate of £40 millions to more than an estimated £375 millions, the Scottish Members of Parliament who have been tasked with overseeing the Parliament's construction, decided to visit the Aberdeenshire quarry where the stone that is to clad the new building is being cut. A young reporter from a local television station, seized the moment, thrusting a microphone towards

an SMP he asked the question of the delegation, '*aren't you concerned about the criticism of escalating costs and incidentally, what is the final bill?*' The SMP leading the group looked astonished and replied '*This project is being procured using competitive tendering and it is impossible to know the final cost until all the tenders have been received and the job is complete*.' and with this he waved the journalist away to continue the tour. How little seems to have changed when it comes to procurement of buildings during the past 4700 years, Cheops's quote could equally well be applied to this project.

A further indication of attitudes to construction procurement was given in an article in the *Sunday Telegraph* (25 April 2003) concerning the same 'Edinburgh Extravagance' and quoted the editor of the *Journal of Scottish Architecture* who upon hearing that contractors on the project had been paid advances of £250,000 replied '*it is unheard of for cash to be advanced to contractors in this way*'. Not so, in France many contractors, including the really big international names, ask for advances at the start of a project as part of normal business, a practice that will be discussed in Chapter 8. You see in France, the client actually trusts the contractor not to disappear off on the next airplane with the cash, like some sort of criminal. As a final word on the Scottish Parliament building, well for now anyway, perhaps it is not entirely fair to judge the performance of the UK construction industry from high profile mega projects, as they appear to have their own particular multi-layered agendas, as will be discussed in Chapter 2.

This book draws heavily on the experiences and best practice of other industries and market sectors who have, just as construction is now having to do, taken a critical look at their procurement practices and techniques and the inherent waste in many traditional systems. From his experience in education it has become apparent to the author, that in a majority of cases, architects are taught to approach procurement from the elitist stance that, the process is 'architect led' and by definition everybody else follows: commercial managers from the point of exploiting an inherently flawed process to maximize profit for the contractor, including a good measure of bullying sub-contractors and quantity surveyors approach the process from the starting point of – 'let the wars begin.' Rarely does the client seem to be the main focus.

For the majority of construction professionals, the subject of procurement is most often introduced and taught along the stereotypes referred to in the previous paragraph. Consequently, when it comes to the choice of a procurement path few construction professionals know the basics of, for example; good procurement, supply chain management, value for money, or how to select an appropriate strategy. Organizations in all market sectors increasingly operate in a service-oriented culture where the expectations of consumers and indeed construction clients, have been inevitably raised. In general, the approach to the construction procurement process has not yet moved to a consumer orientated approach, although, there has been increasing acknowledgement that customer care must become part of the provision of built assets and as such will be a major step in achieving the aims of Latham and Egan and the many initiative that these reports spawned.

There can be no doubt – the creation of a complex new building carries inherent risks, both technically and commercially and improving the procurement performance is about changing the hearts and minds of professionals, of whatever discipline, involved with the procurement of built assets, preferably at the start of their career.

Quite simply therefore, the rationale of this book, is to introduce best practice construction procurement to a wide range of construction professionals, clients and the industry as a whole in the expectation that construction procurement becomes more responsive to clients' needs and helps deliver projects on time and to budget.

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Acknowledgements

My sincere thanks go to the following people who have contributed their enthusiasm, time and considerable expertise to the contents of this book.

Kevin Thomas for case study 2, Chapter 7

Kevin Thomas is Director of Worldwide Strategic Planning for GlaxoSmithKline Research and Development. With a background in the defence and pharmaceutical industries, Kevin has over 25 years' experience in the construction, operation and reconfiguration of buildings as well as sites and the management of the facilities and services provided to their occupants. Kevin was instrumental in redefining Glaxo Wellcome's approach to R&D construction activity as sponsor of its Fusion programme. Fusion was successfully applied to the restructuring of the company's Biopharmaceuticals site at Beckenham, Kent, winning the 1999 Contract Journal Single Project Partnering Award.

Kevin is Deputy Chairman of 'Collaborating for the Built Environment' and has been a lead member of the Strategic Forum Integrated Teams Working Group who have been drafting the Strategic Forum Toolkit.

Rory Lamont for case study 1, Chapter 7

Rory Lamont is a Supply Chain Management Specialist for British Petroleum's UK Continental Shelf Operations. As well as championing the appropriate use of reverse auctions in the

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Sean Lockie for advice, comments and contribution to Chapter 3

Sean Lockie is a technical consultant who is part of the Whole Life Value division at Atkins Faithfull and Gould. He has over 10 years' experience in the property sector covering a range of projects in commercial, educational, leisure and health sectors. He has worked on over 30 PPP projects.

Faithfull and Gould are part of the Atkins Group of Companies. Atkins is one of the world's leading providers of professional, technology-based consultancy and support services, with over 14,000 staff worldwide.

Mohamed Kishk, The Robert Gordon University, for his contribution on whole life costs in Chapter 3. Since his return to academia in 1998 to start a PhD programme in whole life costing based decision-making Mohamed has published more than 25 articles on WLC in referred academic journals as well as giving presentations at major regional, national and international conferences.

Cliff Jones, NHS Estates, Leeds, for his advice and guidance on NHS ProCure 21.

Ray Robinson, AON Risk Services, London for his advice on insurance matters.

Dedication

John (Jack) Cartlidge 1914–1980

1

Construction procurement – the case for a new way

In no other important industry is the responsibility for the design so far removed from the responsibilities of production.

—Sir Harold Emerson 1964

Introduction

The ability successfully to procure built assets is at the heart of the construction process and in turn at the heart of the procurement process is identifying the constantly evolving needs of the construction client.

Just what every construction client wants!

What are the drivers of construction procurement in the UK and are they so much different to other sectors? If one were to ask some of the 2.5 million customers in the UK who annually buy a new car – what were the criteria for buying a particular model? – the answers would probably be:

- long warranties, reliability, no defects;
- fitness for purpose, that is, 4 × 4, family saloon, etc.;
- features, such as air conditioning, CD player included as standard;
- long service intervals and low running and maintenance costs;
- delivered promptly.

In fact criteria that all in all, add up to perceived value for money over the life span of the vehicle. Criteria that appear to be

Figure 1.1 The construction client's dilemma.

recognized and taken into consideration by the automotive industry, as the following quote from BMW's marketing information illustrates:

> *The true cost of the vehicles on your fleet is a balanced measure of all the relevant attributable costs. Servicing, on-the-road price, depreciation and days off road are all essential measures that will directly affect your fleet budget. With high residual values, lengthy servicing intervals and excellent build quality, the BMW and MINI range are well placed to offer some significant advantages over competitive marques … with the Whole Life Costs of the BMW and MINI ranges you will be pleasantly surprised to find that it makes financial sense to offer our cars to your company car drivers as part of your fleet.*

Admittedly the life span of a family car is not as long as the average new construction project, but if only procuring built assets sounded so simple. As illustrated in Figure 1.1 not only do construction clients traditionally have to grapple with a

Table 1.1 Key performance indicators

Key performance indicator	*Measure*	*2000*	*2001*
Client satisfaction			
Product	Scoring 8/10 or better	72%	73%
Service	Scoring 8/10 or better	63%	65%
Defects	Scoring 8/10 or better	53%	58%
Safety	Mean accident/incident rate/ 100,000 employed	1088	990
Cost predictability			
Design	On target or better	63%	63%
Construction	On target or better	48%	50%
Project	On target or better	46%	48%
Time predictability			
Design	On target or better	41%	46%
Construction	On target or better	59%	62%
Project	On target or better	36%	42%

Key: 10 = totally satisfied, 5/6 = neither satisfied nor dissatisfied, 1 = totally dissatisfied.
Source: dti (2002), *Construction Statistics Annual*, HMSO.

whole range of diverse issues, but in addition with a diverse range of professional and technical advice.

Similarly, if British Airways were to consider replacing its ageing transatlantic fleet of Boeing 747 jets, the criteria for choosing the most appropriate aircraft would probably be similar to those of the car buyer. By way of contrast, Table 1.1 taken from the dti 2002 annual construction industry performance indicates that 10 years post-Latham the UK construction industry is still failing to meet the expectations of its clients. How many car buyers, for example, would be prepared to accept a 58% rating for defects?

Why then does it appear that construction clients are still unable to find the same levels of value for money as the average car buyer?

The case for a new approach to procurement

The challenge that has been laid at the feet of the construction industry is to transform the diverse and often separate processes

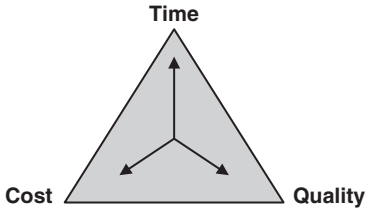

Figure 1.2 Procurement drivers.

of design and procurement of built assets into one single integrated production process.

The long established principal drivers for construction procurement have been said to be (it's no coincidence that the model is pyramid shaped) time, cost and quality as illustrated in Figure 1.2.

Traditionally, the relative importance of these drivers determined the selection of procurement path. The client being asked to identify which of the drivers was the most important – the inference being that it is impossible to have all three simultaneously. Therefore, if time were of the essence then cost and quality would have to be compromised and vice versa. However things have moved on and modern forward thinking construction clients are now taking as read that, just like the car buyer, supply chains can deliver all three of the above, that is: built assets that are delivered on time, within the cost target with zero defects. For example, later in this book the role of frameworks and procurement will be discussed along with the rigorous prequalification processes during which contractors have to demonstrate their ability to deliver added value as a prerequisite to even being placed on a tender list. What now, therefore, do construction clients want from their construction industry partners in the field of procurement? Progressive clients, some of whom have contributed case studies to this book, are now demanding that construction procurement is not detached from their mainstream business operations, organized and delivered by construction professionals operating to their own agendas. Progressive clients are now demanding that procurement mirrors corporate strategies and targets including addressing the following areas:

- Understanding clients' needs which may, depending on circumstances, include producing solutions that satisfy

the following criteria:
  – flexible and adaptable facilities,
  – maximize use of existing assets,
  – immediate start and early finish,
  – minimal waste and defects,
  – lower and predictable whole life costs,
  – greater predictability in cost and time,
  – a long-term vision of short-term demands.
- The ability to demonstrate pro-activity and innovation by:
  – questioning and challenging clients' needs,
  – develop the ability to question and challenge conventional practice, on the basis that in many cases so far, it has not produced satisfactory solutions.

Collaboration with clients and supply chains

From the mountain of information, reports and statistics that are available, relating to the performance of the UK construction industry during the past 50 years or so, it would appear that the case for a new approach to procuring built assets has been proven. However, despite all of these studies, spanning both the public and private sectors, the UK construction industry is letting its clients down and is perceived by many other industries to be a dinosaur in procurement terms with each new initiative being met with a barrage of scepticism and resistance.

It has been argued that one reason for construction's comparatively poor performance is that the construction process is unique. This uniqueness is said to be characterized by a wide spectrum of clients as follows:

- Small one-off client or large corporate investor.
- Occasional or experienced client.
- Public or private sector client (Morledge *et al*., 2002).

Unfortunately, the Luddites within the industry have traditionally seized on these facts to champion the cause of Not In My Industry Thank You! (NIMITY). It could be argued that a similar client/end user spectrum can be found in a number of market sectors, for example computing, but this has not prevented other industries from moving forward and adopting

integrated procurement practices. In addition to the above factors the following views have also been identified as peculiarities of construction products and construction (source: adapted from Koskela (2003)):

- The complexity of organization and manufacture of built assets.
- The small extent of the penetration of standardization.
- The high turnover of workers.
- The localized nature of orders of extraordinary diversity.

Why do so many projects fail to meet targets?

Poor procurement performance transcends both the public and private sectors and some clues for this may come from a government sponsored report. In July 2002 Mott MacDonald prepared a *Review of Large Public Procurement in the UK* for HM Treasury, as part of the Green Book Review, referred to in more detail in Chapter 3. One of the areas considered by the review was the poor performance of UK public sector construction projects. The study identified what it called 'high levels of optimism' as one of the principal causes for poor performance. Optimism being defined as 'the tendency to underestimate project costs and duration and overestimate project benefits, or the inability to identify and mitigate risk.' The study continued to identify critical project risk areas that cause cost and time overruns where optimism bias was found. The report calculated an optimism bias, which is expressed as a numerical indication of the level of such bias and can be applied to estimates in order to improve reliability. The report concluded generally that the performance of projects procured using public private partnerships (PPP) was much higher due in part to the much more rigorous approach to the establishment of a robust and realistic business case, combined with rigorous risk analysis. This point is underlined in the case of the new Scottish Parliament project, see Preface, where a similarly complex project, the Edinburgh Royal Infirmary, was completed on time and to budget using a PPP/Private finance initiative (PFI) approach. It is not surprising that the optimism bias levels for PPP/PFI projects are lower than for some traditionally procured projects, as more project risks are identified

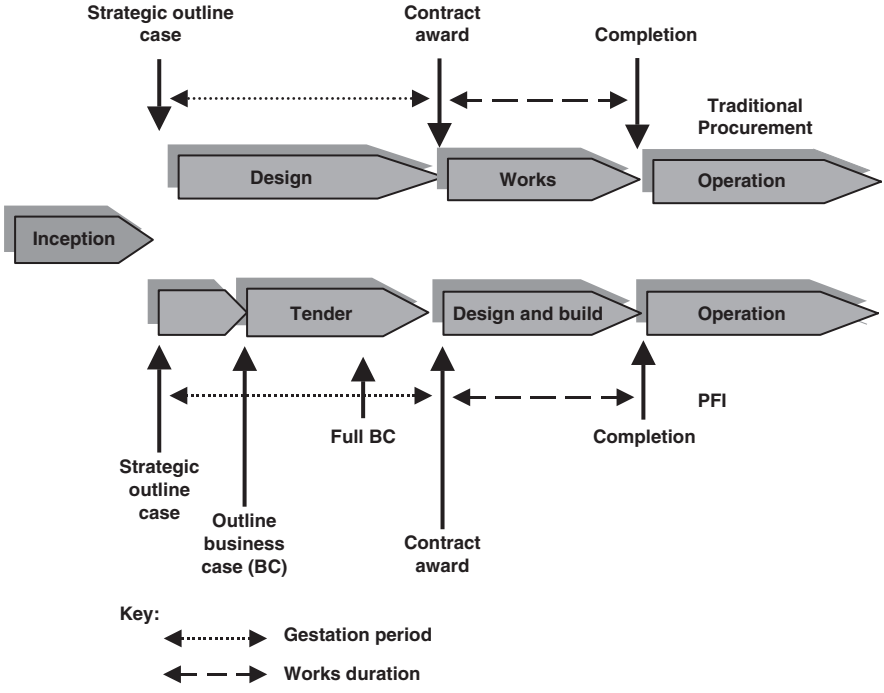

Figure 1.3 Review of large public procurement in the UK (source: Mott MacDonald, 2002).

and mitigated at the full business case stage than at the strategic outline case and the outline business case stages. As illustrated in Figure 1.3 the PFI procurement route contains a much more rigorous procedure for business case development than traditional procurement routes. The review concluded that one of the primary objectives of the business case is to identify risk. The Mott MacDonald report also gives an indication of the project risk areas most likely to cause overruns if sufficient risk mitigation strategies are not in place. It would appear therefore that the provision of a sound business case and the correct identification of risk are of great importance in ensuring efficient project delivery. Both of these topics will be discussed in Chapter 2.

A more controversial explanation as to why large scale public sector projects such as the Channel Tunnel so often are a procurement disaster, is put forward by Bent Flyvbjerg (*Megaprojects and Risk: An Anatomy of Ambition*, 2003). Concluding that bad procurement is not just a public sector phenomenon,

Flyvbjerg and his co-authors at Aalborg University in Demark, Bruzelius and Rothengatter, examined over 250 mega projects, from all over the world, mainly in the transport sector, undertaken between 1924 and 1998. As well as reaching the same conclusion as Mott MacDonald (2002), namely that civil servants have a tendency to be overly optimistic when it comes to estimating costs and time scales, they go further by suggesting that there is often a good deal of deceit at the planning stages of large prestigious projects by politicians and professionals alike: '*Cost underestimation and overruns cannot be explained by error and seem to be best explained by strategic misrepresentation, namely lying, with a view to getting projects started.*' The authors go on to suggest that criminal penalties should be introduced if this type of conduct were found to be responsible for project excesses!

Is construction that unique?

Koskela (1998) rejects the premise that construction is unique and suggests that it is in fact just another production system. According to Koskela the differentiating characteristics often cited by the construction industry of one-of-a-kind nature of projects, site production and temporary teams, are present in several other types of production.

There follows the sequence of events, based on *The Machine that Changed the World*, Womack *et al*., of the typical approach towards the procurement of a new motor car around 1970/1980:

- The overall concept is planned in detail by the senior management.
- Detailed drawings and specifications are produced for each part, such as steering wheels, bumpers, etc.
- Only at this point are the organizations, the suppliers (typically 1000–2500), who will actually make the parts, called into the process. However, by this time it is too late to improve the design.
- The suppliers are shown the drawings and asked to produce bids.
- The suppliers know from experience that from the assemblers' point of view 'cost comes first'. Therefore, quoting a low price is absolutely essential to winning a bid. This practice

leads to implausible bids winning contracts followed by cost adjustments that eventually make the cost per item higher than those of realistic, but losing bidders.
- Since this is the case should they, the suppliers, bid below cost, because as the suppliers also know, once production has commenced they may be able to go back for cost adjustments and variations.
- The mass production assembler has played this game thousands of times and fully expects the successful suppliers to come back for price adjustments.
- The assemblers would dearly like to know the suppliers' real costs. But these are jealously guarded by the suppliers in the belief that by revealing only the price per component, they are maximizing their ability to hide their true profits from the assembler. Playing the bidders off makes them very reluctant to share ideas on improved production techniques.
- Once the suppliers have been chosen they start to produce the parts. Often, many problems are uncovered as the components are produced by suppliers who have no direct contact with each other.
- Revised drawings are produced.
- The new model reaches the market often to find that something is not right – the cars have to be brought in for modifications.

For those familiar with the traditional approach to the procurement of built assets the above sequence will be all too familiar, and some reassurance can be taken from the fact that adversarial practices have not been confined to the construction industry!

Despite the apparent similarities in the procurement of motor cars and built assets there is no disputing or overlooking the fact that construction is a very diverse activity, operating at a variety of levels, from complex civil engineering projects to simple domestic alterations and consequently procurement will require an equally diverse approach. Also it should be remembered that despite the rhetoric large organizations continue to run many different procurement methods, therefore it is important to ask questions each time, for each new project. Problems may arise if, when for example, organizations decide to adopt a single approach to procurement as has happened in some public sector agencies in the UK. Although it must be

stated that it is not always necessarily a poor strategy to adopt this approach. For example, National Health Service projects in England and Wales are very unlikely to proceed unless the Private Finance Initiative or ProCure 21 procurement paths are used and both of these systems will be discussed in Chapters 4 and 5. Even if the uniqueness of construction is accepted the industry has proved to be less able to develop radical new ways of working which build on the experience of other industries. In addition, the UK construction industry, with a turnover of £70 billion per annum has a particularly unique structure.

According to the Department of the Environment, Trade and the Regions (detr) in 2001, out of a total of approximately 168,000 firms and a total workforce of approximately 1.5 million, in the UK construction industry less than 90 firms or 0.5% have a work force of over 600, while approximately 130,000 firms or 72% employ between 1 and 3 people, with over half the total number of firms being single person organizations. However, the top 0.5% of companies carries out approximately 20% of all construction work in terms of value. This structure is by no means unique on the world stage and in Chapter 8 it can be seen that figures for the Australian construction industry reveal similar patterns. By comparison, the automotive industry has a turnover of £40 billion per annum and employs approximately 800,000 people but has only 10 major manufacturers. The consequences of this structure for UK construction are as follows:

- Difficulties in developing the 'visionary leadership' called for in the many government initiatives such as Accelerating Change and in effecting widespread change, as there are few large organizations able to champion new ideas and approaches.
- Difficulty in introducing new skills to the 130,000 firms who do not have the resources, time or inclination to become familiar with techniques such as e-procurement and supply chain management.
- New initiatives are perceived as being relevant for the top companies only, the so-called 'A list' leaving the majority of the industry to maintain the *status quo*.
- A paltry £147 million per annum spent on research and development in an uncoordinated and unfocused way.

Table 1.2 is Koskela's overview on problems related to the peculiarities of construction procurement with corresponding solutions. In this table process control refers to the management of a project, process improvement to the development efforts of the permanent organizations in construction (designing, manufacturing of materials and components, and contracting).

One of the fields where the UK construction industry does seem to lead the field is silo working, that is working in isolation, guarding and protecting any information which it is feared may give commercial advantage to a competitor. In this approach the stakeholders in the construction supply chain work in isolation, that is, the design team keep the contractors and they in turn keep the sub-contractors at arms length for as long as possible into the project, and as a result a significant proportion of built assets are procured by means of a system where the design and production are separate operations and lack buildability. As will be discussed later in the chapter the breaking down of this silo mentality is a major step in moving away from current construction procurement culture. One of the characteristics of the many new approaches to procurement is the abolition of fear and the creation of a safe commercial environment in which suppliers can operate.

A prime example of the benefits of how project cooperation can be of benefit comes from another sector. The Human Genome Project, started in 1990, was originally a 13-year effort to identify all of the approximately 30,000 genes in human DNA and to store this information on databases. The importance of this project to mankind is self-evident, as is the tremendous commercial importance of the research to a fiercely competitive pharmaceutical industry. If construction is considered to be a risky business, then consider the development of a new drug; £250–300 million in development costs over a 10-year period before any return and a patent limited to 20 years for successful products. The outcome of the Genome project therefore is clearly of great interest to commercial biotechnical organizations worldwide, searching for the illusive next blockbuster drug. However, the project was unique in one very important way; it was a collaborative exercise, with the transfer of the technologies used in the research and the subsequent results, to the private sector, freely available without constraints, via the Internet. Originally, the project was planned to last for 15 years but collaborative working has shortened the

Table 1.2 Application of the new production philosophy to construction

Peculiarity of construction	*Process control problems*	*Process improvement problems*	*Structural solutions*	*Operational solutions for control*	*Operational solutions for improvement*
One-of-a-kind	No prototype cycles Unsystematic client input Coordination of uncertain activities	Processes do not repeat – long-term improvement questionable	Minimize the one-of-a-kind content in the project	Upfront requirements analysis Set up artificial cycles Buffer uncertain tasks	Enhance flexibility to cover a wider range of projects Accumulate feedback
Site production	External uncertainties: weather, etc. Internal uncertainties and complexities: flow interdependencies, changing layout, viability of manual work	Difficulty of transferring improvement across sites solely in procedures and skills	Minimize the activities on site in any material flow	Detailed and continuous planning Multi-skilled work teams	Enhance planning and risk analysis capability
Temporary organization	Internal uncertainties: exchange of information across organization borders	Difficulties of stimulating and accumulating improvement across organization borders	Minimize temporary organizational interfaces	Team building during the project	Integrate flows through partnerships

Source: Koskela (1992).

programme by 2 years than otherwise would be possible with silo working, thereby potentially saving thousands of lives as the findings are used in worldwide research projects. Full details of the human genome project are at www.ensembl.org/

A genealogy of procurement

As previously discussed, the UK construction industry, unlike other major industrial sectors, has never appeared to have seen the necessity to challenge long held industry beliefs/practice or to question the *status quo*. In the main, change has been brought about as the result of client pressure or economic circumstances or a combination of both, but seldom from within the industry itself. The 21st century is witnessing some construction clients developing the same expectations that, for example, retail customers now regard as normal. As Table 1.1 illustrates construction still has a long way to go before it matches, for example, the defects target of five parts per million demanded by Toyota. Figure 1.4 plots the correlation of market trends with the development and use of the predominant procurement strategies demanded by clients.

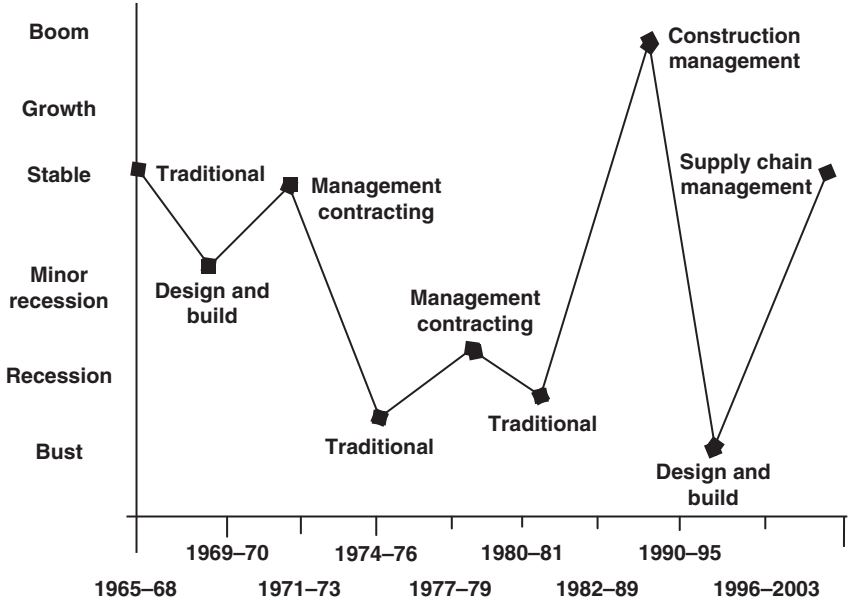

Figure 1.4 Economic and procurement trends (source: Gardiner and Theobald 2002).

The UK construction industry has always been subject to periods of boom and bust. Traditionally the quiet periods have been times of reflection for the industry and the publication of reports cataloguing the deficiencies of the system. Organizations vow to improve performance, promises that usually fall by the way side as soon as the flickers of an upturn in the market appear on the horizon.

The property market has always driven procurement trends and not vice versa. During the past 160 years or so, there have been a wide variety of fashionable procurement strategies adopted by the construction industry. Table 1.3, a genealogy of procurement, attempts to relate the emergence of new procurement paths to external drivers.

1834–1945: the quantity surveyor and contracts

Long before Cheops commissioned the building of the great pyramid, clients had been procuring built assets. However, this brief history of construction procurement will start in 1834 – notable for the birth of the quantity surveyor, for most people a profession still synonymous with construction procurement. The reason behind the quantity surveyor's emergence at this time was architect's desire to rid their professional institution of surveyors and their perceived obnoxious commercial interest in construction. Also during this period the emergence of another major influence on procurement was The Standard Form of Contract. The Joint Contracts Tribunal in their publication The Use of Standard Forms of Building Contract advises that from about 1870 the possibility of a standard form was discussed among various trade bodies and the Royal Institute of British Architects (RIBA). Agreed forms were subsequently issued in 1909 and 1931. New editions followed to take account of change in industry practice.

1946–1969: post-war regeneration

For the UK construction industry, the legacy of the Second World War was a massive demand for new buildings and infrastructure. Not only had many major cities, like London, Portsmouth and Liverpool suffered extensive bombing damage during the war, but in addition the 1950s and 1960s saw vast tracts of inner

Table 1.3 A genealogy of procurement

Dates	*Economic milestones*	*Procurement trends*	*Construction activity*
1834–1945	Few corporate clients	Sequential, fragmented process Bills of quantities, competitive tendering	Traditional approach
1946–1969	Post-war regeneration	High value = low cost Lump sum competitive tendering Cost reimbursement	Rebuilding post-war Britain
1970–1979	Rampant inflation 25% + pa Historically high interest rates	Management contracting Two stage tendering	Property boom 1970–1974
1980–1989	1989 base rate reaches 15% Financial deregulation Privatization 1987 inflation reaches 7.7% pa 1987 stock market crash	Construction management Management contracting Compulsary Competitive Tendering Bespoke contracts to load risk onto contractors	Property slump 1980–1984 Property boom 1985–1990
1990–2000	Globalization Low interest rates and inflation World economic slump	Partnering PPP/PFI	Property slump 1991–1997 Property boom 1997–2000
2001 >	Globalization Sustained economic growth Low interest rates and inflation	e-Procurement Prime contracting Relationship contracting	Property boom

city housing; housing that had been built during the mid-19th century for industrial workers, flocking to the cities from the countryside, becomes available for compulsory purchase and redevelopment by local authorities. With an almost evangelical fervour most major cities in the UK were drawn into the spirit of the age and planned massive redevelopment programmes. With such a large programme of works the over-riding procurement strategy was lowest initial cost – so much had to be rebuilt and money was in short supply. Considerations such as life cycle costs were very much in their infancy and unfortunately the legacy of this time can still be seen in most major UK cities in the form of flatted tower blocks with major maintenance and running cost problems. The rebuilding programme was given further impetus with the election of a Labour government in 1964 which, at the same time, sought to shackle developers from making what were considered to be excessive profits, with the introduction of a Betterment Levy, that was included in the Land Commission Act of 1967. The effect of the land commission was to stifle development activity in the private sector and dampened prices until its dissolution in 1971, when the genie was let of out the bottle! This period, immediately prior to the development of information technology was the golden age of the bill of quantities. Even modest projects routinely had lead-in times of several months or even years, while each post and posthole was drawn, specified, counted and recorded in bills of quantities. Despite this period of sustained, continuous economic growth, several government sponsored reports, namely Simon (1944), Emerson (1962) and Banwell (1964) suggested that all was not well within the construction industry and pointed the finger particularly at procurement. But the reports were without teeth and were in the main confined to the filing cabinet. This period was also a golden age for construction professionals, operating on generous fee scales, before compulsory competitive tendering was to savage income flow. The predominant forms of procurement/contract during this period were single stage lump sum contracts based on bills of quantities. A Code of Practice for Single Stage Selective Tendering was developed as a highly prescriptive guide to this form of procurement.

This period saw the emergence of cost reimbursement contracts which allowed a contractor to be reimbursed for the costs of a project on the basis of actual cost of labour, material and plant plus a previously agreed percentage, to cover profit