As an industrial process, construction is unique. The procurement processes used to achieve the successful completion of built assets requires a different approach to that adopted in most other industries, due to the bespoke nature of building design and geographically varied sites. The procurement process is central to the success of any construction project and many of the problems which impact construction projects can be traced back to the procurement phase, so a good understanding of the methods of procurement, the development of a procurement strategy and the influence it has on project success is essential for all those working in the industry.

Much has changed in the global construction industry since publication of the second edition of *Building Procurement*, for example the increase in debt burden of many major economies, widespread adoption of Building Information Modelling (BIM) Technology in the industry and the United Kingdom's exit from the European Union. This new edition has been rewritten to take account of these significant developments, but at its core it continues to provide a critical examination and review of current procurement practices in the UK, continental Europe (including EU procurement procedures), China, Middle East, Sub-Saharan Africa and the USA. It retains its original strong emphasis on the need for clients to establish achievable objectives which reflect the project business case and focuses on development of suitable strategies and management structures to meet those objectives in the current construction climate.

Building Procurement will be essential reading for senior undergraduate and postgraduate students of construction management and related disciplines, and practitioners working in all areas of construction management.

Review of the first edition

"...a thorough and comprehensive investigation of building procurement..."
Construction Management and Economics

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BUILDING PROCUREMENT

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BUILDING PROCUREMENT

ROY MORLEDGE | ADRIAN J. SMITH
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Third Edition

Roy Morledge
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Preface to the Third Edition

Although the construction of buildings has been commonplace for many thousands of years, the ways in which that construction activity has been procured and managed have all too often been both time consuming and inefficient, and the end result frequently unsatisfactory in terms of failure to meet basic time, cost and quality goals. There are many reasons for these failures, but perhaps the most fundamental arise not only because building is itself a very complex process, but because that complexity is compounded by the fact that most buildings are to some extent unique and bespoke, constructed in the open air by a team assembled especially for that project, and must be completed within demanding time, cost and quality and quality parameters.

In addition, the spectrum of customers of the construction industry is arguably the broadest of any industrial sector, ranging in size from very large organisations to single individual consumers, and in knowledge and expertise from organisations with substantial construction programmes and extensive construction knowledge and experience, to naïve consumers with no previous experience and little or no knowledge of the process.

It is in the context of a continuing search for greater satisfaction of this broad and disparate customer base that considerable amounts of effort and expertise have been expended over many years in an attempt to ensure efficiency and economy in the procurement of construction activity. That procurement process itself is complex, requiring the mobilization and management of an extensive range of professional, managerial, technical and financial expertise, and a successful outcome is frequently elusive. The procurement of construction work is significantly different from purchasing almost any other commodity in that most products are the result of a manufacturing process based in an environment that is permanent and controlled. The product can be designed, prototyped and tested prior to final production, quality can be readily assured, there is the opportunity for prototyping prior to production of the final product, and potential purchasers can view and even try the product before making their final decision to buy. The only sector in which the construction industry comes close to this mass production approach is arguably the construction of residential developments. Projects, and particularly construction projects, generally follow a process that has few of the above characteristics and which can provide none of the benefits.

Experience over the past few decades has shown an increasing demand from regular clients of the industry for significant improvements both in the predictability of construction projects in terms of time, cost, quality and fitness for purpose, and also for a substantial increase in value for money. Value for money in this case has often been characterised by the

need for projects to be cheaper in terms of both capital costs and revenue expenditure, and for development and construction periods to be significantly reduced, whilst at the same time maintaining or improving the quality and functionality of the final product. These issues have been further complicated in recent years by the need for the industry as a whole to become 'greener' and more environmentally sustainable.

It must be said, however, that although significant improvements have been made, and the performance of the construction industry in satisfying its clients has demonstrably improved in recent years, the successful completion of construction projects, both large and small, within budget, to time and to the satisfaction of customers is still by no means as common as it ought to be in the UK. There is significant evidence that in many cases the way in which the procurement phase has been carried out has proved to be crucial to eventual project success, but also a significant component in project failure.

This book continues the approach set out in the second edition in that it seeks to explore approaches to improving the successful procurement of buildings, whilst incorporating recent developments in both research and contemporary practice.

It is worthy of note that purchasers of construction projects are usually referred to as clients rather than customers. This is appropriate since it suggests that they are purchasing services rather than products – construction is after all primarily a service industry. The distinction also hints at their possible legal position if the project does not meet that requirement of 'fitness for purpose' which is inherent in the purchase of other products. The term 'client' suggests the difference in approach that needs to be adopted for a satisfactory outcome to be achieved, and in this respect clients increasingly seek a fitness for purpose guarantee, particularly in the case of projects procured on a design and build basis. This issue will therefore continue to impact upon the procurement process.

The importance of understanding the need to establish realistic and measurable objectives, both for clients and contractors, linked to a carefully evaluated business case and supported by rigorous post-project analysis is particularly emphasized. The importance of those early project stages which are so often given insufficient emphasis or time prior to focus upon concept design is also highlighted. The initiation of the project and the need for the development of a justified business case are explored along with the need to identify measurable outcomes against which the completed project can be judged. The value to the client of the project output, a primary driver which is often forgotten as direct project issues such as time and cost dominate the construction phase, is emphasized. Upon completion these issues become historical fact and emphasis returns to the value or performance benefit derived from the completed project.

The UK is an example of an island nation which has steadfastly hung on to those traditional procurement practices with which it is most comfortable. Historically, data regarding the relative use of different types of procurement strategy has indicated a numerical dominance of these traditional approaches with little evident sensitivity to varying client needs, although the relatively few experienced clients often do adopt different approaches. Traditionalism has historically been sustained largely through the conservatism of professional institutions, universities and colleges in terms of the nature of professional education, but this tendency towards the traditional has significantly changed in recent years with a significant rise in the use of design and build approaches and, particularly in the public sector, a growth in approaches requiring increased collaboration and trust.

Project management tools and techniques suitable for adoption in the management of the procurement process are explored and evaluated in this book. Some considered to be innovative and beneficial have existed for many years, but their adoption has been limited largely to those projects where experienced clients understand the benefit and ask their consultants to provide the necessary services. The Construction Act which provides a mandatory framework for payment and dispute resolution within construction contracts in the industry is explored, with particular focus on how the requirements affect the various functions and roles within the contractual framework.

Public sector clients and commissioning authorities are increasingly becoming more imaginative and innovative in considering how they can best maximise the value generated by their projects, not only to themselves as clients, but also to the communities which they serve. This 'social value' has, in recent years, become an increasingly important element in the procurement of goods and services in the public sector, and we have therefore included some commentary on the concepts of social value, and the associated concepts of health, safety and 'wellbeing', within the public sector procurement process.

In recognition of the increasing interest shown in recent years in many parts of the world in both the preservation and adaptive reuse of historic buildings, we have again included a chapter devoted to the challenges inherent in procuring construction work to historic buildings. It should however be noted that work of this type requires a skilled and specialist understanding of the issues involved, and the employment of specialist skilled expertise in its execution. The information we have presented here is therefore given simply as a guide, and more specialist expertise will usually need to be sought. We have also enhanced the relevant chapter by the inclusion of a second extended case study of a recent very successful project of this type, and the two studies graphically indicate in different ways some of the particular challenges and problems which such projects may pose.

We have already noted that construction clients differ widely in terms of their experience, purpose and size. Numerically, inexperienced clients dominate and on average their projects are relatively small and short-lived. On the other hand, the minority of regular and experienced clients are by far the biggest spenders and they tend to benefit from their experience and buying power. Nevertheless, whether the client is an inexperienced small-to-medium-sized enterprise, a major corporate organisation or a public body, exposure to risk is inherent in the procurement of construction. Perhaps the inexperienced small and medium-sized enterprise (SME) is likely to be proportionally most exposed, but managing that risk is a key part of the process. The issues surrounding client and project risk are explored.

Recent years have seen a significant increase in understanding the importance of selection of the most appropriate procurement approach as a means of managing project risk, and a key component of this is now seen to be the effective use of Building Information Modelling (BIM) techniques. The recent upsurge in interest in BIM should provide a further boost to ensure that future buildings are both more economical and more efficient in use throughout their useful life, and some of the possible impacts on the procurement process of the more widespread use of BIM are therefore considered. Even given the recent economic difficulties faced by the construction industry, collaborative approaches to procurement continue to gain support from experienced and regular construction clients where they can see that continuous measurable value-based improvement has been achieved by adopting

such practices in preference to price-led traditional practices. Contemporary approaches such as Cost Led and Two Stage Open Book procurement, which are designed to promote early supplier engagement, transparency of cost and collaborative working, allow clients to lead change and promote efficiency with positive results. Both procurement strategies where collaboration is enabled and the culture underlying the management of collaborative business relationships such as partnering are therefore explored in some detail.

Governments have for many years adopted a range of approaches to procurement based upon long-term agreements of various kinds with project funding provided by private sector investors. Public private partnerships and private finance are therefore explored, and the processes outlined together with the benefits and the inherent difficulties of complex schemes where traditionally disparate participants have to collaborate if successful bids and outcomes are to be achieved.

Internationally, procurement practices in Europe, as well as the Middle East, USA, Africa, and China are reviewed to enable some comparison to be made, not just about the practices themselves, but also about the context and attitudes of clients. In Europe, although traditional differences are still evident in the way in which construction is procured in different countries (and there may well be potential benefits for clients in some of the adopted practices, particularly the post-completion protection required in some countries), the European Union progressively imposes an increasing level of regulation in the constant search to provide a Europe-wide open market with standardised procurement procedures. With construction output of over 1300 billion dollars, the USA's construction industry is both huge and complex. This book therefore provides only an overview of the general procurement processes in use in America. The Middle East, particularly countries such as the UAE, Bahrain and Qatar continue to develop as vibrant construction markets, and we have therefore included a brief overview of construction procurement practice in this region.

Procurement approaches developed in Europe were exported to the developing world mainly as a by-product of colonial development. These approaches continue to be the foremost procurement options in many countries within the Sub-Saharan African region. The growing involvement of external parties in financing major infrastructure projects in Africa has seen more foreign construction companies operating in the region. This is resulting in more competitive procurement practices and impacting negatively on the development of local small and medium enterprises in the region. The procurement practices in Sub-Saharan Africa, including the influence of Chinese investment in the region, have been explored.

China remains important as a worldwide construction market, and represents a fascinating instance of an economy developing at a tremendous pace, where procurement influences from many parts of the world, largely focused on geographical areas with extensive traditions of western influence such as Hong Kong and Shanghai, collide with traditional Chinese values and a centrally controlled state construction industry.

Our intention in revising and updating this book continues to be to provide students, researchers, practitioners and those involved in the provision of construction services with a wide-ranging appreciation of the issues involved in the procurement of building projects. We have endeavoured to include in this edition a review of significant advances which have emerged in both research and practice since publication of the first edition. The book covers an exceedingly broad canvas, and we are well aware that some areas are treated

somewhat superficially. This is partly deliberate in the search for readability (this is after all not a research thesis) and partly imposed by pressures of space, but we trust that the references given will enable those seeking a deeper understanding of specific issues to be able to explore the subject in greater depth.

May we jointly express our grateful thanks to all of those colleagues and friends with whom we have debated issues and discussed techniques and points of principle over the years. Many of the outcomes from these discussions have found their way into this book in one form or another.

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Introduction

The worldwide construction industry embraces the sectors of building, civil engineering and the process plant industry. It includes projects of dramatically different types, sizes and complexity and requires extensive professional and trade skills. Groak (1994) suggested that the construction sector was more an agglomeration of projects than a discrete industry or a fixed constellation of firms. Winch (2002) suggested that construction is essentially a service industry. He argued that what is sold to the client is not a product but a capacity to produce.

However construction is described, it is an important contributor to the national economy (CIOB 2020); without adequate construction capacity, aspirations for economic growth cannot be achieved. Economic activity, self-evidently, is the primary driver for construction activity and the two are inextricably linked.

There is, however, an inherent dysfunction between demand and supply because of the extended time period between the initiation of the project procurement process and its eventual delivery. This period of time can encompass significant changes in economic activity, and this may provoke changes to the initial rationale for the construction process.

There is constant demand for the construction sector to source the physical assets necessary to live and work in modern society. The building industry produces a diverse range of outputs ranging from products verging on mass production, in the construction of houses, through bespoke service facilities, such as schools and hospitals, and elements of production, in the form of industrial premises to house the manufacturing operations of organisations both large and small, to minor repair and maintenance work. Civil engineering, on the other hand, provides for many of our transportation needs in the form of roads, tunnels and bridges, railways, docks and airports, for our energy needs in the form of pipelines and power lines, and for the essentials of civilised life in the form of water and sewage treatment facilities, distribution and disposal systems. Indeed, the capital assets of a country consist predominantly of built environment assets. For instance, more than three quarters of the UK's stock of economic assets result from construction. In 2017, dwellings and other buildings and structures accounted for £3620 billion of the UK's £4670 billion of capital assets (CIOB 2020).

There is therefore no doubt that construction forms a major aspect of the economy. For example, in the UK it currently contributes approximately 6% to the GDP and provides direct employment for 7% of the working population (House of Commons Library 2019).

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History shows that, over time, construction demand is variable and is often affected by government policy changes as well as national and local economics. In 'Construction Matters' (Business and Enterprise Committee 2008), the UK House of Commons suggested that as many as 95% of clients were either one-off or inexperienced clients. A significant minority of more experienced regular clients spend very significant sums on construction but there is little evidence of the cascading of knowledge and experience from these regular buyers to the inexperienced majority. Equally there appears to be little understanding by inexperienced clients of the need for that knowledge. The result is a heavy dependence upon construction professionals who have, in the past at least, tended to limit their exposure to risk by leaning towards traditional practice.

Few construction companies employ skilled craftsmen, preferring to outsource rather than to retain and train. Most skilled tradesmen are self-employed or employed in small specialist companies because the returns are greater than employment by contractors. This scenario results in huge fragmentation and specialisation, with 99.7% of firms in the industry being small and medium-sized enterprises (SMEs), most of which employ fewer than seven people and take work on a project-by-project basis (Business and Enterprise Committee 2008). Small firms rarely feel able to afford to train new people and, consequently, there have historically been comparatively few young tradesmen in the industry. At the same time, the role of traditional contractors has moved from one in which they manage their own people to one in which they coordinate the activities of other, typically smaller companies and organisations.

This fragmentation of the industry means that it tends to be a diverse supply market from which clients may source their specific needs. There are subcontractors or specialists who occupy specialised niches in order to survive by avoiding direct competition with established market-leaders. There are also firms that are spanning these 'niches' in the provision of complete 'solutions' to large organisations and who act as 'integrators'. The end result is a very large number of specialists with which any client may do business in the delivery of his or her construction requirements.

A further consequence of fragmentation is that the industry has in the past taken little or no responsibility for seeking improvement in terms of either design or process. The inexperience of most clients of the industry means that they have tended to rely heavily upon advice from construction professionals who, unless any improvement is tried and tested, are reluctant to use their client's project as a test bed.

Even 25 years after Sir Michael Latham (1994) highlighted the difference between construction and other industries, investment in construction research and development is still significantly lower than in other industries. Consequently, if there is innovation it tends to be driven by legislation, by the client or by other industries' changes in technology which can be imported to construction through specialist suppliers. Perhaps the exception is the attempts made by companies to develop new ways to deliver housing. In some cases, modern methods of construction are proposed using off-site production. These proposals, usually adopting a pre-prepared panel system, do meet the requirements of legislation but also require a client, such as a local authority or housing association, to need a relatively large number of completed homes before the up-front investment is viable (EMDA 2011; Trowers and Hamlins 2019).

The construction industry is unique in the way that it responds to the need to deliver predominantly one-off products. In this sense, the industry is quite different from the manufacturing or retail sectors which have continuous demand and are thus able to construct and refine stable supply chains. These industries can focus on improving the product or streamlining their supply chain management processes. The product of construction is bespoke in nature and the supply process is more an inconsistent network than a coordinated and carefully managed supply chain. This can often cause conceptual difficulties for clients coming to the industry with a value proposition associated with the delivery of a project. Clients, who usually purchase defined and specified goods in the course of their normal business and who concentrate on price and delivery, usually need considerable assistance to purchase undefined, unspecified projects where price and delivery are both vague at the outset.

The process has been described and analysed as having six primary steps (Egan 2002), commencing with a business case rooted in the client's established need for the project. From this business case or value proposition, the client will be able to identify a multiplier from the investment. User value is usually significant as a multiplier of spend.

Whilst the benefits from the construction process can be immense in investment or business terms, the perceived performance of the construction industry appears historically poor. Many, perhaps most, projects are delivered late, over budget and with variable quality standards. Often these are unwelcome outcomes which frequently surprise the client organisation and cause significant problems.

Table 1.1 summarises the UK construction industry's performance over 10 years to 2018. This is based upon construction industry key performance indicators (KPIs) and indicates

Table 1.1 Summary of UK construction industry performance 2008–2018 based upon industry key performance indicators (KPIs).

KPI	Measure	2008 (%)	2009 (%)	2010 (%)	2011 (%)	2012 (%)	2013/ 2014 (%)	2015 (%)	2016 (%)	2017 (%)	2018 (%)
Client satisfaction – product	8/10 or better	83	86	87	87	83	82	81	85	90	87
Client satisfaction – service	8/10 or better	77	84	82	80	75	75	73	77	81	77
Predictability of construction cost	% on target or better	48	46	47	59	58	57	56	64	65	66
Predictability of project cost	% on target or better	49	48	52	63	61	69	69	68	65	66
Predictability of construction time	% on target or better	58	59	57	60	42	57	48	55	67	59
Predictability of project time	% on target or better	45	45	43	45	34	45	40	41	66	63

Source: The KPI Team (2018).

some improvements compared with previous surveys, such as those carried out by client groupings (CCF 1999/2000).

At first sight, this performance does not look very good. Some improvement has been identified in relation to client satisfaction with the product but client satisfaction with the service received from contractors has dropped back to the 2008 level, with 77% rating their satisfaction as 8 out of 10 or higher. There has been a significant improvement in both project cost and time predictability but there is more room for improvement in predictability. Each project is, however, unique and it is very difficult to estimate the cost of a future design or when it can be delivered.

The lack of a consistent, industry-wide database of project costs and project times is a huge disadvantage and there are so many variables. Whilst the Building Cost Information Service run through the Royal Institution of Chartered Surveyors is an extremely useful source of information, it is limited to the extent to which data is voluntarily supplied.

It is the client who takes the initiative to start a construction project and, therefore, construction is often a customer-driven, one-off production process. Frequently the client will set targets based upon a set of expectations drawn from his or her own experience, which may well be unsuitable for a construction project. Inevitably, construction professionals and constructors will strive to meet the client's demands, often taking a much too optimistic approach, in the absence of a completed design, to what can be achieved for the price or in the time allocated.

The initiation of the construction process is usually aligned to the strategic or business need by the client for a constructed asset, e.g. a school, a factory, or an office complex. After developing an appropriate brief for the project and establishing and prioritising parameters and priorities, a project organisation will be created to provide the necessary expertise to finalise the design and specification. Usually a tendering process will follow to select a contractor. In most cases, this contractor will take care of the employment of specialists and subcontractors and the procurement of materials. When contracts are signed and enough of information is available, the physical execution of the construction project can start. This includes obtaining materials, manufacturing, engineering and assembly of elements, and finally construction on site. After the successful completion of the project, there will be a hand over and use will be made by the end user of the completed asset.

Construction is largely a site operation, confined to the specific location where the final assembly takes place, and it is important to note that construction takes place at the site of consumption unlike in the manufacturing industry, where products are produced in bulk for subsequent consumption at a distance.

Construction project organisations, in contrast to manufacturing organisations, tend therefore to be temporary. The participants involved with this temporary organisation experience frequent changes of membership but are totally interdependent on each other, operating through a variety of contractual arrangements and specific procedures.

In summary, it can clearly be seen that the construction industry is vital to the economy but that both demand and supply are fragmented, inconsistent and complex. Collaboration and innovation are the exception, not the rule, and most purchasers of construction are inexperienced. Nonetheless its products are valuable, useful and serve their purpose, and the key to their successful production is effective procurement. This book aims to explore the factors that are influential on success in procurement.

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2

Procurement Strategy: A Literature Review

Introduction and Early History

The efficient procurement of construction work (defined here as the framework through which construction is brought about, acquired or obtained [Sharif and Morledge 1996]) through choice of the most appropriate procurement strategy has long been recognised as a major determinant of project success (Bennett and Grice 1990). Indeed, Newcombe (1994) argued that the selection of the procurement path is much more than simply establishing a contractual relationship. Rather, building on the work of the Tavistock Institute (1965) and Cherns and Bryant (1984), he argued that the procurement strategy not only creates a unique set of social relationships but also 'forms a power structure within a coalition of competing or co-operating interest groups'. In terms of quantifiable project deliverables, Gordon (1994), in an American study, reported that it was possible to reduce project capital cost by an average of 5% through selection of the most appropriate procurement methodology.

In the modern world, client satisfaction is increasingly seen by all concerned with the development and construction process to be largely dependent upon the selection of the most appropriate procurement methodology and failure to select an appropriate procurement approach was recognised well over two decades ago as a primary cause of project failure (Masterman 2002). Hibberd and Djebarni (1996) reported that whilst 64% of the clients they surveyed were happy with the procurement methodologies they were using at the time, 89% stated that they had previously been dissatisfied. Smith and Wilkins (1996) reported that, in a study of 11 publicly funded major hospital projects constructed in the UK, USA, and Hong Kong, projects procured using a traditional approach consistently failed to achieve the client's objectives in terms of time or cost or both, whereas projects procured using a design and build route consistently fared much better. They did, however, point out that this was not necessarily because the design and build route is generically better than the traditional path; simply that, at the time the reviewed projects were procured, the choice of a design and build path was the result of a careful analysis of project characteristics and client expectations, whereas the traditional path was generally chosen 'because it's always been done that way'. This last point then appears to indicate a lack of skill or knowledge on the part of those making the procurement decision.

These issues were in fact already well recognised by early researchers in the field. Authors such as Franks (1984) and Nahapiet and Nahapiet (1985) offered critiques of the major procurement methods in common use with some advice on how to go about making the most

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appropriate choice, based largely upon the client's perceptions of what would constitute project success in terms of time, capital cost and quality. Nonetheless Bowen et al. (1997) reported that their research led them to believe that relatively few construction industry professionals fully understood the differences between the various procurement systems and that most would be unable to make sensible recommendations as to which system would be most appropriate for a specific project. Similarly, Broome (2002) noted that the process of developing a procurement strategy was like 'a black box' to many in the industry. More recent industry guides and reports such as the Institution of Civil Engineers' (ICE 2009) client best practice guide, the British Standard for Construction procurement policies, strategies and procedures (BS 8534:2011 2011) and the RIBA (2013)'s work plan have helped to demystify the concept of procurement strategy in project delivery.

Procurement Route Selection Models

Early attempts to examine the strategic procurement selection process led a number of academics and practitioners to develop structured methodologies, tools and models of various types to aid this selection process. Among the models published in the UK, one of the earliest was *Thinking About Building* (Economic Development Committee for the Building Industry 1985) and its approach was further developed, and made progressively more complex, by a wide range of researchers using a variety of mathematical and statistical techniques. Many early researchers proposed some form of multi-attribute decision analysis, among them Skitmore and Marsden (1988), Bennett and Grice (1990), Cook et al. (1993) (who proposed the use of multilevel decision trees), Chan et al. (1994) (who adapted Skitmore and Marsden's model to suit the Australian construction industry), Zavadskas and Kallauskas (1996), Dell'Isola et al. (1998), and Love et al. (1998b). Ambrose and Tucker (2000) continued the theme with the development of yet another multi-attribute model, but this time based on a three-dimensional matrix, and Chang and Ive (2002) carried out a critical examination of the multi-attribute approach.

Cheung et al. (2001) and Al-Tabtabi (2002) presented further variations on the theme with models using an analytical hierarchy process built upon the work of earlier researchers, including Saaty (1980) and Skibnewski and Chao (1992). The successful practical use of Al-Tabtabi's model was demonstrated with a live case study showing how it was used in the procurement of the Kuwait University Expansion Program, a substantial project comprising more than 40 design and construction packages and costing approximately 132 million Kuwaiti dinars (approximately US$467.5 million in August 2012). Seydel and Olson (1990) and Ng et al. (2002) took a somewhat different approach, presenting models based on the use of fuzzy set theory, and Alhazmi and McCaffer (2000) developed the Project Procurement System Selection model (PPSSM) based upon a four-step screening process.

In spite of all of this, not inconsiderable, academic effort, Chan (2005) wrote that 'none . . . [of the existing models] . . . has been adopted widely in practice' and proposed yet another model based upon a combination of the multi-attribute and fuzzy set models previously published by Cheung et al. (2001) and Ng et al. (2002), respectively.

ELSIE, developed under a project funded by the Royal Institution of Chartered Surveyors (RICS) and based at Salford University (Brandon et al. 1988; Brandon 1990), and PASCON

(Mohsini and Botros 1990) are two examples of attempts to automate the procurement selection process through the development of computer-based expert systems. Again, neither appears to have been widely adopted in practice.

A rather more radical approach was the Best Value Procurement/Performance Information Procurement System (BVP/PIPS) developed over a 20-year period by Dr Dean Kashiwagi and the Performance Based Study Research Group based at Arizona State University in the USA (PBSRG 2012). The BVP/PIPS system is described as an integrated and detailed structured methodology which includes not only selection of the initial procurement route, but also contractor selection, bidding and price analysis (Kashiwagi et al. 1996; Kashiwagi and Mayo 2001). The approach was claimed to have been widely used in the USA and PBSRG (2012) discussed a number of case studies. It was also claimed that the approach had been used for several projects in Botswana. Although successful projects have been run using the PIPS system within its home environment, it is openly admitted that, despite attempts to transfer the technology to other universities in the USA, the UK, Malaysia, Botswana, New Zealand, and Australia, 'the PBSRG research model had not been proven to be successfully transferable to other research group [sic] or to other countries' (Kashiwagi and Kashiwagi 2011). Nonetheless Kashiwagi and Kashiwagi (2011) claimed that the system had been successfully introduced into the Netherlands.

More recently, Appiah (2016) continued the theme by developing an electronic system for selecting building procurement routes. The procurement design support (PDS) software takes users through a series of questions about the client and project requirements and then recommends the most suitable procurement approach based on a detailed qualitative and quantitative assessment of the project specific information. Appiah (2016) argues that his PDS system acts as an intelligent assistant that helps client advisors to ask the right questions and encourage decisions aligned with organisational requirements and project objectives. It also encourages users to set down their justifications for decisions made in order to facilitate the auditing process.

Towards a Broader View

In contrast to those who believed that a purely systems-driven, mathematically derived approach would deliver project success, other commentators recognised selection of the most appropriate strategy for large or complex projects, particularly those involving multiple stakeholders, to be a difficult and complicated process dependent upon the interaction of many variables and incorporating a high degree of subjective, and in many cases intuitive, judgement (Luu et al. 2003). We should also note that the problems of complexity tend to be magnified greatly where the overall complexity of the project depends not only upon the technical complexity of the work but also upon the complexity of the context in which the project is to be developed and constructed.

Issues of complexity and the difficulties of improving project success came to a head in the UK in the early 1990s, when client concerns over the generally unsatisfactory performance of the construction industry in terms of its ability to deliver on time, within budget and to the expected quality and performance standards placed the role of the client in construction procurement firmly in the spotlight.

In light of the above, it is no surprise that procurement issues featured strongly in Sir Michael Latham's government-sponsored report on the UK construction industry (Latham 1994). Latham's recommendation that the construction industry should move towards more collaborative methods of procurement built largely upon existing experience elsewhere. In Japan, for example, it is claimed (Reading Construction Forum 1998) that partnering was part of the normal way of working. In the USA, partnering had been practiced from the mid 1980s; the term appears to have been first used to describe the Fluor Daniel/Du Pont alliance for construction work at the Cape Fear plant in 1986 (Kubal 1994), although it was not until the early 1990s that 'time and money . . . being . . . wasted in defensive posturing, case building, developing claims and litigating' in the late 1980s (ATI 2007) led the Construction Industry Institute to develop a formal partnering approach. The approach was soon picked up and used with some success by the US Army Corps of Engineers (Cowan et al. 1992). McGeorge and Palmer (1997) reported that trials took place in Australia, also in the early 1990s. Similar concepts were also introduced in international oil exploration projects, where alliancing as a concept was pioneered by Shell and British Petroleum in the North Sea, again in the early 1990s, as a method of sharing risk and reward in high-risk, high-cost activities (NEDO 1991; Skeggs 2003; Sakal 2005).

The need for change in the UK was also fuelled by a growing insistence by major clients that, rather than being considered simply as passive customers of construction services, they should actively participate at the very heart of the construction procurement process as a full partner. Liu (1994) understood this issue well, suggesting that successful procurement approaches would be more likely to result from a deeper mutual understanding of the organisational and performance goals of the parties involved. She clearly pointed to the importance of understanding the cultural and organisational aspirations of all stakeholders in the procurement process, in particular those based upon a collaborative relationship. A number of academics and researchers examined various facets of the client's role (see for example the work of Wilkins and Smith (1995)) and concluded that, particularly in the case of complex buildings, there was evidence that closer involvement of the client in the procurement process appeared to be a significant factor in project success. The enhanced client interest in the procurement process, coupled with demands for clearer guidance on procurement issues, led directly to the publication of *The Procurement Guide* (RICS 1996), which was republished in 2013 (RICS 2013).

A second government-sponsored review of the UK construction industry by Sir John Egan (Egan 1998) set targets for improvement in construction performance designed to improve customer satisfaction; the implementation of Egan's recommendations was subsequently accepted as UK government policy for centrally funded public sector projects. The targets were also made implicit in the public sector 'best value' legislation introduced in 1997, which required all public bodies to show that they were achieving maximum value for money (defined in terms of whole-life cost not just initial capital cost) in all of their projects including construction work. The message was further reinforced by the National Audit Office (NAO) 'Modernising Procurement' report (NAO 1999), which amongst other things emphasised the need, particularly in the case of strategic projects, for close client involvement in allocating and managing risk and setting out effective mechanisms to incentivise superior project performance.

In the spirit of the new paradigm, Newcombe (2000) adopted a somewhat different approach to modelling procurement, and presented the development and field testing of a

construction procurement simulator designed to aid the development of skills in analysing client needs and translating them into an appropriate procurement path. More recently, concerns over the environmental performance and social sustainability of the built environment have led some to question how these specific issues ought to be addressed in the construction procurement process.

Interest in the integrative aspects of construction procurement has, predictably, led to a more detailed and extensive study of the different elements of the procurement problem as part of the wider discipline of construction management. In recent years, therefore, we have seen considerable attention being paid to understanding how the individual elements of the procurement process work – individually, in combination with each other and in interaction with the rest of the construction management process. This process has been carried out largely by attempting to relate practical empirical experience of successful and unsuccessful projects to established theoretical concepts in general management, industrial psychology, and motivation. A number of major threads in procurement research have emerged from this work including, in no particular order:

- More complex procurement strategy selection models (see for example the computerised decision making tool presented by Luu et al. (2003, 2005, 2006), which combined the use of case-based reasoning, fuzzy logic and elements of the earlier expert systems approach).
- Team relationships, supply chain management and communication and their effect on project performance.
- Defining in greater detail the role of the client in the procurement process.
- The interrelationship between the various components of the overall procurement approach (e.g. the overriding strategy, the contractor and consultant selection processes, the contractual framework and tender evaluation models) in enhancing project success (the general presumption seems to be that, for a process to be deemed successful, then the whole must be greater than the sum of the parts).
- Legal and contractual issues, including public sector procurement legislation, and their impact upon project performance.
- Comparative analysis of international procurement practice and the impact of cultural differences.
- Risk allocation and reward.
- Bid evaluation techniques.
- The impact of environmental and sustainability issues upon the procurement process.
- Sustainable procurement for construction projects.

Defining Project Success

It has already been shown that many attempts have been made to develop selection models designed to match a range of project performance indicators to the project characteristics with the aim of achieving improved overall 'project success'. The problem, however, lies in the definition of 'project success' and there have been many attempts to define how success might be measured (see for example the work of Cooke-Davies (2002)). Eriksson and Westerberg (2011) pointed out that although many still held firmly to what they termed the 'iron triangle' of primary success criteria (time, cost, and quality), in reality it was no

longer adequate, and additional criteria, such as environmental impact, work environment and innovation, are now assuming increasing importance.

Many construction professionals believe overall project success to be a comprehensive assessment arising out of a consensus of all key stakeholders. Others, however, appear to believe that this approach is much too complex and that client satisfaction with the final outcome is perhaps the most important indicator of whether a project can be considered successful or not. The problem here is that many complex projects are commissioned by complex and multi-headed client bodies, who may find it difficult even among themselves to agree on a generally acceptable definition of overall project success.

If the key objectives can be isolated, then it has long been recognised that the selection of an appropriate procurement methodology which adequately matches the objectives of the key stakeholders is an important contributor to overall project success (Akintoye 1994; Naoum and Mustapha 1995).

Kumaraswamy and Dissanayaka (1996) reviewed existing attempts to model the procurement process and suggested that the debate on what constituted project success could perhaps be moved forward by considering not only the identified project success criteria but also the linkages between them. Based on this presumption, they went on to hypothesise how a theoretical client advisory model based upon weighted client objectives might be constructed. Eriksson and Westerberg (2011) address this theme in an extremely wide-ranging study of the way in which cooperative procurement procedures (defined by them as joint specification, select tendering, soft parameters in bid evaluation, joint contractor selection incentive-based payment, quality, environmental impact work environment and innovation) impact upon project performance. They put forward a theoretical framework linking all of these concepts and describing how the various relationships may be moderated by issues such as trust, commitment and the characteristics of the project. Kwegyir-Afful (2018) argues that the use of time, cost, and quality as project success criteria has resulted in several projects being prematurely classified as failures. He further suggests that the benchmarks may have been underestimated or erroneous in the first place, and therefore failure to meet the required project management success criteria may not necessarily mean that the project is a failure. He therefore suggests that a project which delivers the intended benefits can be classified as successful. Williams's (2016) study on success factors in construction projects, which explored the multifaceted nature of success, illustrates the nature of project success as being multidimensional with different criteria; only some of which are directly measurable. Where clients have established a set of specific objectives for their projects, these objectives can be used as a framework within which the design and construction process must fit, and they therefore become the key factors against which project success will ultimately be judged (Morledge 2010).

Team Relationships, Supply Chain Management and Communication and Their Effect on Project Performance

Teamwork and Team Performance

Teamworking has long been recognised as a key management area in construction (see for example the work of Walker (1989) and Bennett (1991)) and, in recent years, researchers

have become increasingly interested in the contribution good team performance can make to project success. The problems faced by construction project teams operating as temporary multi-organisations have long been recognised, and have been addressed by a number of researchers including Shoesmith and Langford (1991), Mohsini and Davidson (1992), and Bowen and Edwards (1996).

Walker (1997) provided a useful review of the relevant literature concerning the effect of team performance on project timescale through a series of 64 major Australian projects (defined as projects in the range A$3–80 million). He concluded that:

> Team performance appears to be a complex balance of the management action, undertaken through planning, co-ordination and communication, to aid and inform decision making. Various team members employ different levels of task or people oriented management styles and different organisational responses in terms of rigidity or flexibility towards rules and regulations. These are undertaken in response to situational factors and different groups respond in different ways depending on their management maturity and/or willingness, as well as the perceived level of complexity of the tasks they face.

He also concluded that inhibited team management would inhibit team performance and he agreed with other researchers (Smith and Wilkins 1996) that, particularly for complex projects, non-traditional procurement methods are more likely to enhance construction time performance. Newcombe (1999) supported the idea that the chosen procurement path has considerable influence upon the project team's ability to learn, a contention for which he presented a detailed theoretical justification. Moore and Dainty (2000) examined a series of issues relating to communication specifically within design and build teams. Kumaraswamy (1998) concluded that, irrespective of the procurement system used, project success depends primarily upon the attitude, determination, and capabilities of those involved. Tennant and Langford (2006) examined the assertion that better performing teams produce better performing projects. Based on their findings, they argued that a genuine commitment to team working can remodel organisational relationships that better transgress the short-term site environment representative of the construction industry into long-term strategic partnerships that will benefit both the client and the provider over several projects. As pointed out by Baiden et al. (2003), integrated teams enable efficiency of the delivery process, cost effectiveness through elimination of waste and increased profitability. Ochieng and Price (2010) examined how cultural differences could impact upon multicultural team performance. Their findings highlight certain attributes required by project leaders managing multicultural construction project teams, including the ability to build trust among team members, provide good planning and institute good communication techniques. The Association for Project Management (APM)'s *Body of Knowledge* guide (APM 2019) indicates that for project teams to be effective it is important that team members are understood as individuals in terms of their capabilities, their preferences, their cultural norms and expectations as well as the social dynamics between team members. By paying attention to these differences, project leaders can create positive working cultures that enable high performance of the team and an increased chance of success.

Partnering: Introduction and Early Development

We have already seen that partnering as a concept for improving team performance has a significant history and has been well described by, amongst others, Patching (1994), Baden Hellard (1995), and Stephenson (1996). In truth, the thinking behind the original concept originated much earlier than many realise. In the USA, in a seminal paper published in the *Southern California Law Review*, MacNeil (1974) foresaw collaboration as an improved contracting strategy for long-term work, although some see the origins of the concept as being earlier still and seek to draw lessons from biblical history (Lynch 1989; Ogunlana 1999). The long-running strategic alliance in the UK between Marks and Spencer and Bovis, based upon the Bovis System contract (essentially prime-cost contracting with pre-agreed fees for overheads and profit) began in the 1930s and remained in force into the late 1970s (Cooper 2000).

There can therefore be little doubt that partnering has long been the most frequently discussed institutional form of cooperative relationship (Wood et al. 2002; Eriksson 2010a), and, predictably, a considerable part of the academic discussion has comprised reports of its claimed success.

In the USA, Weston and Gibson (1993) reported average cost savings of 18.49% and time savings of 12.33% on a sample of 120 projects let by the Arizona Department of Transport; Larson (1995) reported significantly improved results in terms of controlling cost, technical performance and client satisfaction arising from the use of partnering on a sample of 280 projects.

Uher (1999) presented a review of Australian experience and concluded that, from its introduction in 1991, despite its relatively short (and somewhat chequered) history, partnering (later renamed 'relational contracting') was firmly established as an integral part of the Australian construction industry. Lenard (1999), also commentating on contemporary Australian practice, reported that a study of 17 construction projects in and around Sydney found that a symbiotic contractual and working relationship between the client and the contractor encouraged innovation and facilitated the development of a learning environment within the project team. Kenley et al. (2000) provided yet another view of Australian practice in the context of the *Construct Australia* report published by the Australian Procurement and Construction Council (APCC 1997).

In the UK, partnering was strongly advocated by Sir Michael Latham in his review of the UK construction industry (Latham 1994) and was later endorsed by the government as the way public sector projects should be let whenever possible.

Partnering: A Critical Review

The partnering concept has received significant academic approval and widespread endorsement in the UK by clients, contractors and researchers alike. See for example the work of Bennett and Jayes (1995, 1998), Walter (1998), and CIB (1997). Smith (1999), in Chapter 10 (later republished in Grimsey and Lewis (2005)), argued more broadly that the concept of partnering was fundamental to the development of the strong and stable relationships required to successfully deliver major long-term public service schemes delivered through any form of public/private sector collaboration. There are, however, those who

questioned the effectiveness of partnering as an improved method of procurement (see for example the work of Cox and Thompson (1997) and Smyth and Thompson (1999)), whilst others maintained that it was merely seductive rhetoric encouraged by large corporations eager to flex their commercial muscle (Green 1999), and one would have to admit that in some supposed partnering relationships, although the parties spoke of trust and commitment, the thinly veiled threat of differential commercial muscle appeared to lurk only just beneath the surface.

Particularly relevant in this regard are the relationships between main and subcontractors. Miller et al. (2003) explored these issues from the point of view of small construction enterprises in the construction industry in South Wales. They concluded that although 'the degree of harmonisation between the contractor and small subcontracting firms is inextricably linked to client satisfaction', it was nonetheless 'evident that the partnering philosophy is not currently embodied within the industry in industrial South Wales despite continued attempts by policy makers to encourage construction firms to subscribe to such concepts'. They also suggested that the needs and objectives of the smaller subcontractors were frequently overlooked and that, despite exploiting partnering agreements with employers, main contractors still treated their relationships with their smaller subcontractors in an opportunistic and somewhat cavalier fashion. Mason (2007) also reviewed the partnering experience of specialist contractors across the UK, finding that although there were some examples of successful collaboration, there was also cynicism and mistrust. He concluded that, despite some positive developments, little had changed in the decade prior to publication of his study to improve the lot of the specialist contractor. Anecdotal reports of the number of adjudications commenced by subcontractors against main contractors under the statutory adjudication provisions brought into law in the UK through the Housing Grants, Regeneration and Construction Act 1996 (the Construction Act), and later strengthened in the Local Democracy, Economic Development and Construction Act 2005, would appear to indicate that little has changed in this respect.

Nonetheless commentators such as Wood and McDermott (2001) argued that there was significant evidence (Lewicki and Bunker 1996) that, provided the parties were able to establish even a fragile level of trust, then collaborative relationships were viable. Establishment of at least a basic level of trust is vital and is extremely difficult to achieve. Ekström and Björnsson (2002) explored the use of source credibility theory (Hovland et al. 1953) in building trust in an e-tendering relationship and Das and Teng (1998) explored the issue of managing relational risk in cooperative alliances.

Many academics have attempted to investigate the extent to which partnering arrangements may be deemed successful and the characteristics which influence that success (see for example the work of Black et al. (2000) and Yeung et al. (2008)). By and large partnering has been endorsed in a substantial number of studies across the world as an effective tool for the enhancement of project success (see for example the work of Naoum (2003), Wood and Ellis (2005), and Matthews (1999) in the UK; Rahman and Kumaraswamy (2002) in Hong Kong; and Kwan and Ofori (2001) in Singapore). Jeffries et al. (2001) take the partnering issue one stage further with a detailed case study examining how a strategic alliance model derived from the oil industry was used to structure an alliance between a number of specialist companies in order that an economically marginal project could be successfully completed.

Skeggs (2003) however pointed out that, at the time of his study, partnering did not seem to have been successfully established in countries such as France and Germany. He speculated that this may be because 'there is a lack of effort by government and industry to reform the construction industry' and that there are inherent 'difficulties in implementing partnering under civil law systems', but Crespin-Mazet and Portier (2010) attributed the lack of enthusiasm in France to 'the resistance of purchasers who feel threatened by the structural changes it involves in their purchasing habits'.

Notwithstanding academic endorsement and the zeal of partnering enthusiasts, there are those who point out that hard research evidence on the tangible benefits and limitations of partnering is both limited and mixed (Nystrom 2008; Greenwood and Wu 2012). Phua (2006), citing Wood and Ellis (2005), maintained that the partnering literature is focused almost entirely on 'success stories which are largely anecdotal' and, together with others (see for example the work of Kadefors et al. (2007)), she maintains that partnering had still to achieve its full potential. Phua is also scathing about some of those academics who have reported project success in terms of performance improvements in terms of time, cost and quality performance, maintaining that 'no empirical evidence concerning the nature and effects of any or combination of these different aspects of partnering on project success exists.' Reports of partnering failures do however exist (see for example the work of Larson (1997), Angelo (1998), and Alderman and Ivory (2007)) but they are, admittedly, thin on the ground.

Several researchers have addressed the criticism made by Phua. Yeung et al. (2007) derived a set of key performance indicators (KPIs) to measure the success of construction project partnering arrangements in Hong Kong on the basis of a Delphi study with 31 local construction experts. They concluded that the seven most important KPIs, ranked in order of importance, were time performance, cost performance, top management commitment, trust and respect, quality performance, effective communication, and innovation and improvement. Greenwood and Wu (2012) attempted to address the criticism through a rigorous examination of a sample of 44 projects against a set of clearly identified indicators of project performance using a social network analysis approach. They conclude that their study clearly shows a positive linear relationship between collaborative working and performance.

Some other commentators (for example, Bresnen (2009, 2010) and Eriksson (2010a)) believed that at the time of their studies there was still an incomplete understanding of what partnering actually meant, or how it fitted into an established body of management theory, and that partnering would not achieve its full potential until these shortcomings were addressed. Bygballe et al. (2010) reviewed the literature with a view to identifying the main assumptions about construction partnering and concluded that improvements in performance might be achieved through a greater appreciation of the theoretical perspectives of supply chain management and the industrial network approach. Bresnen (2010), in an attempt to forge a respectable academic foundation as a basis for practice, revisited a theoretical model of partnering as an approach based upon information sharing and knowledge transformation across organisational and contractual boundaries first proposed almost two decades previously by Crowley and Karim (1995). Pemsel and Wídén (2011) examined the general issue of knowledge transfer across inter-organisational boundaries in the context of real estate companies and end users and concluded that the successful transfer of

knowledge was largely dependent upon an accurate and shared understanding of all participants' needs. The issue is studied in the context of a partnering relationship by Ruan et al. (2012), using a social network analysis approach, through a case study examination of four UK public sector projects.

Partnering Variants

It has long been recognised that the term 'partnering' is frequently used as an umbrella term for a number of different arrangements. The distinction between short-term project partnering and long-term strategic arrangements has been well explored, but there has long been confusion and misunderstanding about the meaning of the labels given to the different types of multi-party contractual arrangement. An early distinction between partnering and alliancing was set out by Walker and Hampson (2003) in the following terms:

> with partnering . . . partners still retain independence and may individually suffer or gain from the relationship. With alliancing the . . . parties form a cohesive entity, that jointly shares risk and rewards to an agreed formula.

Rowlinson and Cheung (2004) provide an exploration of the differences between partnering, relational contracting and alliancing but it is clear with the benefit of hindsight, that the distinctions were neither fully understood nor appreciated, since Lahdenperä (2012) again returned to the theme in an attempt to clarify the similarities and differences between project partnering, project alliancing and integrated project delivery.

In light of the fact that, notwithstanding the problems of convincingly linking collaborative approaches to a tenable theoretical base, collaborative approaches have now achieved a substantial degree of maturity and acceptance, we might expect to see further research interest in the various different ways in which the basic concept might be expressed.

Partnering Dissected

Other researchers have concentrated on an examination of the contribution made by the various elements of both the partnering process and the environment in which it takes place. Some typical examples include the work of Halman and Braks (1999) (the organisational structure of the partnering arrangement), Bresnen and Marshall (2000) (the contribution made by long-term relational links), Cheung et al. (2003) (open and reliable lines of communication), Rahman and Kumaraswamy (2005) (establishing joint risk management structures), Ngowi (2007) (team member trust and confidence), Eriksson and Pesämaa (2007) (elements in client procurement procedures which facilitate the establishment of trust and cooperation), and Eriksson et al. (2008) (client perceptions of barriers to partnering).

Doloi (2009) in a study of relational partnerships in Australia considered the cumulative effect of communication, trust and joint risk management. He concluded that, counter to the prevailing Australian view at the time, successful partnering was dependent not only upon trust and confidence, but that communication based upon confidence and trust was deemed the single most important factor impacting upon partnering success, and

true success was only achieved when all of these factors resulted in effective joint risk management. In a similar vein, Kaluarachchi and Jones (2007), in a case study of a strategic partnering undertaken in a social housing context, concluded that 'mutual trust, effective communication, a changed mindset from all parties, [and] the quality of the services and commitment of all stakeholders seem to be the key factors that contribute to a successful partnering process'.

Procurement and Multicultural Teams

Many researchers have studied the challenges which arise, and the advantages which may arise, from the use of multicultural teams on construction projects, and Ochieng and Price (2009, 2010) present a brief review of the literature.

There can be little doubt that, to be successful, partnering is dependent upon assembling a project team which already shares (or may be persuaded to share) a common set of ethical and cultural beliefs and values, and the impact of cultural differences in the project team, at the organisational, national, and personal levels, is a further factor which has been considered by many researchers. Comparatively few researchers however appear to have studied the effect of a multicultural environment specifically on the procurement process.

Ngowi (1996) considered the impact of multicultural teams on project procurement in his review of the experience of procurement innovation in 10 major projects in Botswana, half of which were carried out by local teams and the remainder by multinational, multicultural teams comprising combinations of British, Chinese, German, Kuwaiti, Belgian, and local Tswana organisations. He found evidence that where multicultural teams were involved innovation tended to be less prevalent, whilst miscommunication and disputes tended to increase within a multicultural framework. He concluded that teams sharing the same culture tended to be characterised by lower degrees of uncertainty and anxiety than those that did not. Plainly care needs to be taken to ensure that particular attention is paid in multicultural teams to ensuring not only good communication and a clear understanding of shared language, but also that each team member has a good understanding, appreciation and acceptance of the cultural values and beliefs of the others involved.

Liu and Fellows (1996, 1999, 2001) have extensively explored the impact of culture on construction project goals, on the construction procurement process, and on construction partnering. Kwan and Ofori (2001) considered the relationship between the traditional Chinese culture and partnering in the context of the construction industry in Singapore. Shiyamini et al. (2005) studied construction procurement methodologies in Sri Lanka and concluded that the combination of national culture and the organisational culture of the local construction industry did not favour the use of new procurement methods, although these factors were, to some extent, moderated by economic growth. The increase in complex overseas projects, particularly in emerging markets, has led to a need for internationally focused construction companies to form relationships of some kind with local partners who have access to contacts or experience of the particular construction industry concerned. Sometimes, the involvement of a local partner may even be one of the client's main requirements (Henty 2011). A study carried out in 2004 (PWC and CFO Research Services 2004) found that when joint ventures fail, 30% of the time they do so because of differences in culture between the parties. Even when the parties are from the same construction jurisdiction,

differences in organisational culture can present a major challenge in partnering arrangements and the management of the procurement process.

Supply Chain Management

The area of supply chain management (Saunders 1997) within the construction project team has also received considerable attention over an extended period of time with several researchers asserting that construction can learn key lessons from manufacturing and production management. See for example the work of Koskela (1992), Love and Gunasekaran (1996), Kornelius and Wamelink (1998), Love et al. (1998a), Howell (1999), and Green et al. (2002). Lee et al. (2000) describe the development of a supply chain management tool, called the Generic Design and Construction Process Protocol (GDCPP), which attempts to provide:

> a common set of definitions, documentation and procedures that provides the basis to allow a wide range of organisations involved in a construction project to work together seamlessly.
>
> (Kagioglou et al. 1998)

Root et al. (2003) explored the application of supply chain management techniques to the construction design process. Following Schneider (1993), they contended that organisational boundaries posed a significant barrier to collaboration, concluding that there was a clear need for integration within the design process, and that formal supply chain management techniques could be used to overcome the problems.

Finnemore et al. (2000) argued for improvements in project delivery driven by improvements in management of the process of construction and reported upon the early stages of the development of a tool called the Standardised Process Improvement for Construction Enterprises (SPICE). SPICE followed the philosophies of Deming (1986) and Juran (1988) and was predicated upon putting into place continuous process improvement based upon a series of small evolutionary steps.

It has however more recently been found that effective management of supply chain relationships is particularly problematic in project-based industries, due to the discontinuity of demand for projects, the uniqueness of each project in technical, financial, and socio-political terms, and the complexity of each project in terms of the number of parties involved (Segerstedt and Olofsson 2010; Skaates et al. 2002).

Nonetheless, there appears to be at least some level of international agreement that excellence in supply chain management is a crucial component of lean construction management (Eriksson 2010b) and this has generated further interest in how it may be made more effective. Davis (2008) reviewed supply chain management practice in Australia on the basis of a large sample of 898 construction professionals, finding a mix of relationship-based and traditional supply chain management techniques. Löngren et al. (2010), in a case study of a strategic alliance between German contractors and their supply chains, found that key factors for success were central coordination among partners employing decentralised task management, the application of appropriate IT solutions and mutual trust. They further concluded that strategic supply chain alliances are crucial for successful management

within the German construction industry. Bankvall et al. (2010) however questioned the extent to which lessons learned from other industries are directly transferable to construction. Their study comprised an examination of interdependencies which exist between supply chain members in construction in comparison with other industries. They concluded that the application of supply chain models developed for other industrial sectors, such as the automotive industry, to construction may be problematic because of the different patterns of interdependence experienced in different industries between supply chain members. They further believe that their findings bring into question traditional construction supply chain concepts, such as moving production from the site to the factory.

At the heart of modern procurement approaches are the appointment of integrated supply chains where the parties in the supply chain have a long-term objective to work together to deliver added value to the client. Constructing Excellence (2004) identifies a number of benefits for individual construction companies in the supply chain. They include: reduced real costs, with margins maintenance, greater certainty of out-turn costs, more repeat business with key clients, and greater confidence in longer-term planning. It is important for project professionals to balance the competitive advantage gained from frequent tendering against the benefits of long-term relationships. The marginal cost-saving gained from frequent competitive tendering may be easily outweighed by the advantage gained from working with a supplier who has grown to understand the organisation and has structured their operation to align with the project's demands (APM 2019). Advantage can be gained by offering the supply-chain continuity and generating efficiencies in the procurement process.

The Role of the Client in the Procurement Process

The role of the client in collaborative procurement has already been explored, but it is also worthwhile summarising the client's role under traditional procurement methods.

Traditional methods of contracting generally involve employers or their agents designing, or at least specifying in detail, the work required prior to competitive tenders being invited from some group of construction contractors. The employer subsequently chooses which of the tenders submitted appears to represent the best value for money and enters into some kind of contract for the construction work. The contractual relationship that results from this traditional process is therefore essentially that of supplier and customer, where the employer decides, in theory at least, in detail what he or she wants and the contractor simply constructs the work as designed. To be successful, the method depends upon employers being able to specify their requirements in sufficient detail for the contractor to accurately price the work. Whilst this becomes progressively more difficult the more the design responsibility is passed to the contractor, it is still possible for the process to deliver acceptable results, but choice of the most acceptable tender becomes more problematic as the number of variables involved increases. Clear goal definition has long been known to be a major determinant in management success (see for example the work of McGregor (1960) and Hersey and Blanchard (1982)) and failure by employers to accurately represent their requirements to the tendering contractors usually leads to confrontation and dispute.

Avoiding confrontation and dispute leads directly to the idea of alternative methods of procurement based upon achieving congruence between the objectives of the principal

stakeholders, shared risk and return, and the joint resolution of problems. Working in this way, the relationship between employer and contractor becomes less 'supplier/customer' and more like a partnership, and therefore places much more emphasis on the whole project organisation working together in pursuit of common goals.

The way in which the client interacts with the remainder of the construction team has long been seen to be a key issue in project success (NEDO 1988; Potter 1995; Green and Lenard 1999; Barrett and Stanley 1999). Whilst it is of course possible that regular construction clients with a deep understanding of the way the construction industry works can operate a supplier/customer relationship very effectively, indeed some, including some large property developers, appear to prefer to do so, it was pointed out many years ago (see for example the work of Ferry (1978)) that 'the uninformed client has an unrealistic idea of what he is letting himself in for'. Most clients interact with the construction team through the appointment of a client representative, sometimes termed a 'project sponsor', 'client's project manager' or 'project director', and it appears that project success may be significantly influenced by the level of confidence that this client representative inspires in the client team (Walker 1995).

The Interrelationship Between the Components of the Overall Procurement Approach: Strategic Procurement Management

Strategic procurement management in construction has attracted comparatively little research attention. Strategic procurement management was defined by Cox (1995) as:

> the development of an external sourcing and supply strategy which links the total business plan of an organisation (public or private) so as to maintain a sustainable position for that organisation in the total value chain.

The significance in enhancing project success of each of the various elements (for example, the contractor and consultant selection processes, the contractual framework and tender evaluation models) embodied within the overall strategy has, however, been the subject of some research and debate. Kumaraswamy (1994) pointed out the need to develop synergy through informed choice of the components of the system and careful alignment of the system with the objectives of the stakeholders, but the evidence as to the particular contribution made to overall project success by individual components seems to be far from clear cut. Walker (1995), for example, concluded that contract type did not significantly alter the speed of construction. Rwelmalila and Hall (1994) found that lack of adequate management of the 'human aspects' contributed significantly to poorer performance.

These strategic issues are addressed directly in some of the procurement models described earlier, in particular those proposed by Kashiwagi and Mayo (2001), Luu et al. (2003, 2005, 2006), and Eriksson and Westerberg (2011).

A contemporary case study reviewing a range of aspects of the development and delivery of a very ambitious programme of complex projects on a tightly constrained and occupied site in a relatively short period of time, using a collaborative approach based upon a complex and progressive alliance of client, professional advisors and a single construction contractor, is presented in Chapter 12.

Legal and Contractual Issues, Including Public Sector Procurement Legislation, and Their Effect on Project Performance

Common law contractual practice has, in general, provided an adequate framework for 'traditional' client-designed construction projects, but recent years have seen the growth of design and build methods and, more recently, the encouragement of innovation through the process of inviting contractors to submit 'alternative' tenders of various kinds. Craig (1999) presented a detailed critique of the legal theory and practice surrounding the process of tendering for construction work and discussed the concept of a collateral contract arising during the tendering process, which may constrain both the employer's freedom in deciding which tender he or she should accept and the contractor's freedom to withdraw his or her tender prior to formal acceptance. Craig further pointed out that, in the light of established legal precedents, it is increasingly important for those engaged in construction procurement, particularly where innovation is sought, to design tender processes that encourage innovation, but at the same time to place sufficient limits on contractors' freedom to innovate in order to retain proper control of the tender process.

Early researchers (Emmerson 1962; NEDO 1983) found that the construction contracts in use at the time of their research provided little or no incentive for contractors to look for opportunities to add value to the client. This is not altogether surprising since the construction industry has historically had a reputation for being confrontational and 'claims conscious', and this attitude was largely fuelled by the predominant supplier/customer contractual relationship. There is some evidence that this situation was not altogether unhelpful to contractors, with one 1995 survey apparently indicating that, of the top 50 UK contractors, 25% earned as much as 10–15% of their turnover from contractual claims (Cox and Thompson 1998).

In terms of contractual relationships, Cox and Thompson (1998) showed that little had changed in 35 years. Their study of 163 construction clients revealed that, notwithstanding a high level of customer dissatisfaction with the standard forms of contract in common use, amongst predominantly building-biased respondents, the Joint Contracts Tribunal (JCT) range of contracts (comprising the JCT 80 Standard Form of Building Contract, the CD 81 Standard Form of Building Contract with Contractor's Design, the IFC 84 Intermediate Form of Building Contract and the MC 87 Standard Form of Management Contract) jointly accounted for 76% of the sample. In civil engineering, however, whilst some 55% of respondents used the traditional ICE 6th Edition and the Agreement for Minor Building Works, only 9% said that they would use only the ICE forms. Their work led them to believe that 'a small minority of clients have developed rigorous techniques for establishing the most appropriate contracting strategy for their needs', whilst the remainder continued to base their choice on tradition and what they had always done before.

The theory of relational contracting was first formulated by MacNeil (1974) almost 50 years ago in his seminal *Southern California Law Review* essay in which he drew attention to differences in the kind and scope of possible contractual relationships. MacNeil made a firm distinction between 'transactional' contracts, such as buying a newspaper, which are essentially short term and where the contract is affected by no past events and

concerned with no future ones and upon which the classical law of contract has been developed, and 'relational' contracts, in which the parties anticipate a lengthy relationship and where the contract attempts, in one way or another, to predict future events. He goes on to suggest a framework for extra-contractual alternative dispute resolution.

Campbell and Harris (1993) (also subsequently reprinted in Grimsey and Lewis (2005)) went further, maintaining that the foundation of classical contracting is based on the principle of 'presensiation', defined as an assumption that one can predict the future with some degree of accuracy and that contracts can then be drawn up that adequately apportion the consequent risks and assign strict liabilities for breach. This, they maintained, is a somewhat unrealistic view of the real world as far as complex long-term relational contracts are concerned. Their research led them to believe that, where such contracts contained strict liabilities in respect of foreseen future breach, the contracting parties, in the private sector at least, frequently compensated for the contractual inadequacy by ignoring them in favour of 'a repertoire of extra-legal strategies when liability arises'. They went on to assert that:

> Efficient long term contractual behaviour must be understood as consciously co-operative. We see a long term contract as an analogy to a partnership. The parties are not aiming at utility maximisation directly through performance of specified obligations; rather they are aiming at utility maximisation indirectly through long term co-operative behaviour manifested in trust and not in reliance on obligations specified in advance.

The growth of partnering has given rise to considerable debate about the legal significance of the partnering relationship and the undertakings given by the parties in respect of how they intend to conduct their business. Uher (1999) provided a useful summary of the issues and a detailed review of the major points of contention. Much revolves around the notion of good faith in commercial contracts. The good faith concept is widely accepted in many jurisdictions; in fact, in some legal systems, such as the ones practiced in some Muslim countries, it is a central tenet. In the UK, the courts have consistently avoided finding any such duty in commercial transactions, preferring to stay as far as possible with the common law doctrine of caveat emptor. In the USA, however, and in European law, the legal establishment has been much more amenable to the notion of fair trading including an implied promise of good faith in commercial transactions.

The issue of good faith plainly lies at the heart of any partnering relationship which purports to rely on trust; the absence of hidden agendas and full disclosure of all relevant facts are major planks in its construction and successful operation. Australian legal commentators have advised against attempting to include 'good faith' clauses in contracts on the grounds that, under the doctrine of *contra proferentem*, a court or an arbitrator would be likely to construe them against the party responsible for their insertion (Davenport 1993). In contrast however, Dagenais (2007) provided a revealing portrait of the way in which the concept of good faith has been developed in construction contracts in Canada.

Recent years have seen the development of a number of standard forms of contract specifically aligned to collaborative forms of procurement. The best known, certainly in the UK, are the NEC3 Engineering and Construction Contract suite (NEC3), which was rewritten in 1995 to incorporate the findings of Sir Michael Latham (1994), and the PPC 2000 Standard

Form of Contract for Project Partnering (Trowers and Hamlins 2000), which was described by Sir Michael Latham in *Building* on 10th May 2002 as 'the full monty of partnering and modern best practice'. The author of the PPC2000 form, Dr David Mosey, has published a detailed discussion on the relationship between contracts, partnering, and project management (Mosey 2009).

International Procurement Comparisons and the Impact of Cultural Differences

A number of researchers have presented analyses of construction procurement practice in various parts of the world and the internationalisation of the construction industry is frequently a cause for concern and debate. In developing countries, for example, there is always the danger that projects constructed using overseas aid and resources will, whilst proving to be a successful source of income for international consultants and contractors, nonetheless fail to deliver facilities that provide maximum benefit for the host nation. The question of the impact of culture and organisation on project performance has been considered in depth by several authors including Winch et al. (1997), Winch (1999), Seymour and Fellows (1999), Liu and Fellows (1999), Rahman et al. (2002), and Ochieng and Price (2009, 2010).

Bin Abdul Rashid and Morledge (1998) and Bin Abdul Rashid (1999) considered the role of construction in economic growth within the framework of a rapidly developing country, Malaysia. They argued that the effective and productive procurement of construction work is an essential ingredient in maximising the contribution made by the construction industry to overall economic development in attaining the required levels of economic growth, but that this process is typically constrained by a lack of the necessary skills and resources. Bin Abdul Rashid (1999) presented a series of measures that could be taken domestically to address the problems, but there is little doubt that whilst self-development is a vital part of the strategy, few countries could attempt to solve these issues by 'home growing' alone. Considerable care therefore needs to be taken to ensure that where external skills and resources are employed, their use is carefully controlled and managed by the host nation in order to ensure that the economic and social benefits are maximised. Technology transfer is plainly an important issue here and poses serious challenges to the world construction industry as a whole.

An alternative view, again with a Malaysian focus, was put by Abdul-Aziz (1998). The issue of localisation was considered from the point of view of the company through a study of 26 Japanese contractors operating in Malaysia. Building upon the work of management theorists, such as Lawrence and Lorsch (1967), Fayerweather (1969), and Doz and Prahalad (1984), the author pointed out that while localisation can help by opening up opportunities within national markets whilst generating a minimum of local hostility, the downside for companies is that excessive localisation may lead to the company losing the benefits of integrating its activities in the international marketplace. He concluded that the mingling of cross-cultural concepts in this way needs to be carried out with extreme care if the company involved is to successfully bid for work in local markets whilst at the same time securing its future in the international marketplace.

Ngowi (1996) discussed the changes emanating from increased internationalisation of construction procurement in Botswana. He pointed out that the local culture in procurement is by nature collaborative due to the fact that 'construction activities were carried out by members of the community who owned the work'. This naturally collaborative state had, he reported, been adversely affected by increasing internationalisation caused by increasing sophistication and complexity of projects, the use of international funding and scarcity of skilled local labour. In a similar vein, Santoso (2009) discusses the problems faced by minority migrant workers from Indonesia and Thailand working in multinational, multicultural project teams in Brunei. In a deep and thoughtful paper, he highlights the important factors which need to be considered in the socio-cultural interaction of site workers and concludes that failure by company and project management to take measures to build understanding and trusting relationships between disparate groups of workers will impact seriously upon production, and thus on project success.

Dorée (1997) examined a number of factors affecting public sector construction procurement in several Dutch municipalities. In the Netherlands, the predominant method of procurement has historically been based around limited competition, supported by an 'atmosphere of co-operation between municipalities and contractors' which was characterised by 'attitudes [which] were far less antagonistic, opposing, hostile and conflicting than were predicted in the literature'. Dorée's conclusion was that this natural cooperation had again been adversely affected by external forces, in this case by the imposition by the European Union of binding procurement legislation.

Kumaraswamy et al. (2002) adopted a somewhat different approach. Working from a base of recent experience (Grove III 1998; HKHA 2000; Rowlinson 2001; Tang 2001) in Hong Kong, possibly the most 'international' construction industry in the world in terms of the breadth of experience and expertise carried by the construction companies and consultancy practices operating there, Kumaraswamy et al. linked experience from Hong Kong with experience gained elsewhere in the world to develop the hypothesis that major cultural change within the world's construction industry must be driven from within through systematic changes in construction procurement practices and processes. Whilst they admitted that 'attempts to merely "bolt on" collaborative elements such as partnering to existing cultures and contracts have rarely succeeded', they contended that cultural change can be accelerated through factors such as:

- Better briefing (Green and Lenard 1999; Barrett and Stanley 1999).
- Improved selection systems and a more careful matching of client and contractor objectives (Lowndes 1998; Crane 2001; Bayliss 2002).
- The careful use of incentives (Scheznayder and Ohrn 1997; Wright 1998).
- More effective use of information technology.
- A wider acceptance of 'lean construction' principles.

Finally, in the international arena, Lahdenperä (2001) presented the results of a 10-year study (1989–1998) covering 20 050 projects in Finland, each with a value greater than one million Finnish marks (about 170 000 euros). In the public sector, the balance was tilted overwhelmingly in favour of traditional procurement with separation of the design and construction functions, with minority use (14%) of design and build. In the private sector, however, the use of design and build increased to in excess of 23%.

Risk Allocation and Reward

Risk allocation in construction projects has long been a subject of intense debate. There is evidence that inappropriate and unrealistic risk shifting is a major cause of disputes (Wall 1994) and that risk allocation determined on sound commercial principles helps to avoid disputes (NPWC 1990).

It is often said that 'risk should be placed with the party best able to control it' but Cheung (1997), following on from work by Abrahamson (1984), asserted that a more detailed taxonomy of risk distribution is more appropriate. The taxonomy suggested by Cheung suggests that risk should be allocated using the following scale of priorities:

- The party best able to control it effectively.
- The party best able to absorb it financially.
- The party who has most information to control it.
- The party who benefits most from controlling it.
- The party for whom the risk is inherent in its commercial role.

Cheung used these principles together with a set of risks developed from the work of Casey (1979) in the construction of a risk allocation model which was subsequently tested with some success in Australia, although the sample size was rather small.

Also in Australia, Kenley et al. (2000) examined rewards and incentives in the context of public sector construction (APCC 1997). They provided a useful review of the literature relating to incentives and rewards and concluded that appropriate incentive and reward systems can help to change a contractor's behaviour both during the bidding process and during project execution.

Forbes et al. (2008) re-examine the risk allocation and management problem in considerable depth. Following a review of the literature, and taking a case-based reasoning approach, they present a reinterpretation of the political, economic, social, technical, legal and environmental (PESTLE) model in the form of a risk management matrix.

Fair and equitable allocation of project risks are essential to ensuring the successful delivery of projects. According to Baker et al. (2020), both the employer and the contractor should work cooperatively to seek an equitable sharing of risk based on an appropriate procurement approach and to allocate typical risks in an efficient manner, in the light of the nature of the particular project and its specific considerations. Citing Abrahamson (1984), they suggest that in order to achieve a fair and equitable allocation of the risks inherent in construction projects, a risk should be allocated to a party if:

- The risk is within the party's control.
- The party can transfer the risk, for example, through insurance, and it is most economically beneficial to deal with the risk in this fashion.
- The preponderant economic benefit of controlling the risk lies with the party in question.
- To place the risk upon the party in question is in the interests of efficiency, including planning, incentive, and innovation; and/or
- The risk eventuates, the loss falls on that party in the first instance and if it is not practicable, or there is no reason under the above principles, to cause expense and uncertainty by attempting to transfer the loss to another.

Similarly, Bunni (2009) proposes four principles that are to be used for allocating risks in construction contracts. His principles are based on asking:

(a) Which party can best control the risk and/or its associated consequences?
(b) Which party can best foresee the risk?
(c) Which party can best bear that risk?
(d) Which party ultimately most benefits or suffers when the risk occurs?

The project team should seek to undertake an accurate identification of risks and determine the answer to these four questions before allocating the project risks. Whenever risk is transferred to other parties, there is usually a premium to be paid; therefore, experienced clients are likely to transfer risks only where accepting the risk would not give them best value for money (RICS 2015). Risk transfer measures include taking out insurance cover where appropriate.

Payment mechanism on contracts and the approach to risk transfer must go hand-in-hand. Where risk has been transferred, it would be assumed that the contractor has accounted for this in their price and therefore there will be no mechanism to adjust the price if the risk occurs and impacts the contractor's cost base. Where a risk is not transferred (or not wholly transferred) to the contractor, usually contractual mechanisms will exist to adjust the price paid to the contractor (Government Commercial Function 2019). A review of the adopted payment mechanism will reveal the client's risk position.

Bid Evaluation Techniques

It has been argued (Trickey 1982; Smith 1986) that seeking the lowest tender price on the basis of common tendering information leads to maximum value for money for the client through free and fair competition. This may well be true in an environment of perfect economic competition, but in the real world, where price has often in the past been the sole criterion, the bidding problem for the contractor becomes simply to submit the lowest price. Contractors have historically derived some comfort from the fact that the forms of contract employed would provide them with the opportunity to increase their return through claims made as the result of client variations and other changes. Contractors' actions in deciding what figure to bid have therefore been largely governed by their attitude to risk and their expectations of the way the client and his or her representatives will behave during the construction process. There is also evidence, perhaps not surprisingly, that:

- Lowest initial bid does not necessarily equate with lowest out-turn cost (Pearson 1985; Dawood 1994; Pasquire and Collins 1997).
- Contracts let by open competition are often less successful than contracts awarded by other means (Holt et al. 1995a, 1995b).
- Lowest price exposes the client to an increased risk of post-contract claims and cost over-runs (Crowley and Hancher 1995).

In order to counter these problems, a number of alternative bid models based on price alone have been developed; they are designed to identify and eliminate 'rogue' bids, thus

hopefully increasing the client's chances of project success. The work of Lingard et al. (1999) contains a concise review.

There now appears to be a general acceptance, in the UK at least, that bid acceptance based on price alone is unlikely to lead to improved project success, although Holt and Proverbs (2001) found that, out of a sample of 120 English local authorities comprising equal numbers of counties, district authorities, metropolitan districts and London boroughs:

- 11% believed that lowest price provided best value for money.
- Only 18% believed that best value would be delivered through a combination of price and quality.
- 50% believed that price was the most important aspect of a contractor's tender submission.

Several researchers have attempted to develop quantitative models, such as the following models, to aid the process of analysing multi-criteria bids:

- Multidimensional utility analysis (Diekman 1981).
- Cluster analysis to identify the bid representing overall utility optimisation (Seydel and Olson 1990).
- Models based on fuzzy set theory (Nguyen 1985; Wong and So 1995; Tsai et al. 2007).
- Hierarchical decision models (Mustapha and Ryan 1990; Russell 1992; Kong and Cheung 1996).
- Expert systems (Russell et al. 1990).
- Discriminant analysis (Tam 1993).
- Performance ranking using a Likert scale (Assaf and Jannadi 1994).
- Composite models involving a combination of processes (Prasertsintanah 1996).

Lingard et al. (1999) contended that contractor selection models ought to be considered in respect of their propensity to reduce the transaction costs involved, and that this could best be achieved by multiparameter models, since they address a broader range of sources of uncertainty and opportunistic behaviour than do the simpler comparative bid evaluation models.

As explained earlier, some clients have attempted to introduce innovation into the procurement process through the introduction of 'alternative tenders', but some commentators believed that such practices may pose significant legal difficulties (Craig 1999).

Bid evaluation is now more commonly carried out using a combination of price and 'qualitative' factors such as the contractor's attitude and proposed method of working, the strength of the contractor's team, etc. This issue becomes even more important where projects are to be conducted under some form of collaborative arrangement and it has been proposed that in these cases the price and qualitative factors should be supplemented by a series of factors concerned with aligning cultural fit between the employer and the contractor. Examples of such factors might include ethical values and principles, and common and transparent business practices.

Hampson and Kwok (1997) suggested testing the following attributes in order to indicate likely success in collaborative relationships between firms:

- Trust in one's trading partners.
- Commitment to a win–win solution.

- Interdependence and a recognition of the benefits to be gained from shared mutually agreed goals, shared risks, and shared rewards.
- Recognition that self-interest requires cooperation and that cooperative working integrates self-interest in order to achieve mutual goals.
- Recognition that effective communication is essential in cooperative working.
- Commitment to joint problem solving.

Diekman et al. (2000) proposed the use of similar techniques to help potential developers of privatised infrastructure projects assess the relative merits of alternative projects through a series of discrete clusters of information based on:

- Political issues (legislative status, organisational structures, etc.).
- Public private partnership (PPP) attributes (the nature of the partnership agreement, ownership, operational responsibility, length of concession period, etc.).
- Project scope.
- Environmental factors.
- Construction risks.
- Operational risks.
- Financing issues (debt/equity, project subsidies, etc.).
- Economic viability.
- The developer's financial involvement (including development rights, performance incentives, etc.).

A detailed set of scoring documents is also presented.

A number of authors have considered the issue of unbalanced bidding. Contributions to the debate cover a period of more than 40 years, and those advocating its use range from Gates (1959) to Cattell et al. (2008). Over time, the various techniques employed have become increasingly complex, but they all attempt to adjust the rates in the tender bill to maximise profit for the contractor and to reduce risk (Cattell et al. 2007). Approaches discussed by Cattell et al. (2008) included front-end loading, item-spotting, back-end loading, and complex item loading (which aims to unify the other three techniques into a single methodology). Cattell et al. (2010) followed up their earlier work by developing a new risk framework which enabled contractors to assess the risks they face in submitting unbalanced bids. No research seems to have been reported enabling clients to assess the risks they face from accepting such bids.

Environmental and Sustainability Issues and the Procurement of Construction Work

Environmental sustainability has long been a topic of intense discussion in the construction industry. Langston (1997) provided a useful review of contemporary issues, and there is now general agreement that increased sustainability and mitigation of the environmental impact of major projects form two of the construction and development industries' more important key performance indicators. For example, the Olympic Delivery Authority (ODA 2013) proposed extending their tender evaluation criteria beyond the traditional themes of cost,

time, and quality to include other themes such as safe and secure, equality and inclusion and the environment. This initiative enabled a more proactive approach to addressing environmental issues in the procurement process. Moreover, they established a Timber Supply Panel to provide a robust and reliable means of supplying legal and sustainable timber. To be appointed as a member of the panel, companies had to go through a bidding process that questioned their environmental and sustainability policies.

Some however believed that, in the wider international arena, for many construction businesses the adoption of strategies for construction sustainability may be too far from their current set of cultural values and business reality to be a practical proposition (see for example the work of Gilham (1998) and McMurray et al. (2014)). For instance, Walker and Brammer (2009) identified cost, conflicting priorities and attitude/culture as some of the common barriers to the development, adoption, and implementation of organisational sustainable procurement. McMurray et al.'s (2014) study of how Malaysian organisations implement sustainable procurement policies and key barriers has highlighted the significance of culture as a barrier or an opportunity in the implementation of sustainable procurement policies. Delmonico et al. (2018) also found cultural factors to be a significant barrier to sustainable procurement.

A wide range of tools has been developed to aid in the environmental assessment of both construction materials and buildings. Typical examples of tools for assessing construction materials include the Green Materials Index (Shiers and Keeping 1994), the Building Materials Ecological Sustainability Index (Lawson and Partridge 1995), and the Environmental

Preference Method (Anik et al. 1996). Similarly, several tools and aids have been developed for assessing green buildings. They include Environmental Value Engineering (Roudebush 1992), the Building Research Establishment Environmental Assessment Method (BREEAM) (BRE 2020) used in the UK, the Leadership in Energy and Environmental Design (LEED) by the U.S. Green Building Council, and the Excellence in Design for Greater Efficiencies (EDGE) certification which is an innovation of the International Finance Corporation (Edge buildings 2020). Other assessment tools include Comprehensive Assessment System for Built Environment Efficiency (CASBEE) in Japan, Green Mark (GM) in Singapore and the Evaluation Standard for Green Building (ESGB) in China (Liu et al. 2018).

Furthermore, it has been proposed (Langston 1996) that cost–benefit analysis can also be adapted for use in this way. A combined framework incorporating both environmental assessment and environmental sustainability is presented in the *Green Building Challenge* (Larrson and Cole 1998).

A number of commentators and researchers have suggested that environmental issues should form part of the project procurement process (see for example the work of Baldry (1997), Walker and Lloyd-Walker (1999), and Berry and McCarthy (2011)).

Graham and Walker (2000) reviewed a range of environmental performance assessment tools in order to explore the extent to which they were able to provide a robust process to enable the assessment of overall environmental sustainability. On the basis of their analysis, they proposed a 'triple bottom line' model for project assessment based upon financial viability, environmental performance, and social sustainability, which they then suggested should be incorporated into project procurement strategies. Varnäs et al. (2009),

in a Swedish study, reviewed the problems of, and the opportunities offered by, green procurement of construction contracts. The study found, despite both public and private sector clients taking environmental considerations into account in their procurement processes, that environmental references are often formulated as environmental requirements. In addition, environmental assessment criteria usually relate solely to the contractor's operations on site and rarely affect award decisions. As noted by Berry and McCarthy (2011, p. 5) 'sustainability is seldom about stopping what we do but about doing it in a way that has minimal effect on the world'.

Sustainable Procurement for Construction Projects

Sustainable development has been defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Bruntland 1987). The term development used in this definition can be activities across different industries, including the construction industry. As construction activities and the built environment have a significant impact on communities, businesses, and the natural resources, sustainable procurement in construction can lead to positive outcomes in supporting a better quality of life (OGC 2007).

Sustainable procurement in construction involves seeking the most positive environmental, social, and economic impacts of construction projects over their entire life cycle whilst minimising the adverse impacts. Considering the effect of procurement decisions on organisations within the supply chain, procurement can be a powerful tool for achieving sustainability objectives (BSI ISO 20400 2017; Meehan and Bryde 2011). ODA (2013) provides a typical example of sustainable procurement for construction projects, outlining eight key principles which informed the procurement of the London 2012 Olympic facilities. They are:

1. Seek a clear and public commitment to sustainability at the highest level of the organisation.
2. Prepare thoroughly: early consideration of sustainability.
3. Set specific, clear, and challenging sustainability targets from the outset.
4. Be an intelligent client: get the right people on board, define the project, and set the budget.
5. Embed sustainability objectives throughout the team and supply chain.
6. Identify and use low impact responsibly sourced products and materials and ensure good supply chain management.
7. Create a structure that supports a collaborative approach whilst maintaining an environment of challenge.
8. Organise procurement so services can be shared.

The appointment of contractors was preceded by a period of planning, which included setting sustainability objectives and strategy development. ODA (2013) also emphasised the need to appoint the right people and to educate them about its sustainability vision and objectives, addressing any potential resistance to take on board sustainability

considerations. Based on the above principles, ODA (2013) used a number of opportunities within the procurement process to influence positive sustainability outcomes, including:

- Early engagement with the supply chain, which allowed identification of best practice, innovative products, and suppliers.
- Developing a comprehensive design brief outlining key sustainability requirements.
- Use of a Balanced Scorecard as part of pre-qualification selection criteria and for bid assessment.
- Contract requirements incorporating detailed sustainability requirements.
- Rigorous monitoring of contractor compliance.

The JCT (2013) carried out an industry consultation with the specific focus of establishing how sustainability should be addressed as part of construction contracts. They found that there is no single solution and that sustainability provisions can be included in the contract conditions, in a schedule to the conditions, or in the other contract documentation. The JCT (2013) consultation also revealed that there is a preference for inclusion of detailed sustainability requirements in the project specification rather than the contract itself.

Whilst sustainable construction has received a lot of research focus over the past two decades, research in the field of sustainable construction procurement is in its infancy. Meehan and Bryde (2011) conducted an empirical study of sustainable procurement in the UK social housing industry. They found that there was no strong presence of sustainable procurement practices in the social housing sector. They also concluded that this is a widespread problem across many industries and is not confined to the UK.

In their study of sustainable infrastructure development under the PPP procurement process, Agarchand and Laishram (2017) recommended that there should be modifications in procurement mechanisms such as environmental impact assessments, Value for Money analysis, and bid evaluation criteria in order to promote sustainable development goals. Walker et al. (2012) highlight methodological challenges which could affect the results of sustainable procurement research. They argue that social desirability bias, which makes respondents want to be perceived in a socially acceptable way, may cause findings to be more positive than they are in reality. Respondents can be compelled to give a positive impression of their own and their organisation's activities.

Conclusion

So what general lessons can we learn from the above, admittedly brief and to some extent selective, review of research into the process of construction procurement? It is evident that there is now considerable expertise around the world in many aspects of the discipline and there are many instances of good practice. On the other hand, there are areas where there are considerable differences of opinion and where considerably more work is required in order to establish a consensus view.

It is also heartening to note a significant shift in construction management research as a whole away from the simple evaluation of practical experience and towards a process of integrating the observation of practical experience with more mature and generally