Procurement, contracts and project management

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While many in the construction sector view the industry as unique, there is no one feature of the industry that is unique. Economists who study the construction sector have often pointed out that, while it shares many of its economic features with other industries, it is the particular combination of features that make it unique (see, for example, Grunberg and Francis 2019).

Construction is a complex activity, involving many different organisations across extended timescales, with a view to long-term impact of some sort. The processes around the procurement of a construction project may be viewed at three levels: governance, organisation and management. Project governance involves the same processes as the governance of any other kind of organisation (International Standards Organization 2021). Indeed, every organisation will be subject to its own governance regime. However, by bringing numerous organisations together to achieve the purposes of a construction project, it is useful to think of the project organisation as a temporary multi-organisation, which demands governance at the project level. Increasingly, legal requirements for governance impact on projects.

The organisation of work is about splitting a complex whole into a series of parts. In the case of a construction project, it is common for each of the work packages to be defined by contracts since different parts of the work are carried out by different organisations. Going to the market with defined pieces of work to form a contract is needed because so much of the work is carried out by specialised firms, whether design, fabrication, logistics, assembly, commissioning, operation or maintenance.

Project management is the process that ensures the clarification of aims and objectives for each work package, the establishment of control mechanisms and an adequate discharge of responsibilities by all those involved in the process. Many clients with large programmes of work apply common strategic objectives across their projects. Programme managers ensure a collaborative focus on those objectives across the various contracts procured to deliver the programme.

Each of these themes is outlined in this Chapter, with references to further reading for each topic.

1 The nature of projects and the networks of contracts

Construction projects are typically a means to an end. A construction project may be seen as a factor of production for industry or as an enabling function for other purposes. Thus, it is not an end in itself. The context and impact of construction activity are important in understanding what construction projects are and how they are managed. For an introduction to the topic of management in construction projects, see Sherratt and Farrell (2015).

1.1 Defining the system boundaries and project scope

There is a strong tendency in construction project management literature to focus on managing the client's requirements in relation to time, cost and quality. This is how project management is often defined. Indeed, it is difficult to escape the importance and immediacy of objective measures of project performance, as exemplified by Flyvbjerg, *et al.*

(2002), whose focus on these contractual measures of performance concludes that project management personnel are either systematically wrong about project planning, or compulsively misleading their clients and the public. However, there is more to a construction project than the objective measures that are set out in contracts. Projects have a context: for example, physical, environmental, economic and social. It is important to recognise the distinction between such policy and strategic aims, on the one hand, and the execution of contractual objectives, on the other. It is helpful to conceive of a construction project as an instrumental part of the fulfilment of wider aims, such as governance, social value and sustainability.

There is a growing recognition that business cannot simply focus on maximising profit. To complement this, there is also an expectation that professional civil engineers should focus on the wider impacts of their work and not just the contractual imperatives of time, cost and quality. The ICE Code of Professional Conduct (Institution of Civil Engineers, 2022) imposes a responsibility to behave ethically – to do the right thing - to protect the health and well-being of present and future generations and to show due regard for the environment and for the sustainable management of natural resources. These are not normally in conflict with project scope but may lead to professional advice to clients to include broader objectives within project scope. Thus, a wide range of issues and public interest have helped to expand the system boundaries for business activity and for project organisations. Understanding the boundaries of a project help us to identify what is included in project work and what is not. However, public policy means that we must do more than merely include consideration of these issues. We are required to actively manage them.

One widely used source of information, training and qualifications is PRINCE2, which is an acronym for **Pr**ojects **in C**ontrolled **E**nvironments. This is a process-based method for managing projects, which is supported by a range of training materials/qualifications and is adopted in many countries. It draws together governance and risk management processes set out in this Chapter (ILX Group, 2022).

There has been much work in codifying processes through which a project may be better understood in its wider context. The following sections give an indication of the kinds of issues to be engaged with, including relevant British or international standards that provide guidance.

1.1.1 Governance

- *ISO 21505:2017 Guidance on governance of projects, programmes and portfolios*. This standard is about the context of project, programme and portfolio governance issues. It is aimed at governing bodies and executive and senior management who have roles and responsibilities related to governance in this kind of work (International Standards Organization 2017a).
- *BS 95009:2019 Public sector procurement. Generic requirements for organizations providing products and services*. This standard deals with concerns about "value for money, quality, ethics and transparency of business relationship relationships within the procurement process and supply chain, particularly with regards to public procurement in the UK" (British Standards Institution 2019a).
- *ISO 26000:2020 Guidance on social responsibility*. This standard focuses on "the underlying principles of social responsibility, recognizing social responsibility and engaging stakeholders, the core subjects and issues pertaining to social responsibility … and on ways to integrate socially responsible behaviour into the organization" (International Standards Organization 2020a).

1.1.2 Sustainability

- *ISO 15392:2019 Sustainability in buildings and civil engineering works. General principles*. This standard "identifies and establishes general principles for the contribution of buildings, civil engineering works and other types of construction works … to sustainable development", applying "to the life cycle of construction works, from inception to the end-of-life" (International Standards Organization 2019a).
- *ISO 21931-2 Sustainability in buildings and civil engineering works. Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment. Part 2: Civil engineering works*. This standard "identifies and describes issues to be taken into account in the development and use of methods for the assessment of the sustainability performance for all types of civil engineering works, both new and existing, and it is relevant for the assessment of the environmental, social and economic performance of both new and existing civil engineering works over their entire life cycle" (International Standards Organization 2019b).
- *ISO 21678:2020 Sustainability in buildings and civil engineering works. Indicators and benchmarks. Principles, requirements and guidelines*. This standard is intended for setting up "benchmarks that support target setting, decision making and communication to third parties" (International Standards Organization 2020b).
- *ISO 20400:2017 Sustainable procurement. Guidance*. This standard "provides guidance to organizations, independent of their activity or size, on integrating sustainability within procurement, as described in ISO 26000. It is intended for stakeholders involved in, or impacted by, procurement decisions and processes" (International Standards Organization 2017b).

1.1.3 Social value

- *BS 8950:2020 Social value. Understanding and enhancing. Guide*. This standard "focuses on the role of organizations (including businesses) in understanding, preserving and enhancing social value. Social value is created through the generation of personal and collective wellbeing over the short and long term" (British Standards Institution 2020).

It should be noted that the UK seems to be at the forefront of the social value agenda in that, as far as we know, at the time of writing, it is the only government, to have defined social value (HM Government, 2020a).

1.1.4 The significance of context in project management

The context of a construction project, then, is important in understanding purposes beyond the immediate contractual constraints. This understanding will ensure compliance with legal requirements and professional standards in a way that guides decision-making at all levels of a project. An example of how the different kinds of context may be viewed is shown in Figure 1. Project controls may focus on budget, time and specification but the culture of the organisation should be to maintain a continuous focus on the contextual issues that define project purpose, shown in the first column of Figure 1. This is done through the lenses of constraints shown in the second column. In the procurement and execution of the work, this focus will also have to be extended into the supply chain.

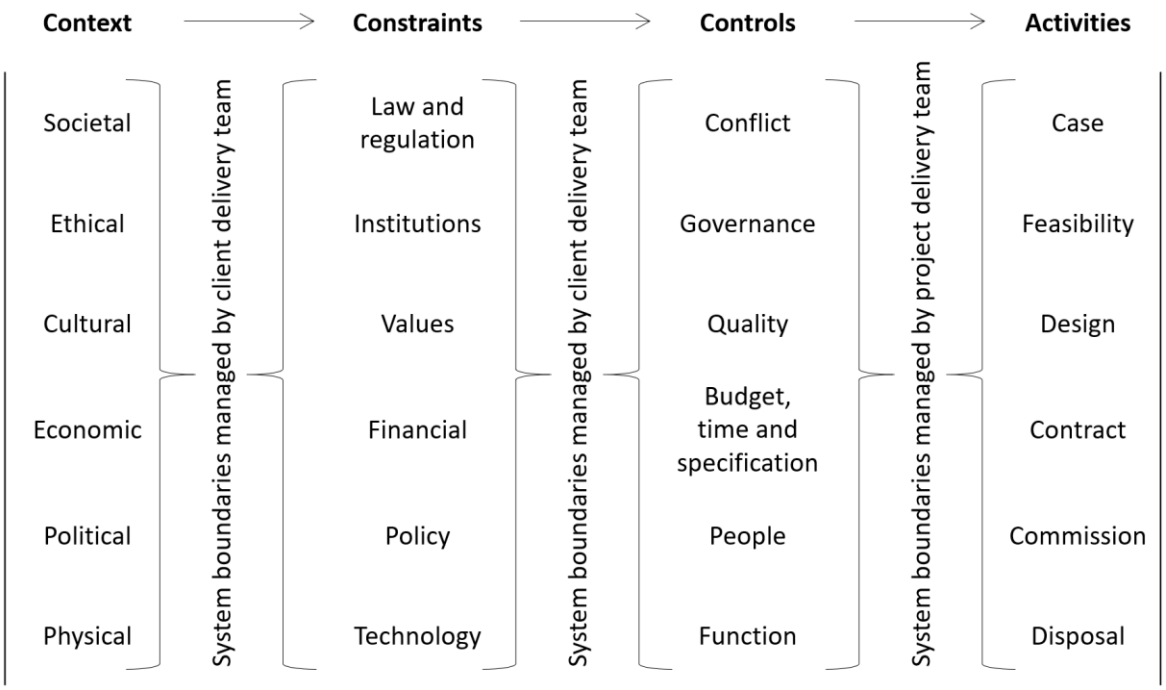

Figure 1: Contexts of procurement and system boundaries

Figure 1 illustrates how construction takes place within regional, organisational and project contexts. The contextual issues at the broadest level, in the left-most column, apply to all industry sectors. Therefore, they apply to construction. These issues are shaped by national policies and by legislation. As such, they must be understood. It is increasingly common for legislation to require that any organisation must ensure that everyone in their supply chain also work within the requirements and limitations set out at this policy level. The physical context explains the tangible world in which a project is being developed. These contextual issues are rarely discussed or set out for a local project with local participants, as they already have a shared understanding of what appears to be obvious to them. However, in projects that span countries, regions and occupy long timescales, changes in the context of a project may have a profound impact. Moreover, in a rapidly changing international project, the need for explicit statements about context are important, because of the impact they have on the constraints within which projects are procured and managed.

The internationalisation of major construction projects is a long-running trend (Ye *et al.* 2018). Clearly, this is part of a wider economic trend towards globalisation of all kinds of business. Emerging markets only add to this trend. However, this does not always mean international working, since contracting activities in international projects are often organised at the local level, with little impact on the way that construction work on the ground is organised. Nevertheless, such projects require careful setting up in relation to the applicability of legal systems and other societal expectations (see, for example, El-adaway *et al.* 2018). Mistakes and misunderstanding of the contextual issues of a project can have profound impacts on the success or failure of a project. Working in different contexts offers unique challenges for the assumptions we all make about how we work and what we do. International working requires some careful analysis of the things we usually take for granted. Local knowledge about the constraints that arise from the contexts is invaluable in international work (see also Section 1.1.5).

In all contexts, the contextual policy issues are translated locally and regionally into constraints, such as legislation. Practices become institutionalised through customs and conventions.[1] The second column of Figure 1 lists the issues that will frame the procurement of a project and define its purpose. These issues should be made explicit in project documentation, especially at the beginning of a project when the case for investment and expenditure are considered. Generally, these issues explain the purpose of project, dealing with the questions of why a project is being carried out, what is seeks to achieve, and what the limitations are, legally, financially and technologically. Clearly, the case for a project is not solely financial.

In the third column of the Figure, the control systems are shown as the mechanisms for managing work. Each control system involves a plan-do-check-act cycle. Some controls are more obvious than others, but current work on standardisation of procurement processes is showing how the management of procurement deals with control systems within the wider context of human activity (see, for example, International Standards Organisation, 2022).

The final column in the Figure shows the main stages in the project work. It would be usual to have a decision gate between each of these stages, such that resources may be committed to the next stage and a decision made by the client about whether to continue with the project or not. The project activities and decisions may be described in different ways, depending on the context of the work. A good overall indication is provided in *ISO 22058: Construction procurement – Guidance on strategy and tactics* (International Standard Organisation, 2022).

1.1.5 Construction projects within international legal systems

Ordinarily, domestic commercial transactions are concluded with little consideration of the legal system within which the transaction is carried out. We buy a book in a bookshop; a contractor buys materials locally; or we arrange for a profession to provide a service. Each transaction involves contract formation even if we do not consider it so at the time. Our consideration of the wider legal framework typically only arises when one party or another does not keep to the bargain and the other seeks to enforce obligations to secure some form of compensation. Construction projects are rather more complex commercial transactions because they are executed over an extended period, by many contributors, with an extended supply chain, on a site and to a design that is unique. Almost all projects have an international element in that some goods will be shipped from another country, or some participants will be involved outside the country in which they are based.

Every country has its own legal system, modelled on either a common law or a civil law framework. For countries under a common law system, including UK, Ireland, South Africa, Australia, New Zealand, Singapore, Malaysia, Hong Kong, India, USA and Canada, construction-related law is derived from three sources, all acting concurrently:

- *Statutes*, or Acts of Parliament, sometimes termed legislation, are laws passed in parliaments. Some statutes will be generic in that they apply to all industries (like the Sale of Goods Act 1980 in UK); others may be construction specific.
- *Case law*, being decisions from courts. A large body of case law has built up over several hundred years. Relevant cases are noted within legal textbooks. A decision

[1] In sociology, the idea of 'institution' includes two aspects. First, the meaning we usually use in relation to professional institutions is 'an organisation that governs a specific area of work and action'. Second, the term is used to denote 'stable patterns of behaviour that define, govern and constrain action' (Rojas, 2013). An interesting example of how the study of institutions helps to understand and explain aspects of construction work is provided by Andersson *et al.* (2019).

from a court in one jurisdiction may be noted with interest in other countries, particularly a decision of an appeal court or where the court is known as a specialist centre for construction disputes. Some decisions may provide some interpretation of a statute where, as can occur, application of statute may be unclear in a particular circumstance or setting.

- *Regulatory Orders* or decisions are produced by central and local government. Examples include planning consent, which may have detailed conditions attached, regulating how or when construction works on a particular site may be conducted. Whether decisions have been made lawfully can be tested by a challenge in an administrative court.

Where a country operates under a civil law framework, the principle source of law will be statutes and regulatory orders. The views of academics in legal textbooks may also be influential; court decisions are generally not regarded as primary sources of law in civil law. Countries with civil law systems include most European countries, most states in the Middle East and China.

Under all these legal systems, it is open to parties to form commercial agreements and, to a large extent, to provide for themselves how their affairs will be conducted. It is open, for example, to agree that disputes might not be resolved before local courts but instead privately in arbitration. There are several arbitration forums, each with its own body of rules, designed specifically to support parties to international projects to have disputes resolved privately.

For any project, there are two, or possibly three, stages where some consideration of the relevant legal system is necessary.

The first is pre-contract, up to when the agreement is formed. Here the parties have the opportunity to define in advance a range of matters such as the applicable law or dispute resolution systems preferred. There may also be country-specific issues: visas, choice of currencies for payment, language for communication between parties, etc. Usefully, most standard forms of contract require these matters to be addressed before the construction contract is agreed.

Second, during the project, when a problem arises in practice, some consideration is required first of the agreement but also of the legal system in which it was formed or operated. One cannot look to the contract alone. It helps to see this in an example:

> *During a project to build a new port facility, a natural disaster occurs which halts the project for several weeks, causes delays to inward shipping of materials and restricts staff movement. Soon, the contractor may find considerable extra costs being incurred that were not anticipated when the contract was formed. If considering whether the contractor can recover extra costs or losses from the employer, one may have to review: (a) the construction contract itself, which may specifically allocate responsibility for risk of this type and consequences in provisions on instructions, changed conditions, changes of law, insurance and suspension; (b) national laws addressing the event that occurred (for example the Coronavirus Act 2020 in UK); (c) cases from courts under the applicable legal system, relevant to the doctrine of frustration in contract and; (d) local regulations, such as a temporary work-from-home order.*

Third, if there is a dispute that cannot be resolved amicably, some consideration is required of the specific provisions in the contract governing dispute resolution. Of course, there is nothing to stop the parties agreeing an ad-hoc system to resolve disputes even at a late stage. However, there may be some underlying statutes relating to construction disputes

that cannot be ignored. A number of countries have provided an express right for parties to construction contracts to refer disputes involving payment direct to a short adjudication process, but these will be country specific (see also Section 0).

1.2 Defining the objectives of a project

The discussion so far has focused on framing the purpose and aims of a construction project. This is related to the project's context in society, policy and strategic organisational aims of the client.

The next step it to define what, precisely, is to be constructed. In some cases, construction work will be carried out in-house. These cases will involve small-scale works carried out by operatives on the payroll. Alternatively, some organisations include construction as a core activity. They will carry out the work themselves. However, the scale of construction work usually requires specialised resources to be bought in. This requires clear decisions about what is to be built. It also requires clarity about how to put the demand to the construction market. The procurement of construction offers many choices. These choices are dealt with in the next section. The client is required to specify the work to be done in a way that enables contracts to be set up. A contract records the terms of a deal. Work will be carried out in return for payment. The work is specified in terms of a description of what is to be done, a time and a price or mechanism for calculating payment. Having decided what must be done, the client then needs to communicate this to those who will do it.

Management involves control. Control is a process of planning the work to be done and monitoring it while it is being done. When work departs from the plan, there is a choice between bring the work back into line with the plan or changing the plan. The task of project management is frequently characterised as the management of the client's requirements in relation to time, cost and quality. Interestingly, this definition is not simply about enforcing time, cost and quality targets, but about managing the client's requirements in relation to these aspects. For a comprehensive and accessible introduction to the topic of project management, see Fewings (2013).

1.2.1 Managing impacts

Defining the objectives and purpose of a project requires sensitivity to its context. Consider the ideas in Figure 1: for a small local project, the context and constraints around such a project may be obvious. No discussion of context and only a little discussion and expression of ideas around context and constraints would need to take place because these issues are all readily understood in a local market where the scale of the work is small. However, in considering larger projects involving organisations and individuals from diverse backgrounds, it is very important to avoid making assumptions about how the development of infrastructure is impacted by – and has impacts upon – the context in which it takes place. Therefore, explicit statements about context and constraints are needed so that a shared understanding of risks and liabilities in relation to context can be used to frame the risks and liabilities in relation to the project. Indeed, this is a key element of the requirements in *ISO 9001:2015 Quality Management Systems – Requirements* (International Standards Organization 2015), which calls for a quality plan to be established before work commences, specifying actions, responsibilities and associated resources that are needed to achieve the desired outcomes in relation to the organisation and to its external context. Thus, managing impacts is about interchanges between wider society and the project. Conversely, controls and activities are internal to the project organisation.

1.2.2 Describing the construction work

Describing the construction work is rarely a simple task. This is not least because information cannot simply be set down in an unchanging way. First, there are limits to what we can know with certainty (see, for example, Winch 2015). The concept of bounded rationality explains that knowledge is always incomplete. Even if information could be complete, the resourcing of the design process means that a project could not be fully specified and defined before beginning. It may seem obvious to state that decisions about what is to be built are taken and recorded some time before the work is to take place. However, the interval between design decisions and construction activities may be months or years. In that time, the world does not stand still. Markets for labour and materials develop; techniques, components, regulations and expectations are constantly changing. What may have been possible and desirable during the design stage may not be possible or desirable by the time the project gets underway. Thus, the information about what is to be built cannot be seen as fixed and unchanging.

In other words, information is always uncertain and incomplete. It is for this reason that most construction contracts envisage that designs and specifications will evolve and change during the construction process, resulting in a continuous process of change management. This means that the time, price and specification cannot be accurately pinned down in advance of the construction process. More importantly, it also means that the consequent decision-making that will be required during the construction process must be informed with consideration of the broader perspective of the project in relation to its changing societal context. To do otherwise would be to deny the professionalism of the roles engaged for the organisation and management of projects (Hughes and Hughes 2013).

It is not clear that everyone in the construction sector fully understands the provisional and uncertain nature of a specification. However, most contracts envisage the need for change as the project progresses. Mechanisms will usually be put in place to recalculate the duration of the project and the price for the work as it progresses.

1.3 Risk analysis and management

One of the most significant features concerning the planning and procurement of construction work is the distinction between uncertainty and risk. While it is quite usual for detailed plans and estimates to be prepared, the uncertainty that renders these provisional and subject to change is frequently expressed in terms of risk, rather than uncertainty. The tasks of planning, estimating and management are taken up as the preserve of professions in their own right. By dealing with uncertainty as if it were risk, this managerial work can be made more efficient. However, the improvements to the tools of managing risk do not remove uncertainty, since the uncertainty that impacts complex tasks does not arise from the tasks themselves, but from external factors that are beyond the control of those who manage projects. Of course, it would be commercially unacceptable for them to openly claim this, so all the uncertainties are dealt with as if they were calculable risks. Therefore, those who manage project planning can efficiently discharge their responsibilities. But this does not mean that the operational aspects of doing the work are made more certain or in any way better. As a result, disputes over payment for work done, or time taken, continue to beset all projects and expectations that have been encouraged using advanced management tools are rarely met. There is also an argument that, were these expectations less rosy and more realistic, projects would not get approval in the first place. Hence, there is an inbuilt bias towards over-optimistic plans and little interest from those who sponsor projects in making the plans more realistic. Optimism bias is a very real problem in the procurement of construction work (Smyth 2017). One result of this is that rational decision-

making processes in the early stages of projects tend to be misleading, at best, in relation to framing what is to be procured and how. It is useful to reflect more comprehensively on what has happened in previous projects, to understand better how to plan future projects. For example, see Locatelli and Mancini (2012) and for structured guidance on dealing with the management of risk, see International Standards Organization (2020f).

2 Procurement

Procurement, in the construction context, has different meanings, depending on context. Sometimes, it refers to the processes of going to the market to choose a supplier/contractor, agree a price, form a contract and execute it. This is the meaning in ISO 10845 (International Standards Organization 2020c), summarised as the creation, management and fulfilment of construction contracts. However, it is often used with a wider meaning that refers to the organisation and management of the whole process from the inception of a project through to the disposal of the asset.

Most texts on construction procurement take a historical view, explaining a series of procurement approaches that equate to contracting methods. As strategies have evolved to deal with changing priorities, approaches have been developed that have each focused on a specific priority. For example, general contracting emerged in nineteenth century England as a response to site coordination complexities in a process that was becoming increasingly industrialised; construction management in Chicago was a response to the over-heating market in the rebuilding of Chicago after the Great Fire; the use of bills of quantities and the growth of quantity surveying was a response to the UK post-war municipal housing programmes; design-build-finance-operate (see below) was a response to governments trying to reduce capital spending by getting private sector to fund infrastructure that could then be leased; partnering and frameworks have emerged as a response to problems related to open tendering based on lowest price; integrated project delivery has more recently evolved as a response to fragmentation and lack of coordination in the supply chain. There are many other examples of how specific techniques emerged as a response to specific circumstances. It is very difficult to provide an analytical and systematic approach to decisions about how to procure based on historical contracting methods that evolved in response to specific problems.

In this section, a structured approach has been developed to deal with decisions and descriptions of procurement approaches. Rather than focus on contracting methods, the distinguishing features of each have been identified in a way that leads to six questions that have to be answered in explaining how any specific project is being procured. These six questions derive from the differences between historical contracting methods and provide a basis for a systematic approach to the procurement strategy for future projects that will remain contextual despite new terms for different approaches being coined.

2.1 Contracting methods

Typically, textbooks and guides around this topic focus on contracting methods. Many descriptions of contracting methods can be found in the literature. The choice about which one to use is often based seeking similarity with the kinds of project on which each has previously been used. Some texts group similar types of contract together as a means for deciding which approach is best. The general problem with all of this is that the different kinds of procurement method do not all differ in the same way as each other. A quick overview of the key characteristics of each contracting method reveals the following.

- *General contracting*. Frequently known as "traditional", this technique is characterised by the separation of design responsibility from construction. It emerged during the Industrial Revolution as a means of dealing with increasing technological complexity. It is, therefore, not as traditional as (e.g.) design-build, which would have been common throughout history (Hughes *et al.* 2015, pp31-4).
- *Design-build (DB)*. This is a longstanding method of procuring infrastructure where the contractor is asked to carry out design work as well as construction work. This differs from general contracting because of the inclusion of design with construction responsibility (Hughes *et al.* 2015, pp51-66).
- *Novated design-build*. This is a hybrid contracting method that looks like design-build, but the client's requirements have been developed by the client's design team to the extent that they would have been under general contracting. The DB contractor is asked to tender on an almost complete design. This results in a similar amount of control over the initial design for the client, while transferring the design risk to the contractor who may be seen as having responsibility for the design with little authority over it. While it is riskier for contractors than DB, it occurs most in a shrinking construction market when contractors cannot afford to include a premium in their price for the extra risk, for fear of not winning competitive bids (Griffith, *et al.* 2003).
- *Construction management (CM)*. This involves the client standing in the shoes of the general contractor. There is no general, so a series of trade contracts directly with the client replace the subcontracts that a general contractor would use. To ensure effective control, coordination and management of the work, a consultant construction manager is employed to represent the client's interest, but with no liability for the performance of the construction work. This method is popular with private sector property developers when demand for construction work is high, such that contractors can choose not to take on risky contracts. By using CM, a developer can reduce the risk for the contractor (see Hughes, *et al.* 2015, pp69-79)
- *Engineer, procure and construct*. This involves firm commitment from the contractor for fixed time, fixed price and specified level of performance. This transfers a high degree of contractual risk to the contractor and, therefore, many of the decisions about how to fulfil the client's requirements are for the contractor to make. Also known as turnkey, engineering procurement, installation and commissioning (EPIC), engineering, procurement, construction and commissioning (EPCC), lump-sum turnkey (LSTK) (See Eggink 2020).
- *Design-build-finance and operate (DBFO)*. This is a technique for procuring public sector infrastructure by having private sector investment in the project and then charging rent of the use of the facility for a specific term, sufficient for investors to re-coup their investment. It commonly involves a joint venture between a bank, design team, main contractor and key supply chain partners. Examples include the ill-fated private finance initiative of the UK from 1992 to 2018 (Morse 2018).
- *Build, own, operate, transfer (BOOT)*. This is a specific kind of public-private partnership (PPP) model, which is very similar to DBFO (see above), except that the BOOT contractor would not usually have the same extent of design responsibility (Tan and Zhao 2019).
- *Performance-based contracting*. Rather than commissioning the procurement of infrastructure, a client may approach someone who owns infrastructure already and simply rents it for the period for which it is needed. For example, there is a substantial market for offices using this approach. Like DBFO, it involves paying for a service, rather than for infrastructure directly. But, unlike DBFO, it would not usually end with the transfer of ownership to the client. It may be used for a wide variety of situations,

from short-term office leases to longer term bridge deck maintenance (see, for example, Alsharqawi, *et al.* 2021; Gruneberg and Hughes, 2011)
- *Collaborative contracting*. This is a range of techniques and ways of thinking that are designed to reduce the incidences of disputes and adversarial conflicts in construction projects. It often involves carefully selecting contractual partners with whom a relationship can be developed, such that the continuance of a collaborative relationship becomes more important than merely profiting from an individual contract. This encompasses ideas like partnering, framework agreements and so on (Hughes *et al.* 2015, pp81-91).
- *Facilities management*. This is not a construction contracting method but is included to make the point that the decisions about owning an operation or contracting it out extend into the operational phase of a constructed facility. It is important to remember that construction is an event at the beginning of an operational process for the client, not simply the end state of a contract.

One problem with this list of contracting methods is that it explains different ways of choosing how to set up the head contract, but the more important decisions, probably preceding those relating to contracting methods, are about what is to be built and who is to build it. A listing of contracting methods provides only a partial picture of how best to put construction demand to the market.

2.2 Fundamental procurement decisions

Many of the textbooks about construction procurement focus on describing the tactics of different contracting methods. It is, of course, important to understand what is meant by each of these contracting methods, which are outlined in Section 0. Each contracting method has distinctive characteristics:

- *General contracting (GC)* is about the separation of design responsibility from construction responsibility and the involvement of general contractor with contractual responsibility for coordinating and executing construction work. This is the primary feature that distinguishes it from design-build (DB).
- *Design-build (DB)* involves contractual responsibility for both design and construction.
- *Construction management (CM)* involves a role of coordination that does not carry contractual responsibility for the execution of the work; therefore, payment is made **not** through the CM but directly to the trade contractors.
- *Partnering/frameworks* are selection methods.
- *Design-build-finance-operate (DBFO)* and *performance-based contracting (PBC)* include the responsibility for funding the project, with the client only paying for the service being delivered, rather than for the design and construction resources directly.
- *Engineer, procure and construct (EPC)* is a turnkey approach that requires the EPC contractor to organise the entire supply chain and select the designers, the contractors and the suppliers and run the project on behalf of the client. While selection of those supplying goods and services is not the only distinguishing feature, this does raise the issue that selection of these parties is a significant task that has an impact on the outcome. *Collaborative contracting* also involves integrated supply chains and partnering as alternative techniques for setting up sophisticated processes for selection of contracting parties.
- *Performance-based contracting (PBC)* is a kind of lease or outright purchase for value-based goods. *Design-build-finance-operate (DBFO)* is a specific arrangement that achieves a similar result.

This list shows that contracting methods are not different methods of achieving the same aim. They tend to each focus on a different issue in procurement. This list of issues provides a basis for the procurement decisions to be made for a project:

- Funding and ownership of the development of the project
- Methods and techniques for selecting suppliers of services and goods
- Liability for design decisions
- Responsibility for coordinating the construction site processes
- Basis for calculating the price
- Supply chain integration

An appropriate procurement strategy for a construction project is one that fits with the capabilities, risk profiles and resources of the procurer. It is not simply a choice of contracting method but a choice about how to best organise the resources needed for any given project. It depends absolutely on the characteristics of the procuring organisation. Terminology can be very inconsistent in relation to these issues. The procuring organisation may be known as owner, sponsor, employer or client. The latter will be used in this Chapter, but the terms are used interchangeably in the industry.

Any project requires capability, knowledge and experience. A project involves risk, and it requires finance. Because construction generally constitutes a lot of expenditure up-front, the risks associated with construction need very careful management. The characteristics of the client organisation are the primary variable in determining the most appropriate procurement strategy. The decision about how much of the work to carry out in-house and how much to contract out to others is known in the literature as the "make-or-buy" decision (Williamson 1979). The key point for procurement is for clients to consider the extent to which they have the capabilities, knowledge and financial wherewithal to manage a project themselves. Indeed, this can be seen purely as the client's appetite for risk. At some point in the work, the client's experience and knowledge will not be sufficient to deal with the risks involved in the work.

Figure 2 shows how a client may navigate this decision. Those who wish to go to the market for help in developing the business case and who wish to transfer as much risk as possible to the supply side would opt for DBFO, PFI or PBC as a contracting route. Those who have in-house resources (or wish to recruit their own consultants rather than leave the contractor to be responsible for getting design work done) would opt for general contracting or novated design-build contracts. In this way, the contracting method should be a consequence of project organisation decisions based on the client's knowledge, experience, risk profile and access to capital.

In terms of risk profile, the further down this chain a client goes before approaching the market for construction, the more risk the client is absorbing. Essentially, this is because a decision of any kind carries liability.

2.3 Processes involved in procurement decision-making

In terms of navigating the decision in Figure 2, some analysis of the reasons for choosing one route over another is needed. The list of contracting methods in Section 0 is worth exploring in more detail. This reveals some interesting characteristics that may be used for making informed decisions.

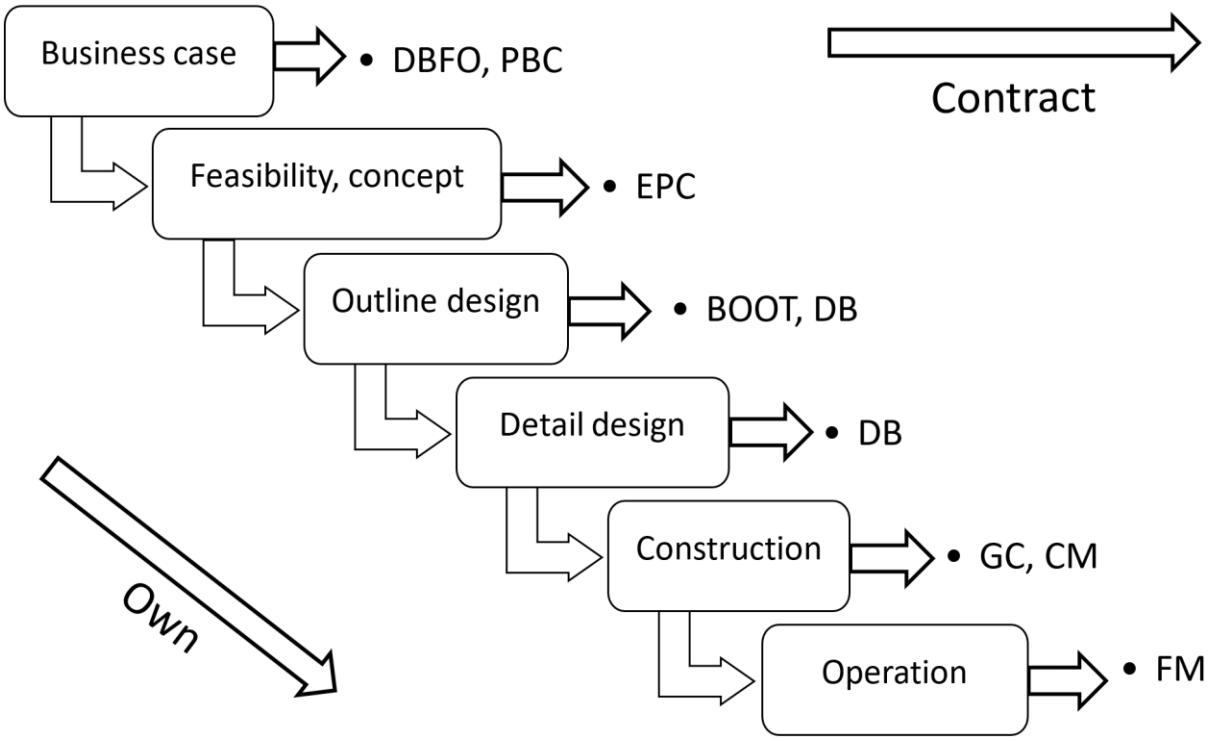

Figure 2: Procurement methods as construction market engagement: the own or contract decision (Key: DBFO design-build-finance-operate; PBC performance-based contracting; EPC engineering-procurement-construction; BOOT build-own-operate-transfer; DB design-build; GC general contracting; CM construction management; FM facilities management)

2.3.1 Organisation of the project

The primary decisions are delineated in Table 1. These begin with decisions about responsibility that will be informed by strategic issues of value and risk, based on the resources and capabilities of the client organisation.

Based on the client's position in relation to the factors outlined previously, the primary decision for any client approaching construction is how to fund the development. Of course, it is not always necessary for the client or end user to fund construction. As we have

Table 1: Principles of procurement and example

Principle	Examples
Responsibility for funding	Owner-financed, public sector-financed, developer-financed, PFI, PPP…
Responsibility for design	Architect, engineer, contractor, in-house design teams, supplier…
Responsibility for site coordination	Client, lead designer, principal contractor, joint venture, construction manager…
Selection method	Negotiation, partnering, frameworks, selective competition, open competition…
Price basis	Work and materials defined by bills of quantity, cost reimbursement, whole building, a fully maintained facility, performance…
Supply chain integration/transparency	Single source, integrated, fragmented, competitive, collaborative…

(Hughes, *et al.* 2015, p105)

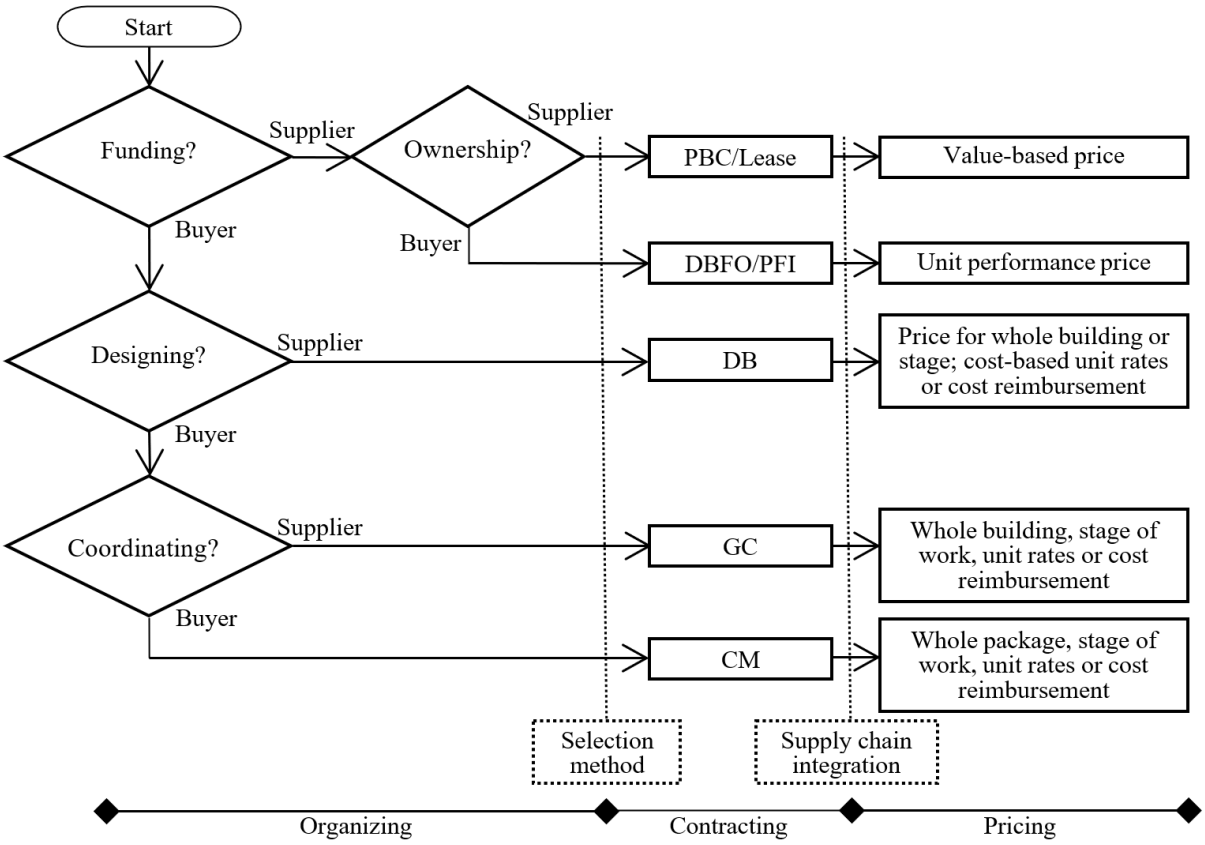

Figure 3: Procurement decision flowchart (after Hughes, *et al.* 2015, p104)

seen in the list of contracting methods, some of them involve the supply side in providing the funding for a project, leasing the completed facility to the client for an operational period. So, the first question for the client is, where is the money coming from? At one extreme, the funder may also carry out everything in the process, owning the whole process and contracting none of the work out. Indeed, as noted by O'Neil (2019, p8), it is increasingly the case that major international civil engineering firms have become asset owners. They have their own firms to provide operational and maintenance services, asset management, investment management and so on. Thus, they can carry out the whole of the activities, including the operation of the asset. More usually, clients will choose to go to the market and contract works to specialists if they do not have the capability and resources in-house. The point in the process at which they decide to go the market is a strategic decision based on client resources and capabilities. This point is the major determining factor in understanding which procurement method will be used for a project. Bridge and Tisdell (2004) provide a detailed discussion of the theoretical context for the ideas of boundaries to a firm, vertical integration, resources and capabilities.

An analysis of the distinctive characteristics of different approaches (Section 0) leads to a simple set of choices that are open to the client who seeks to procure infrastructure or buildings. Table 1 summarises the principles and provides five examples for each principle. These examples are not intended to be exhaustive but illustrative. Even so, they lead to a dizzying number of possibilities. With five choices to be made from each of six decisions, the number of possible procurement routes is 5^6 or 15,625.

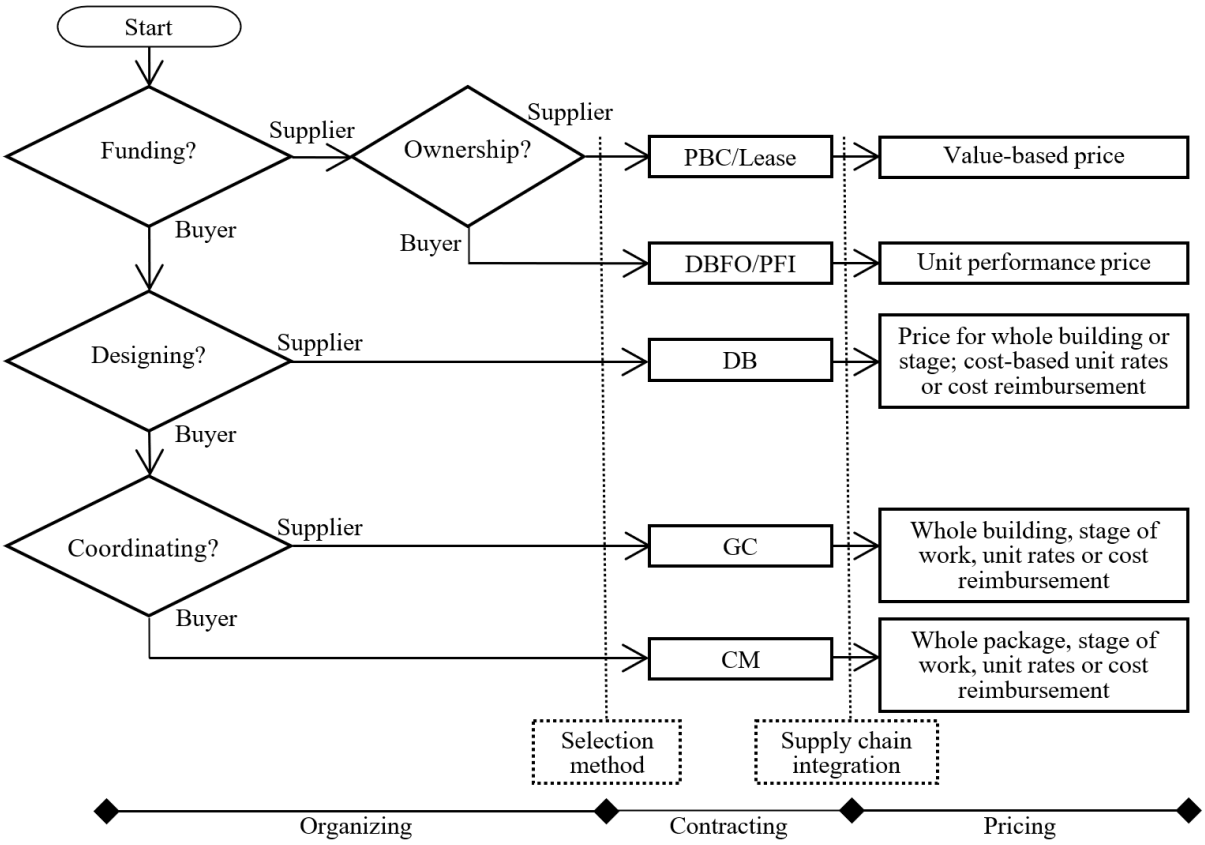

Figure 3: Procurement decision flowchart (after Hughes, *et al.* 2015, p104)

One useful feature of this analysis is that it provides a structured approach to the procurement planning. There are decisions to be made around organising the main groups of responsibilities. The decision about presenting demand to the market involves decisions on selection methods and these lead to contracting methods as well as methods for calculating the price. These may be seen as a flowchart of decisions in Figure 3.

2.4 Effects of contractual risk allocation on the procurement decisions

One way of dealing with uncertainty and risk is to seek to transfer risk to someone else. Rationally, this should also involve payment for the organisation taking on the risk, which is easy to perceive when it comes to insurance, for example. However, there are a several issues that muddy the waters.

3 Construction contracts: significant features

3.1 Contract formation and standard forms

Where a contractor is engaged to carry out building or civil engineering works, the obligations of the contractor and of the client (or employer) are found in the agreement between the parties. It is important for participants to understand the key features within such an agreement to know something of the wider context: how are such agreements formed? What documents might be required? What participants are involved? Is there one agreement or several?

3.1.1 Construction project participants

It is useful to consider the parties involved in construction contracts.

- The builder, or contractor will have an obligation to carry out and complete the required works. Where assisted by subcontractors, suppliers and others, the contractor remains responsible for discharging the obligations to complete the works under the construction contract. Alternatively, the contractor may be engaged as a construction manager, leaving separate works contractors to execute the physical works on site.
- The client, or employer, will be obliged to provide and give possession of the site to the contractor and to pay for the works. The users of the completed facility might be part of the employer's organisation or may be entirely separate; the employer may have complex arrangements in place with third party organisations or future users.
- The designers might be employed by the employer, the contractor, or might work for a separate consultancy. It is important to know which party in the project will prepare designs and be responsible for the designs. The question of which party this is will depend on the provisions of the construction contract: the design might be provided entirely by the employer, or by the contractor, or partially by each party.

There may also be other organisations directly involved in the project in some way. Some examples are approval agencies, insurers or bondsmen, and specialist consulting groups interested in archaeology, environmental issues or acoustics, for example. Research has shown that, even in relatively small projects, the number of such organisations is often counted in hundreds (see, for example Hughes *et al.* 2015, pp100-103).

Involving a wide range of participants potentially leads to differing parties with differing needs. It is important that instructions to the contractor are consistent. To achieve this, a typical feature of construction contracts is that just one organisation is designated to provide instructions and information to the contractor. That may be the employer, or another designated organisation that is named within the construction contract. Standard forms of contract refer to the role of the project manager (PM) or engineer in different ways. The Fédération Internationale Des Ingénieurs-Conseils (FIDIC) *Red Book* refers to the Engineer. The NEC4 Engineering and Construction Contract refers to the Project Manager. The JCT forms refer to either an architect or contract administrator. Where the works are to be carried out on a design and build or turnkey basis, the JCT forms use the term Employer's Agent. The FIDIC *Silver Book* refers to the Employer's Representative. Other terms may also be encountered for this role (Hughes and Murdoch, 2001). In the remainder of this Chapter, this role will be referred to as the PM/engineer for convenience.

What is important to understand here is that projects tend to be unique. Each project will be at a unique location involving a combination of participants, many of whom may never have worked together before. A complex web of parties will be involved, each with obligations under a consultancy contract or construction-type contract. Some basic questions about how contracts are formed will be common to all these engagements, even if the terms on which parties are engaged are very different.

3.1.2 Standard forms of contract

The terms of each construction contract and consultancy contract could be drafted afresh for every project. To do this would be time consuming and inefficient. It would leave each contracting party unsure of their obligations at the outset of each engagement and may lead to parties being asked to contract on unfavourable and ill-considered terms. It will not always benefit the employer to seek to pass all risk to a contractor if the result is an increase in construction costs that might be avoided altogether (also see Section 0). To address these

issues, standard forms of contract are available (also known as standard-form contracts). The drafting organisations, traditionally, were professional bodies like ICE or government bodies, but today are likely to involve a collegiate drafting committee that reflects the interests of employers, contractors, designers and others. It is important to note that these standard forms, in most countries, are advisory and not legally mandated. However, some countries mandate specific contracts for certain kinds of work. It is important to ascertain the situation that applies to the jurisdiction in which the project is located. These days, drafting organisations prepare numerous forms to address various contracting arrangements (see Section 0). Some of those more commonly found in the UK and internationally are:

- **NEC**. The New Engineering Contract is now in its fourth edition, as NEC4. The suite of forms published includes an engineering and construction contract (ECC) and professional services contract (PSC).
- **FIDIC**. This organisation produces standard forms directed at international work. The leading forms are its Conditions of Contract for Construction (the *Red Book*) and Conditions of Contract for EPC/Turnkey projects (the *Silver Book*). FIDIC also publishes Conditions of Contract for Small Works (the *Green Book*).
- **JCT**. The Joint Contracts Tribunal produces a large suite of different standard forms generally directed at building works. They have over 20 standard forms including standard warranties.

The forms produced by these organisations are not directly comparable. Different drafting organisations use different terminology. However, the underlying structure of forms and clauses are underpinned by similar principles, which are, in turn, based on the governing law of contract. These forms contain several sections:

- *Contract clauses.* This section contains the obligations required of each party and provisions contingent on matters that may arise as the work proceeds.
- *Supplementary or optional clauses.* The agreement will need to note which of these apply to the particular project.
- *Appendix.* A form or forms in which requirements particular to the project are added, such as the date for completion and lists of drawings. The NEC forms refer to this as the contract data.
- *Form of Agreement.* This is an overall form referring to the previous sections, which is signed by each of the parties. The core obligation is that the contractor is to provide the works (or project information in NEC4) as described in the documents above.

It is important to note that standard forms of contract are not usually used as published. Many clients of construction re-draft specific clauses to suit their requirements. In many jurisdictions, they are free to do this. Similarly, contractors, in submitting their prices, may insist on specific clauses being changed to suit their requirements. The post-tender negotiation on the precise terms of the contract may involve a considerable effort by both parties. This practice is widespread and may result in the contract containing confusing provisions that could even be inconsistent with each other (Mewomo *et al.*, 2018).

3.1.3 Tendering procedures

Before an agreement is reached between the employer and contractor, some consideration must be given to both how a contractor might be selected and to the processes involved. The usual approach is that a contractor is selected through a *tendering* exercise. Some approaches available include open tendering, selective tendering, two-stage tendering or a negotiated procedure. Where use of central government funds is involved or public works

are involved, the use of tendering is typically mandated. Most countries have detailed public procurement regulations. The purpose of the tendering exercise is that, when a tenderer is selected, the employer can enter into a binding construction contract (or agreement) with the contractor immediately without further negotiation.

Where a selective tendering approach is adopted the process to be followed will involve several parties. The employer, typically with the assistance of a consulting engineering firm, prepares the documentation for the tendering process. This is the full package of documents to be assessed by the contractor when compiling the tender price and involves drawings, specifications, and details of the form of contract and relevant appendix entries. Selective tendering involves identifying a shortlist of contractors from whom tenders will be invited. This may involve a process such as *prequalification* or a *framework agreement* with a limited number of contractors. Prequalification processes typically seek evidence of the contractor having successfully completing similar work previously and to be accredited for health and safety, quality and environmental management processes. Prequalification may relate to a single contract. Framework agreements relate to a series of contracts and may result from a single prequalification and tender process. Framework contractors are then available to complete one or more of contracts within a programme, focusing continually on high-level objectives, and building on lessons learned to deliver continuous improvement in contract key performance indicators (KPIs).

After tenderers have compiled and submitted a tender the successful contractor is chosen. The precise criteria for selection, which may involve a mix of price and other factors, must be published to tenderers in advance and followed strictly. Once the contractor is chosen from the tendering exercise the employer can enter into an agreement with that contractor. In principle, no further negotiation ought to be necessary.

Some organisations have a practise of notifying the chosen contractor of the intention to award the contract, perhaps permitting the contractor to make an early start in the works, via a *letter of intent* with the aim that this is superseded later by an executed construction contract. There is a risk such a letter may result in contract obligations being formed with a greater ambit than planned; the legal ramifications of such a letter need to be considered with care.

The decision about which selection method to use is not dependant on the form of contract, but the client's consideration of strategic issues. The form of contract may be a consequence of the choices made about how the work is organised and how the main parties will be selected. But the choice about selection methods is, itself, a process; a series of activities and decisions, the answers to which depend on client choice. The client has a choice about what documentation is to be used to present the demand to the market. Every decision involves risk and liability, and the extent to which the project is defined depends on the client's choices about risk. The highest level of risk for the procurer of construction work comes with preparing fully detailed documentation and seeking a price for this. The lowest comes from specifying what performance is required and leaving the decision about how to meet that need to the supplier. This may seem counter-intuitive to those experienced in contracting, where the aim of controlling the work leads to detailed contract documentation, inspection and management.

It must always be borne in mind that contractors tend to sub-contract most, if not all, of the work involved in construction. The setting up of the *supply chain* to do this means that a contractor who is invited to tender for work will, in turn, seek tenders from sub-contractors to prepare a price for the project. Similarly, each sub-contractor will need to establish prices from their suppliers, to ascertain the costs of the supplies they make to their

customers. Understanding these supply chain tendering procedures is an important part of understanding how contractors are selected and how prices for construction work are determined (Hughes *et al.*, 2006; Urquhart and Whyte, 2018). It should also be emphasised that price is not the only consideration in selecting participants in a construction project (see, for example, Kwawu and Hughes, 2008).

3.1.4 Contract negotiation

It is commonly assumed that securing a binding construction contract can only be achieved after some negotiation between parties. The assumption is not a correct one. If properly established, it ought to be possible to conduct a tender exercise and to form an agreement based on the selection of the contractor under the defined selection criteria without any negotiation at all. Indeed, one view is that no negotiation should be permitted at all if it were to provide a tendering contractor with an advantage that had not been available to other tenderers. One would not, for example, expect parties to seek a better contract price if a short period for negotiation were available, particularly if one selected tenderer was dealing exclusively with the employer.

Where a tendering exercise has been conducted, some post-tender adjustments may be required before executing the binding agreement. The better view is that these are not negotiations but adjustments and should be limited to adjustments permitted within the tendering procedures. This can arise where: *(a)* there is a mathematical error in the tender pricing document which the contractor has the opportunity to correct; *(b)* the contractor has proposed some alternative goods, materials or design in circumstances where the contractor shows the planned design was impossible or *(c)*, if permitted, the contractor has raised some tender qualifications which it proposes become terms of the agreed contract. Good practice suggests these matters should be resolved before the contractor starts work on site. Clients should avoid the temptation of changing contract clauses in order to award a contract to one tenderer, as other tenderers may rightfully complain that they have not been given the same opportunity. If, alternatively, the contractor makes a limited start to the works under a letter of intent, serious consideration ought to be given to ceasing work on site if the proposed contract adjustments cannot be agreed within a short period.

There is one other context where contract negotiation will be seen, namely, where there has been no tender exercise to select a contract. An employer and contractor may simply form an agreement after discussions between themselves. One might see this where a contractor must be engaged on an emergency basis and where time for tendering is not available. This was seen with construction of coronavirus hospital or vaccination facilities in many countries. Good practice suggests that such arrangements are in place for a short term only and that the terms of appointment are available for inspection if public funds are involved. For commercial organisations, the other context where a contractor might be engaged by negotiation is where a structure is required that is simply a repeat of another already built by the same contractor, if appointment by negotiation alone is permitted.

3.1.5 Supply chain

It is tempting, when considering a construction contract, to think that the employer might only have obligations to a contractor under a construction contract. In fact, this may be one of many contracts entered into by the employer. There will also be a consultancy contract with the consulting engineer and other consultants. The contractor, in turn, as seen in Section 0, will have its own supply chain, involving subcontractors, suppliers and consultants. The contractor always has a choice about whether to carry our work in-house or subcontract it. This choice is dictated by the contractors' business needs in relation to

continuity of work, performance risk, specialisation and the specific assets required for each kind of work (Hughes *et al.*, 2006, pp18-19). It is useful to consider some of the issues arising for the employer and for the contractor relating to the intended supply chain for the works.

On the face of it, the employer's agreement is solely an agreement with the contractor. A PM/engineer acting for the employer will be named as such in the main contractor/employer contract. This usually involves two roles; employer's agent and certification (see Section 0). But the PM/engineer will ordinarily have no contractual relationship with others in the contractor's supply chain. This raises several issues:

- *Whether materials or products will be obtained from non-sustainable sources*. A change to the specification may avoid that difficulty altogether. Sustainable sourcing is increasingly an issue for which the employer must be provide a reasoned account.
- *Whether parts of the supply chain are likely to be sufficiently robust*. If materials or goods are specified in a way that requires sourcing from another continent, the risk of delay in delivery to the site is high. Further, there is a risk that replacement parts may be difficult to obtain in the event of product failures. These risks might be reduced by reconsidering specifications.
- *Supply chain management and operational risks*. The employer may have a choice of engaging two different types of contractor. At one extreme a contractor may operate an internal, integrated supply chain in that the contractor owns or controls the bulk of the sources. The alternative is a contractor who works through an extended supply chain formed of external organisations. The latter may be more susceptible to disruption.
- *Whether it is necessary or desirable for the employer or PM/engineer to have some form of direct engagement with parts of the supply chain*. Where a specialist subcontractor is contributing to design, then direct warranties with the subcontractor would provide useful protection for the employer in the event of the main contractor's demise.
- *The conditions under which labour will be engaged*. For example, in the UK, the Modern Slavery Act 2015 establishes an obligation for companies to manage modern slavery risks in their operations *and their supply chains*. The obligation requires a UK organisation to understand its global supply chain to avoid the risk that labour is engaged under unfavourable conditions.

From the contractor, in addition to the above, there will be a further range of issues to consider. These include liability for escape of pollution from the site; treatment of waste and the related environmental risk; and operational risk issues such as the need to import plant and machinery to carry out the works and restrictions (fiscal and operational) there may be on such imports.

3.1.6 Contracts: role of the PM/engineer

With engineering projects, employers engage PM/engineers so the employer can benefit from the professionals' skill and expertise. If there is a programme of projects, there may be a programme management office (PMO) employing a series of PM/engineers. Traditionally, the PM/engineer has fulfilled two separate roles. One was to translate the employer's needs into designs and specifications. Second, once a contractor was engaged, the PM/engineer acted in a contract administration role. That involved issuing instructions and information to the contractor and, additionally, acting in a certifier role. Although the construction contract is between the employer and contractor, the PM/engineer is named within the contract and given power to act in these roles during the works. A peculiar consequence of this arrangement is that the employer's role within one project is relegated to giving possession of the site and making payments. The control of the works is effectively

allocated to the PM/engineer. The PM/engineer's functions are detailed later in this chapter, in the sections dealing with quality of the work, time, and money.

The fact that control of the works and certification duties are given to the PM/engineer is not detrimental to the employer. The PM/engineer in the certification role is required to act independently and fairly between the parties. Hence, the contractor may prefer to work under the control of the PM/engineer than work directly for an employer.

An overview of the role of the PM/engineer would not be complete without considering the position from a contractor's perspective. In subcontracts there will be no separate engineer, in that the main contractor will perform any certification function. Additionally, the subcontract may provide that the decisions of the PM/engineer under the main contract will apply also within the subcontract: a good example of this is where the works are certified as having achieved substantial completion ready for taking over by the employer. Further, where the contractor or subcontractors have some design responsibility, a PM/engineer may be employed by any of those parties; but the role would be limited to provision of design information, and not certification.

3.1.7 Managing quality

Civil engineering projects are commissioned to provide valuable facilities or assets to employers, so that they can be operated without causing injury to users. A completed project with deficient elements may cause more than mere concern; it may mean the entire facility constructed cannot be used and, until put right, is worthless. Concern for the quality of work carried out applies during construction too; to see that the works are completed safely, mindful of the health and safety of construction participants and the local community. Project control of quality ought to be understood on two planes: the contractual provisions directed at achieving a compliant end product and the wider regulatory environment in which services are provided and goods produced.

It is useful to differentiate different aspects of managing quality. As defined in ISO 9001:2015, quality management is about the relationship between management activities and quality. This involves framing systems in the wider regulatory and policy environment. Quality control is about processes involved with measuring outputs to ensure that they conform with quality requirements. Quality assurance is focused on ensuring that quality control techniques will indeed provide evidence that quality requirements are met.

Quality: contract provisions

From the employer's perspective, control over the quality of work produced involves three stages. First, the requirements as to the standards of work required are specified. Second, the work carried out will be subjected to some inspection and testing. Third, the works will be certified as complete. In practice, these stages can overlap.

The contractor's obligations: The contractor is required to execute the works in accordance with the contract documents. Different forms use slightly different terminology. Under NEC4 Clause 20.1 the obligation is to provide the works in accordance with the works information. Under FIDIC, the requirement is to carry out the works in accordance with the contract. Either way, those contract documents use a defined term. The definition of the works comprises the documents that are specifically listed in the agreement. It may include a vast array of documents including drawings, specifications,

planning consent conditions, contractor's qualifications to the tender[2], or even potentially pre-acceptance minutes of meetings or emails. The contractor is only required to carry out the works to comply with the requirements set out in the contract documents. However, this is not the end of the matter because, during the progress of the works, the requirements can be changed. (Changes to the specification are usually known as variations.) FIDIC contains the helpful clarification that the contractor's obligation is to carry out the works in accordance with the contract documents *as altered or modified by variations.* The NEC4 puts this in stark terms, requiring the contractor to *obey any instruction which is in accordance with the contract,* which is given by the Project Manager. So, if a particular type of concrete finish is required, but not mentioned in the contract documents, confirmation that the contractor is to provide that type of finish would be provided by the Engineer during the works; the additional requirements would probably be a variation for which the contractor will be paid additional sums.

The PM/engineer's capacity to influence or control the quality of work carried out will depend on the type of contract adopted. At one extreme, a performance specification is provided, and the engineer has no influence over how the end product is achieved; the role is limited to checking compliance with the specification required. At the other extreme an Engineer may be responsible for outline and detailed design and can control the works closely. Engineers should be aware of three potential sources of contention:

- Confirmation of a point, even if thought to be just that, may in fact be a variation if it requires more than is required under the contract documents (read as a whole).
- The contractor might suggest changes to the works, including changes to methods, or constraints. If accepted by the PM/engineer, there is a danger that the quality of the works will be compromised inadvertently.
- Instructions relating to testing, even post-completion, which exceed contract requirements, can be a variation.

Testing: Assessing the quality of work done is carried out by the PM/engineer from the moment the construction work commences. The contractor will be paid for work in stages or at intervals as work progresses, but the contractor is only paid for work properly executed. Where a contractor fails to carry out work to the required standard, the right to be paid for that work falls away. The PM/engineer can order the non-compliant work to be removed and replaced. If the contractor refuses to comply, the employer can engage another contractor to comply with the instruction, and the first contractor will have to reimburse the amounts involved.

Testing might be carried out by the PM/engineer or by an external agency. As to the tests required, the NEC4 Clause 40.1 refers to tests and inspections that are required by the Works Information or the applicable law. The FIDIC Clauses 9.1 to 9.4 contain detailed provisions as to tests on completion, delayed tests and retesting, with the tests involved set out in the contract documents. If additional types of tests are required, this will be a variation. If the tests fail the contractor pays for testing costs and for the cost of any delays caused.

Correcting defects: Completion of the works arises in two stages. First, there is the point where the works are essentially complete. The FIDIC forms refer to this stage as Taking Over the works by the Employer. NEC4 refers simply to Completion, a defined term under

[2] Contractors sometimes add conditions (also known as *qualifications*) to their submitted tender, such as alternative contract clauses. Where such conditions are attached to their price, this is known as a *qualified bid,* or *qualified tender*.

clause 11.2(2). The JCT forms refer to this stage as Practical Completion (other terms may be used in differing circumstances, see Hughes and Murdoch, 2001). Under all these forms the PM/engineer certifies when the works are completed. There follows a period for rectification of defects for a defined period, often 12 months. Thereafter a list of remaining defects is compiled, and the contractor's final payment is conditional upon repairing defects on that list. Some care is required when referring to a *defect*. In NEC4, the term is defined. In other forms, a defect arises after the first stage of completion because work done prior to this simply incomplete or temporarily non-conforming. The second stage of completion, or final completion, is when those and other latent defects are certified as having been rectified.

Quality: some current issues

The procedure described above reflects traditional practices where the bulk of work is carried out on a construction site and is subject to regular inspection by the PM/engineer. A critical analysis of the system indicates this approach will not always best suit employers without further modifications. Some weaknesses are:

- The system was never a perfect one because the PM/engineer does not supervise the works; inspections are at defined intervals and may be infrequent. Some non-conformities may go undetected between inspections.
- It will not always suffice to inspect works on site. Where components are formed off-site or in factories there may be a need for inspection during manufacture. This can require visits to suppliers overseas.
- In a system where the PM/engineer designs the works, and the contractor executes the works, there may be no clear view as to who is responsible for defects. If the contractor is provided with a performance specification, stating the outcomes required, this can help to allocate the risk of non-performance with the contractor. However, this may also weaken the PM/engineer's influence over the type and specification of work carried out.
- There is some evidence within the construction and manufacturing industries of manufacturers falsely claiming their goods are compliant with particular standards. Whilst some professionals, like chartered engineers, will be bound by the ethical codes of their professional institution, others will not necessarily feel constrained in this way.

Ultimately, compliance with ISO 9001:2015 (International Standards Organization 2015) and associated documents, such as BS 99001:2022 (British Standards Institute, 2022) will go a long way to overcoming problems and issues relating to the achievement of client objectives within the contemporary regulatory and policy context.

3.2 Project planning or project scheduling techniques and project performance management

Under a construction contract, the contractor is required to complete the works by the completion date as defined, and agreed by the parties, in the contract. If no date or duration is stated, the usual obligation implied by law is a requirement to complete within a reasonable time. But much can occur after commencement that might cause the contractor to complete late. Construction contracts contain several provisions designed to address the consequences of these delays and to encourage timely completion. Before reviewing those provisions, one should recall that, in addition to the construction contract, there may be other related contracts with time-related obligations. The PM/engineer may be required under a design consultancy agreement to provide design information by stipulated dates and to avoid causing delay to the contractor. A suppler engaged directly by the employer

may be obliged to deliver goods to the site on dates that are determined by the main contractor. Local inspection agencies may be under a contractual requirement to visit and inspect. And the client's end-users may be required to supply information or their requirements by stipulated dates. For example, on a project to construct a new toll-road, completion cannot be achieved and profitably used without timely delivery of toll payment machines and without writing and testing the software code specific to those units.

It is essential to understand that, under English law, if a contractor is given a fixed period in which to carry out and complete construction work, then the contractor must be given the whole of that time. Two important consequences follow this thread. The first is that contractors are free to decide how exactly they programme work and arrange to complete. That means there is little room for the PM/engineer to interfere or direct the contractor as to how to carry out work or as to the sequences unless, of course, statutory health and safety issues are apparent (One very important feature of contract law is that contracts cannot override statutes. Thus, statutory obligations, such as those related to health and safety, cannot be contracted away.) The second consequence is that, if the contractor's time to carry out the work is reduced – for example, by the need to carry out additional work requested by the employer – then the contractor should be given extra time to do the works to reflect that addition. If no such addition is made, the contractor cannot be held to any contractual liability for delay damages. The tension between a contractor's apparent freedom to organise the work and the PM/engineer's desire to direct contractors is apparent within the standard forms. Under NEC4, the Project Manager is permitted to issue instructions under Clause 14.3. But if those change the scope of work or key dates (as the contractor will likely contend) then additional sums will be payable to the contractor, as it would amount to a compensation event under clause 60.1. The tension is exposed in FIDIC's Clause 8.7 where, if progress is too slow, the Engineer may instruct the contractor to provide a revised programme with revised methods to expedite progress. The contractor is expected to comply at its own cost and risk. Yet if those same delays were found to be caused by matters for which the employer was responsible (including vicariously, by the PM/engineer), the employer will be obliged to compensate the contractor either as a variation or claim under Clause 20.

3.2.1 Some key contract provisions

Commencement date: Under Clause 2.1 of the FIDIC forms, the contractor has a right of access to and possession of the site from the date(s) stated in the appendix. The NEC4 form refers to these as access dates. In practice, the proposed commencement date will have been advised to tenderers and is then entered in the appendix. There is provision for more than one start date where the contractor will be granted possession in sections, as can occur with road, rail and pipeline projects. If so, the areas of land and dates must be defined in advance. If there is a delay to the contractor gaining possession of a part of the site, the contractor is given a right to claim an extension to the completion date and additional costs incurred.

Completion date: The FIDIC forms refer to the time for completion. There is also provision for the employer to take over the works in sections, in which case a description of each section will need to be set out in the tender documents and annexed to the agreement. NEC4 refers to a completion date and, similarly, makes provision for completion either in full or in sections: see Optional Clause X5. A difficulty can arise where a tendering contractor calculates that it may be possible to complete the works early. Submitting a tender on this basis risks providing a non-compliant bid. For this reason, some tenderers will choose to submit two tenders: one will have the employer's proposed time for

completion; the other will have the contractor's proposal. The contract data section of the NEC4 forms provides an option for the contractor to make its own proposal.

Completion or taking over: It was noted above that the PM/engineer certifies when completion has, in fact, occurred. This is an important stage of the works. Possession of the site will pass to the employer; liability for insuring the works reverts to the employer; A surety's potential exposure under a bond may cease; the interim payments regime will change; and the period for rectification of defects begins. The same consequences follow with completion of sections of the work or where the employer takes partial possession.

Delay Damages: Under Clause 8.7 of the FIDIC form, in the event the contractor completes the works later than the completion date (as adjusted), the contractor will be liable to pay to the employer an amount of loss, typically stated per day or per week. Under most legal systems, the amount of predefined damages must represent a reasonable pre-estimate of the employer's probable loss in the event of a delay. Hence, a reference to a *penalty* for delay is a colloquial term – in law it is not intended as a penalty. There are several reasons why construction contracts make provision for delay damages. One reason is that the amount can be deducted from amounts due to the contractor, so there is no need to make a separate claim in court, for example. A second reason is that the contractor benefits by knowing the proposed amount of damages per day. This might even be factored into the proposed price of the works at the tender stage. It provides the contractor with an informed commercial understanding of the risk of delay; it will not be worth spending more than the potential delay damages to being the project back into line with the contractual completion date.

There are several further provisions relating to delay damages. One is that there may be several rates for delay damages, one for each part or section of the works. Further, if part of the works is taken over early by the employer, the rate applicable to the remaining works is stepped down pro-rata to the area of works not taken over. Third, the FIDIC forms provide for a maximum amount deductible; some contractors are keen to limit their exposure to delay damages to 10% of the contract sum. In the NEC4 form, the delay damages provision is optional, at Optional Clause X7.

Bonus: Payment of a bonus for early or timely completion is something of a double-edged sword. For all the perceived benefit of such a provision, the other side is that the contractor stands to incur a large loss – the loss of the bonus – in the event of just one day's delay. Claims by contractors relating to delay are likely to feature claims for recovery of the bonus that might have been won. Bonus provisions can lead to tension between the contractor and engineer immediately before completion. The contractor may encourage the employer to take possession of those parts that are complete. This may be accompanied by urging prompt payment of the bonus, notwithstanding some parts remain to be completed.

The FIDIC form makes no provision for a bonus. The guidance notes in the form suggest an additional sub-clause for payment of incentives for early completion with the caveat that the completion date is absolute for the purposes of this clause and cannot be extended.

Treatment of bonus provisions in NEC4 is rather different to FIDIC. Under Optional Clause X6 provision is made for payment at a rate per day that completion is achieved before the Completion date. Further, Clause X6 anticipates that the target completion date can be extended by compensation events (as noted later).

Acceleration: Can a contractor be instructed to complete earlier than the completion date? Neither FIDIC nor NEC4 make provision for this; not least because completion by an earlier date may be impossible, or because of difficulty in calculating compensation. Instead, both

forms provide for acceleration by agreement. Under NEC4, the contractor can be invited to submit a quotation, stating the proposed changes. Under FIDIC, the position is more nuanced. The engineer is permitted to instruct that revised methods are to be adopted, including acceleration measures, but only to reduce the extent of an employer-caused delay. Compensation to the contractor for taking such measures is payable as a variation: see Clause 8.7. It would appear the engineer does not have power to order the contractor to complete by a particular earlier date.

Extension of time: All construction contracts ought to include a provision whereby the PM/engineer has power to revise the date for completion to accommodate the additional time required to carry out any employer-caused change. If there is no such clause, any provision for delay damages will be rendered void under English law and the employer will be left to claim actual losses from a reasonable completion date. Both FIDIC and NEC4 have provisions of this nature. The grounds upon which the completion date might be extended are wide, including some neutral events not caused by either party, such as exceptional weather, war or insurance events. Under FIDIC's Clause 8.5 the period of additional time to be awarded is limited by the contractor's obligation to mitigate delays. Under NEC4, time is extended because of compensation events under clauses 60 to 65. What is unusual about that form is an expectation that time will be extended as work progresses to establish new forecast completion dates each time a qualifying delay event occurs. By contrast, under FIDIC, the additional time is more likely to be granted after the event, so retrospectively.

The provision to extend the completion date is a good example of a provision that has been developed over many years taking account of views and experiences of both employers and contractors. The merit of using a standard form of contract is that the provisions are commonly understood across the industry and understood to be structured with a balance of risk between the parties. That balance is disturbed where one party seeks to amend the standard form of contract to allocate more events as being contractor's risks.

3.2.2 Further delay-related provisions

Few employers will be content to await completion of the works before planning how the facility will be occupied and before employing staff and equipment to run the facility. Employers inevitably are interested to gain some understanding as to whether the works in progress might be completed late (and by what period). There has been a move in the last 20 years towards providing greater guidance to the employer and PM/engineer relating to progress and delays.

Early warning or notices: One of the more significant features of the NEC forms, when they were first introduced, was a requirement for the contractor to provide early warning of likely delay. The purpose of this was to encourage and support the stipulation, at Clause 10.1, that the employer, project manager and contractor were to *act in a spirit of mutual trust and co-operation*. The idea is that areas of risk ought to be identified early and resolved by discussion. Under Clause 18, an early warning meeting can be instigated by either the project manager or contractor. A provision for advance warning meetings appears at Clause 8.4 but the sanction for not following the process is not obvious.

Another way that early warnings feature in NEC4 and FIDIC forms relates to advising of delays incurred. Here the provisions are rather more serious. Under FIDIC, a failure to advise that a delay has been incurred within 28 days of the contractor being aware (or ought to have been aware) of it means that the contractor is not permitted to claim an extension of time. Under NEC4 the draconian nature of this provision is tempered in that the project

manager has an obligation to advise if also aware of the same delay event – the right to the claim is not lost if the Project Manager was aware of the event.

Construction Programme: Under both NEC4 and FIDIC forms the contractor must provide to the employer a copy of the construction programme and must provide updated editions in the event of delays. This assists the employer in measuring progress and delays. It also assists the PM/engineer by indicating when design details, or free issue materials, need to be provided to the contractor. FIDIC's clause 8.3 sets out a long list of matters to be shown on the programme and notes the modern trend for submission in native planning software. The contractor is required to proceed in accordance with the programme. However, departing from the programme would not be a contractual breach, because the means and timing of construction processes are matters for the contractor to decide. The obligation here is to maintain and re-issue a programme that shows the most up-to-date picture of progress for project management purposes. The NEC4 form similarly sets out requirements for the programme, noting it is to be accepted by the project manager unless contended. It then forms the basis for extension of time calculations because of compensation events.

Monthly reports: The requirement for the contractor to produce a progress report has evolved into a detailed and prescriptive list of requirements. These requirements will need to be set out and included withing tender documents. These are likely to be bespoke to the project organisation, depending on information sought. The employer can benefit from information gleaned from reports when coupled with monthly progress meetings, in understanding ongoing causes of delay and other issues as they arise at the time. Monthly reports often link to processes such as value and risk management. Earned Value Management (EVM) is a process to control the time and cost performance of a project and to predict the final project duration and cost. EVM is particularly valuable to a client or PMO delivering a programme, as projected savings or overspends can be balanced across a programme prior to contract completion.

The section above has noted various contract provisions relating to time. There are other provisions that are also partially time related.

3.2.3 Some current issues related to planning/scheduling

A recurring question, in UK at least, is how the time-related provisions in the standard forms support collaborative working. The question goes to behaviours and to the extent to which information is exchanged between parties.

As to behaviour, there is a broad policy question over whether, in the event of delays, the contractor should be liable for delay damages. There is a view that the threat of delay damages does not sit easily with a collaborative working relationship with a contractor. Yet a completely different approach is likely to be seen at subcontract level. Here, the contractor is unlikely to be able to forecast likely delay damages as delay might be caused by one or many subcontractors. The costs incurred might be claimed back from one or from many subcontractors if several were thought to contribute to delays. The tradition therefore is that the subcontractor may be charged a portion of the actual or expected loss incurred by the main contractor. Again, none of this is conducive to a collaborative working relationship.

So far as information is concerned, project digital platforms allow for parties to share documents with ease, yet this does not always extend to progress data or to subcontractor programmes. Clearly, where work is carried out with a contractor on a cost-reimbursable basis there should be no barrier to the transparent access to all exchanges with subcontractors yet standard forms of contract do not always reflect this.

A third area for contention is over the precise point at which the works might be taken over by the employer. The question is whether it is desirable to have a contractor remaining on site, engaged in resolving defects, for potentially months after taking over. A more modern trend has been for detailed descriptions and checklists to be developed as a test for whether taking over should occur. There is a contemporary trend for such details to be included within tendering information so that the contractor is aware of the likely requirements.

3.3 Insurance, bonds, warranties and indemnity

Construction companies, or their subsidiaries, rarely have sufficient available funds to reimburse project owners or third parties for the losses incurred after calamitous events. When entering into any consultancy agreement or construction-related contract, consideration should be given to the different types of security required and to the types of risk to be covered. There are also practical matters that face every project manager: Are the policies in place and effective? Are the guarantees being offered worthless? Without securities in place, the entire investment in a construction project can be lost in a matter of hours.

One does not have to look hard to find examples of major project risks: a tunnel collapse during construction; flooding of neighbouring properties; or a design failure soon after construction requiring major repairs. Even if immediate damage is minor, the consequential losses can be large.

Some risks are purely financial. If the contractor ceases trading and a new contractor must be introduced midproject, the client suffers the delay to project completion and the inevitably higher cost of engaging the replacement contractor. It is necessary to have a form of security in place, designed to provide funds to address these types of event. In this section, the different types of security are classified to reflect the parties providing them and to reflect terms commonly used in construction contracts.

Financial protection in the construction sector is a complex topic, involving many different forms of protection. One key reference in this area is Hughes, *et al.* (1998). Even though this seems dated, there is little contemporary material on the topic, but the principles have not changed very much in the last few decades.

3.3.1 Retention

The payment provisions under a construction contract may provide a limited form of security. If the employer withholds an amount from each payment due to the contractor, it helps build a small amount that might fund defects that a contractor might refuse to correct. The percentage withheld, usually 3% or 5%, is called *retention*. Half of retention is released back to the contractor when the works are practically complete. The balance is released when defects are rectified. But there are widely held views that it is unfair to withhold cash from contractors when they may be slow to release amounts down through the supply chain.

Contractors in the UK have campaigned for legislation to be introduced to ban the use of retention on the basis that retention is divisive, breeding mistrust that defects will be rectified, weakens cash flow throughout the industry and can result in the last part of retention not been paid down through the supply chain in heavy-handed commercial bargaining over final accounts. One view is that no retention is required if a retention bond can be provided instead. The alternative view is that deduction of retention is administratively convenient. If no deduction at 5% were made, there is a risk of an

overzealous approach to interim valuations that sees far greater deductions being made. The debate over the utility of retention is one seen across many countries.

3.3.2 Insurance

When setting up a construction contract there will be two main insurance-related questions: What level of cover is required? Which party should provide insurance cover? Insurances do not have to be arranged by the contractor as the policies can be arranged by the employer instead. Either way, the policy is usually taken in joint names so both contractor and employer can benefit from them.

Under construction contracts there are four types of insurance typically found:

- **Insurance of the works**. This provides protection against physical loss, destruction or damage to construction works during the course of construction. The amount insured is usually the value of the works plus an allowance for professional fees. This is known also as a contractor's all risks (CAR) policy.
- **Insurance against damage to property outside the works**, also referred to as third-party property. The amount of cover required will depend on the location of the works, with more required in a city environment, less in a rural setting.
- **Insurance against injury to persons not involved with the works**, also known as third parties.
- **Insurance against design failings**, also referred to as a professional indemnity (PI) policy. If the employer engages an engineer to provide designs to be used in the works, the engineer will be required to provide PI cover.

It is important to note that insurance will not provide an automatic fund to cover every eventuality. Some events or circumstances may be excluded, like terrorism events. The amount of the policy might be insufficient to cover the calamity faced. The policy may be void or found not to respond if notifications of events are not provided within the periods or formats set in the policy, or because of a material non-disclosure of relevant facts at the time the policy was taken out. A wise project manager will obtain copies of insurance policies to confirm they are in place before any design or construction work commences.

3.3.3 Guarantees

It would be mistaken to think that a warranty provided by a main contractor would offer sufficient security to a client. The warranty that work has been carried out with reasonable skill and care, found in every standard form of contract, is of little use if the main contractor ceases trading. Several types of guarantee are commonly encountered. Whether any will be required will depend on the type of project.

A parent-company guarantee is a form of promise from a parent company to discharge debts of another party. If there are defects in the works and the contractor has ceased trading and hence is not available to rectify matters, it is convenient to an owner to ask the parent company to step in and to help fund the rectification works. Any such guarantee will need to be put in place before the works commence.

A collateral warranty is a warranty from a subcontractor direct to the client that the works have been carried out with reasonable skill and care. This is valuable where the main contractor ceases trading as, without such a warranty, the subcontractor would be under no

obligation to assist. An express requirement to provide such warranties will need to be set out in the main contract.

3.3.4 Bonds

A bond is a promise to pay. But in the construction industry bonds are a valuable form of security offered by a bank or a financial institution direct to the client. Many types are available.

Some construction contracts provide for the contractor to receive an advance payment at the start of the works. There is a danger that the contractor will cease trading or abscond with the funds without having performed any valuable work. An advance payment bond is a promise, arranged by the contractor, whereby a bank will pay to the client the amount of any loss if the contractor absconds.

A performance bond, typically set at 10% of the contract sum, is a promise by a bank to pay that amount to the client. The bonds might be available 'on demand' or may require proof that the contractor is in default. In practice, this provides a sum to help deal with additional costs incurred in the event a contractor ceases trading, and a replacement contractor is hired.

A retention bond operates in lieu of retention of payment. This is a promise by a bank to pay on proof, typically, that the employer has incurred costs rectifying defects.

3.3.5 Some complex products

Although it may be mandatory under some legal systems to maintain some types of insurance policy, it is worth recalling that a wide range of insurance products is available. Parties can use insurance as a risk transfer mechanism. The insurance industry offers some complex products to parties that may be interested.

Here are three examples. First, a 'delay to start-up' (DSU) policy is designed to cover losses that might be incurred if a project runs late. An example occurs with a toll road where, if late, there is a loss of revenue. Second is a 'cost overrun' policy. This contributes a sum in the event the project runs over budget, typically within carefully defined financial limits and circumstances. Third, an insurer might offer integrated insurance for an entire project. The principle is that with one common policy, the various participants can concentrate on the common goal of completing the project without worrying about potential liability between themselves had they each taken out their own policies. Complex policies like these are bespoke to each project. They may involve extensive due diligence on the part of the insurer before they offer the policy, and the policy cost can be prohibitively high.

3.3.6 A project management perspective

The provision of insurance and availability of guarantees and bonds can help projects proceed, often in remote parts of the world. Much however will depend on the wording of the policy or bond involved. Helpfully, standard forms of bond are provided by contract drafting committees. It remains for parties to ensure that the bond or surety is provided by a reliable banking organisation. One needs to be particularly wary of any party offering its own terms. Specialist assistance from brokers is required. Ultimately an indemnity provisions whereby one party agrees to refund another for losses incurred is only good if backed by a functioning policy. On major projects, clients will draft warranties and policies that form part of the tender and contract documents, leaving no doubt as to the obligations

involved. And during the works, care is required to avoid rendering bonds invalid by renegotiation of key contract terms.

3.4 Commercialism, liability, change, risk attitudes

Civil engineering projects proceed against uncertainties. The full extent of work required may depend on ground conditions and the local environment. The conditions in which the work is carried out, and related logistics, may be hard to determine with any certainty in advance. Uncertain elements increase in more remote regions or where contributors are working across borders. Parties face currency fluctuations, political risks, the risk of non-payment and cost of addressing defect rectification. The contractor also faces the risk that parts of the work may be more difficult to carry out than expected or poor performance of subcontractors. Construction contracts contain detailed provisions that help address how risks are allocated between parties and provides remedies in defined circumstances.

The price for the works is partly a function of risk. Contractors faced with accepting responsibility for a wide range of risks will need to price the works to accommodate this. Conversely, a lower project risk profile should reduce the construction cost.[3] Construction contracts contain a wide range of options that will need to be selected at the outset to allocate risks. An example of this, commonly found in civil engineering projects, is that the quantities of material to be excavated are tendered at provisional quantities but paid for later based on the actual quantities of materials involved.[4] This is in marked contrast to an arrangement where the contractor must guess at the likely volumes of excavation involved and might vastly overestimate, increasing the contract price at the employer's expense.

It is important to understand that most contractors do not have substantial funds available to carry out an entire project at their own expense. Some form of interim payment will be required. Most contracting organisations are modelled on receiving monthly interim payments. If subcontractors and suppliers are engaged with longer payment terms, the contractor can run projects with borrowing. But this can also mean that contractors suffer cash flow difficulties at short notice if works are delayed. For contractors, maintaining positive cash flow can be as important as working profitably.

3.4.1 Contracting regime involved

Fixed price contracting

In theory, fixed price contracting means that the contractor has provided a fixed price for the works, in what might be termed a lump-sum price. However, the more usual position is that any contracting on this arrangement is subject to change by variations. Further, some quantities of materials may be marked as provisional, meaning that the contractor is, in fact, paid for the volume of that work that has been carried out. In that respect, adjustments to the lump-sum price will arise. Rarely, a contractor may agree to carry out work on a guaranteed maximum price (GMP) basis. However, contracting on that basis is treated with great suspicion as, if incorrectly priced, the successful tenderer can find that the project is

[3] Hughes, *et al.*, (2006) found that tendering and selection processes may make it impossible for contractors to include a premium for risk. For example, a contractor who is desperate for work, or a contractor who has simply not understood the risks involved, may bid well below the busier and/or more experienced contractors involved in bidding. Thus, an open tendering process may be detrimental to an informed commercial approach to risk.

[4] This process is known as *remeasurement*, where the quantity of work paid for is ascertained after it is carried out. Where a remeasurement process is not being used, and quantities in the bidding documents have been specific, the quantity in the documents is the basis for payment, rather than the quantity executed, unless there has been a formal variation to the specification.

vastly unprofitable. Indeed, after well-publicised difficulties with the work on the Cardiff's Principality Stadium and London's Wembley Stadium, few contractors may be prepared to work on a GMP basis at all, or without so heavily qualifying the terms as to convert the contract to another contracting basis.

Remeasurement contracting is where there is a bill of quantities with priced rates for each item of work, which are used to determine the contract sum. The volume of labour and materials actually used is measured during the works and the contractor is paid for that volume but at the rates in the bill of quantities.

Cost reimbursement

Cost reimbursement (NEC4, Option E) is where the contractor is paid the cost of the works plus an allowance for overheads and profit. The contractor's risk under this arrangement is nominal, providing a sound basis for the employer, project manager and contractor to work cooperatively. The reality may be that the contractor acts essentially as a construction manager, engaging subcontractors on a fixed price basis, albeit with the employer's assistance.

The NEC4 contracts helpfully incorporate a schedule of cost components which defines what cost elements are classified as reimbursable and which fall into overheads.

Target cost contracting

Target cost contracting (NEC, Option C) is where the contractor is paid on a cost-reimbursable basis subject to an adjustment. If the cost of the works is below the target cost, the parties will share the savings at a predetermined ratio. If the cost of the works is above the target cost, the parties will share the cost overrun at a predetermined ratio. Clearly, the success of contracting on this basis may depend on the level at which the target cost is set. That may be a point of negotiation at tender stage. Further, the value of variations/compensation events is added to the target cost in calculating the final amounts due. This may result in some complicated final accounts. There is no FIDIC form that provides for contracting on this basis.

3.4.2 Some key contract provisions

Payment provisions

Construction contracts provide for payments to the contractor on an interim or stage basis. If interim, valuation would typically be monthly. Payment in stages relates to stages of work having been carried out. The value of the works in any month is calculated as being the gross value of all work done to date, plus the cost of materials on site and an amount certified in respect of fluctuations (if applicable) and claims, less the amount of previous payments.

The payment process operates in stages. First, the contractor will prepare an interim payment application. This will list each item of work carried out and the amount claimed, plus an amount for materials on site and other matters. Next, the PM/engineer assesses the amount due, which might or might not agree with the amount claimed by the contractor – there is no need to agree. The PM/engineer then certifies for payment the amount calculated to be due. The employer is then obliged to pay to the contractor the amount on the certificate within 14 days of issue of the certificate (or a later period if stated in the agreement). Hence, where an international development agency or bank is funding the project, funds would normally be released to the contractor only against a valid interim

payment certificate because that certificate provides independent confirmation of the amount properly due.

The procedure for valuation and payment in the UK is more complex because of the need to comply with provisions of the Housing Grants, Construction and Regeneration Act 1996 (the 'Construction Act'), as amended. Under the Act, a contractor has a statutory right to interim payments. The key additional point is that if the PM/engineer's assessment is lower than the amount claimed by the contractor then the PM/engineer must provide a payment notice specifying the assessment and the basis of that assessment: a 'pay less;' notice is served. If the PM/engineer does not respond within 10 days of the application, the entire amount of the contractor's application is deemed to be payable. There is also provision for the employer to deduct amounts due to the contractor by way of liquidated delay damages provided proper notice of this deduction is given. However, some contracts specify that the amount of liquidated damages may only be calculated after the date of handover to the employer. The specific contract clauses must be checked before withholding payment.

The basis of payment can be complex, particularly with international projects. There may be provision for an advance payment with associated *bonding* arrangements (see Section 0). Payment may be due in several currencies at pre-agreed exchange rates. The provisions as to tax and customs may be subject to adjustment in the event of changes by legislation of tax rates or local levies. The FIDIC forms address the difficulty where a contractor must import materials and plant for the project but intends to re-export the plant again on completion, thereby avoiding import levies.

The amount payable will typically be subject to and incorporate a reduction for retention, typically at 5% of the amount due. This is partially repaid when taking over of the works occurs. The last portion of retention is released for payment after rectification of defects. This topic is covered in more detail in Section 0.

Construction contracts provide express penalties for late payment by the employer of the amount due. In English Law, the Late Payment of Commercial Debts (Interest) Act may also apply, depending on circumstance.

Valuation of variations

The term, variations (or compensation events under NEC4), is wider than might be assumed. It might more accurately refer to matters for which the contractor is entitled to an adjustment to the contract price. This includes variations to the scope quality or quantity of work initiated by the engineer, variations initiated by the contractor, the consequence of PM/engineer instructions relating to the sequence or timing in which works are to be carried out, expenditure of **provisional sums** and changes to quantities arising from remeasurement. One might also add changes because of a change in law where any additional costs incurred by the contractor are recoverable as an adjustment to the contract price: see FIDIC Clause 13.7. In the NEC4 contract, Clause 60.1 lists over 20 matters constituting compensation events.

Where additional or varied work is instructed by the PM/engineer, the contractor must proceed with the work. The contractor cannot refuse to carry out work because, say, the amount involved has not been agreed. This is to avoid delays to progress of work on site pending agreement on the amount of the change.

There are several approaches to valuation of variations. The first is by quotation: the contractor is invited to provide a quotation stating the change in prices due to the work involved. The quotation might be accepted by the PM/engineer or rejected. If rejected, the contractor can be asked to proceed with the work anyway and the valuation of the variation

is made on the second basis: the value will be determined by the PM/engineer. The valuation regimes under the NEC4 and FIDIC forms are very different. Under NEC4 the valuation of the change is measured by the additional costs involved: see Clause 63.1, and the parties are encouraged to settle the value of the change at or near the time when the work is carried out. The approach under FIDIC is, primarily, that the value of variations should be based on the contract's rates and prices in the tendering document. So, if asphalt top layers are priced at £50/m^2 and an additional 1000 m^2 is required, the value of the additional work is also calculated at the £50/m^2 rate, even if costs have increased since the construction work commenced. Where the varied work is not entirely the same, a rate should be derived based on the contract rates. It is only if there are no applicable rates that the valuation is based on fair rates and prices or, perhaps, on costs incurred. A peculiarity of the NEC forms is that when assessing variations – or compensation events – the cost and time consequences are dealt with together. This differs from other forms where the valuation of variations and claims for extension of time are addressed separately.

A difficulty for the contractor is that, when asked to carry out additional or varied work, the impact of the change may extend beyond the immediate section of work involved. A request for an additional 1000 m^2 of asphalt paving may cause delay to the works overall with the result that some site staff will be retained on the project for a longer period. Equally, the site accommodation, security, site fencing and more will be retained for longer. These might collectively be termed *site overheads*. The valuation of the additional site overheads required is included in the assessment of a compensation event under NEC4. Under the FIDIC form, the contractor makes a separate claim for these additional costs. Going further, where the project is delayed there may be arguments that the contractor will have lost the opportunity to earn profits and a contribution to overheads from a future project that they might have started had the current project not run late. There may also be arguments relating to the additional administrative burden for head office staff. The NEC4 addresses all these points summarily in that the contractor is paid a fee percentage to cover head office costs. That fee percentage is added to the assessed costs within a compensation event. The FIDIC forms require contractors to make separate claims relating to head office overheads. Several formulae are available (like the Emden formula; see, for example, Hughes et al. (2015: pp. 261–263)) to calculate possible losses but the use of these is contentious (Champion, 2021).

Fluctuations

How is the contractor to be compensated for the rising cost of raw material or rising labour costs? The approach in the last 25 years when inflation rates have been low is that the contractor takes on the risk of rising prices. Nevertheless, construction contracts contain optional provisions for adjustment. Effectively, this means that the risk is carried by the employer. There are two different regime types involved. First, and most rudimentary, is that the contractor simply claims the additional cost of materials or labour during the works. This can be contentious where no benchmark cost is identified at the outset. This approach is not supported by the standard forms of contract but might be adopted by agreement of the parties at the outset in relation to some specific work element or product – particularly where imported and subject to exchange rate fluctuations. The second approach is that the contractor is paid additional sums calculated by reference to a published cost index. At the tender stage, the tender documents list the work elements that are to be subject to adjustment and the relevant indices to be used. This latter approach is adopted by NEC4 Clause X1 and FIDIC Clause 13.7.

Liability issues

A review of adjustments to the contract price would be incomplete without some consideration as to how a contractor might suffer liability for work carried out. As noted above, the contractor may incur delay damages in the event of delays. There are also provisions for damages for poor performance where the contractor is working to a performance specification: the NEC4 Optional Clause X17 is an example of this.

Liability for design potentially arises in respect of those parts of the work for which the contractor carries design liability. The starting point is that the contractor has no design liability except for those sections of the work that are specifically listed as being contractor-designed works. The contractor is potentially liable for both failure of the component and consequential costs. Hence, where a car park surface fails that has been designed by the contractor, the contractor is potentially liable both for the cost of its repair and for the car park revenue that is lost for the entire period during which parts of the car park cannot be used. Under NEC4, Optional Clause X15, the contractor is not liable for a defect that arose from its design unless it failed to carry out that design using the skill and care normally used by professionals designing works similar to those installed. Hence, the standard of care expected under NEC4 is one of reasonable skill and care. It is not an absolute standard in that, if a failure is found, one cannot automatically assume that the contractor is at fault. But the approach taken in the FIDIC forms is different. Under Clause 4.1, if the contractor has design responsibility, the design is to be fit for the purpose intended. There is a parallel obligation to maintain insurance in respect of contractor-designed work.

Needless to say, contractors seek to limit the extent of liability. The NEC4 Optional Clause X18.3 provides for limitation of indirect or consequential loss to the extent listed in the contract data. Typically, a limit of liability will be proposed by the contractor during tendering. FIDIC's Clause 1.15 provides for either party to limit liability.

Some current issues

There are several areas where contract drafting policy is in issue because of changes within the wider construction community. An example of this is the policy on withholding retention, covered in Section 0.

A second area of tension relates to the risk of price increases. In the past this was linked to domestic inflation and rising wage costs. But today the risk of rising costs comes for exchange rate fluctuations, especially in the cost of steel or glass imported from, say, Europe or Asia. An exchange rate change may increase the cost of the goods within one year by over 30%. The related area of tension is in the perceived strength of long-distance supply chains. Specifications for goods with long distance supply chains may need to be altered to reduce the risk of delay in delivery to the site.

A third area of tension arises from value engineering or contractor-proposed changes. The PM/engineer may be faced with the need to alter designs if the contractor advises that the specified product is no longer available or that alternative construction approaches are available. Where accepted, those changes will be a variation, but the engineer would remain liable for the design. Great care is needed midproject to avoid adopting designs in haste for which the PM/engineer may later be liable in the event of a failure.

A fourth issue is one of training of engineers carrying out valuation work. Where the Housing Grants (Construction and Regeneration) Act 1996 applies, a failure to value the works and issue valid payment and pay less notices can result in the contractor being entitled for the entire amount it claimed, often to the alarm of the PM/engineers involved because of seemingly patent overpayment. So-called smash-and-grab adjudications,

claiming sums because of invalid payment notices, should act as a warning to maintain vigilance of interim valuation procedures.

3.5 Termination at suspension

Where an employer terminates a construction contract during the course of the works, immediate practical, legal and economic issues are presented: securing the site, finding a replacement contractor, assessing work to be done, settling accounts and claims, and counting the inevitable extra costs incurred. Sometimes the termination is not justified; in other cases, it is necessary for wider reasons, owing to changed circumstances. Or it may be the contractor who opts to terminate. There are detailed provisions within construction contracts to address termination for two good reasons: one is to keep the entire administrative regime of dealing with consequences within the provisions set out in the agreement. The second is to avoid defaulting to remedies at common law (outside the construction contract) where, if one party to a contract substantially fails to perform, the other party is entitled to terminate the contract. Any termination on that basis can involve dealing with breaches of contract or the doctrine of frustration under the law of contract with its attendant uncertainties.

3.5.1 Suspension of the works

Suspension of the works is a step that falls short of termination. It might be regarded as a temporary pause. In principle, there are two potential outcomes. One is that the work is restarted after the pause, the other is that the works cease, thus terminating before the planned completion date. The NEC4 contracts only provide for suspension by the contractor where the work is in UK, covered by the Housing Act 2004, and where the contractor has the right under that Act to suspend for non-payment. The suspension is treated as a compensation event.

The FIDIC forms provide for suspension by the employer (Clauses 8.9 to 8.12) or contractor (Clause 16.1). They address, in each case, the consequences involved, the procedure for restarting the works and compensation incurred. Where the employer suspends, the contractor is entitled to receive compensation for additional costs incurred during suspension and in resuming work.

3.5.2 Termination by the employer

Termination by the employer is permitted on limited grounds. These include the contractor going into administration, failing to provide a bond, unauthorised subcontracting of a substantial part of the works, health and safety issues or failing to comply with instructions (NEC4 Clause 91, or FIDIC Clause 15). The employer can claim back from the first contractor the additional costs incurred in completing the work with the second contractor. The FIDIC forms also provide for termination for convenience – the employer does not need to give any reasons for termination. In that case, the contractor is compensated for lost profit that would have been earned on the incomplete works.

3.5.3 Termination by contractor

Termination by contractor is permitted on limited grounds including non-payment of certified sums, the employer going into administration, or where suspension has been ongoing for more than three months. Additionally, under FIDIC, a contractor can terminate if the employer is found to be engaging in corrupt, fraudulent or collusive practices (Clause 16.2). That might include interference in the engineer's certification process. The contractor is compensated for lost profit that would have been earned on the incomplete works.

3.5.4 Termination on neutral grounds

Termination on neutral grounds might arise in the event of a war, pandemic or major external event. A different consequential loss regime applies in this case.

Acts of termination are notoriously contentious because of the significant cost consequences for each party, depending on whether the termination was justified. It is critically important, to take advantage of the contract provisions, for the termination to be exercised precisely in accordance with the contract conditions, thus avoiding an unintentional breach of the contract. This involves providing a valid notice of an intention to terminate, delivered to the other party at the prescribed address and in writing, providing 14 days' notice before terminating. A failure to provide the correct notice under the correct formalities can lead to an accusation of having repudiated the works in which case the other party's actions may be taken as justified. The notice provisions cannot be ignored: see NEC4 Clause 13 on communication and FIDIC Clause 1.3 on notices and communications.

3.5.5 Some Current issues

The global COVID-19 pandemic provided an interesting example of an event that did not neatly fit with the defined circumstances in which parties could either suspend the works or terminate. External events of this type defy classification and can lead to circumstances where no party wishes to terminate but where the contractor finds it harder or more expensive to proceed with the works. The pandemic can be contrasted with later periods where works were delayed by supply chain shortages which again defied classification as events justifying suspension. A complication, which can arise during a pandemic or war, is that government orders are put into effect under emergency legislation. That can lead to arguments of change of law, itself a ground for compensation as a variation. The better answer may be for parties to maintain a cooperative working approach and to develop a solution that suits both parties.

3.6 Dispute management and resolution

Disputes in construction and engineering projects arise because, once a project is underway, parties find that their commercial interests (or those of their clients) differ as various events arise and are not resolved quickly. The sorts of event that arise may be simple or complex. Over time, costs may increase, or new taxes might be imposed, a subcontractor's performance might not proceed as expected, design details might be provided later than planned or external events might affect the project. Many of these will not have been expected. There may be confusion over obligations under the construction contract or conflicting requirements.

Resolving disputes can involve some interaction with the legal systems of the country in which the project is based or where the parties are based. Lawyers or specialist advisers will often be engaged by one or both parties to advise on management of the dispute, working with the project team. In developing an understanding of dispute resolution within the construction industry one must recall there are two coexisting spheres of influence. First, there are the laws and legal system of the countries where the work is designed, manufactured or built. It is not unusual for the resources deployed in a project to be sourced across several countries. Second, there are the provisions of the form of construction contract, and related supply contracts and consultancy agreements which operate as a subset within that wider legal system or systems. Interestingly, construction contracts offer parties the choice of law governing the works, as well as of dispute

resolution methods and related rules. A dispute arising from the construction of a hydroelectric dam in east Africa, say, may involve at least one party based in another country and an agreement for disputes to be resolved by an arbitration seated in say Switzerland under English law. For a civil engineer, it will be important to be aware of the main dispute resolution processes found in construction and engineering contracts and to have some understanding of different options.

The fact that disputes develop does not need to be seen as a failure and should not necessarily reflect poorly on the project's participants. Rather, disputes are a product of changing circumstances. In this section we look at some key issues that engineers and project boards face: what systems or procedures to put in place to address whatever disputes occur; and later, how parties might choose appropriate procedures when events occur. On a wider perspective, there are considerations as to whether disputes can be avoided altogether.

3.6.1 Legal context

Parties to construction contracts have available several options for resolving disputes. It is useful first to consider the systems typically available before reviewing how these are addressed within standard forms of contract.

Courts: Each country will have its own system of national and local courts. For a significant infrastructure project one or more parties may find themselves dealing with employment issues before the local labour courts, contesting levies before a tax tribunal or dealing with suppliers in local courts. A dispute between employer and contractor, however, is likely to be larger and hence heard in one of the national courts. One or more parties may be reluctant to use the court's service in the country in which work is carried out, whether because courts have public access (adverse publicity) or are considered to be slow or lack specialist construction law expertise.

Arbitration: Almost all countries permit parties to resolve their dispute through an alternative form of dispute resolution, arbitration. Further, most countries will uphold the decision of the arbitrator permitting enforcement action without further recourse to the courts and, thus, preventing parties from avoiding the decision or seeking to hear their disputes again before the courts. Where countries differ is over the extent or circumstances in which a party may seek a stay on the decision pending an appeal before local courts on a point of law. Where countries are signatories to the New York Convention or have bilateral treaties, an arbitration award secured in one country (such as that where the project is held) is binding in another (such as where the contractor is based). This is useful in that it provides greater security to parties considering large investments in other countries. Arbitration is administered through arbitral institutions. Some of the better-known institutions are the American Arbitration Association (AAA), based in New York, the International Chamber of Commerce (ICC), based in Paris, and the Arbitration Foundation of Southern Africa (AFSA), based in South Africa. Each has its own rules providing for appointment of arbitrators, evidence, awards, and procedural matters.

Mediation and conciliation: These are informal dispute resolution systems, privately administered. Typically, they involve an attempt by the parties to resolve their dispute on commercial grounds with assistance from a trained mediator, within just one day. In conciliation, the conciliator may issue a recommendation as to how the dispute is resolved which may be binding on the parties within a set period unless proceedings are commenced. Mediation might take place during the preparatory stages after proceedings in court have commenced. In practice, these are negotiations aimed at settling a dispute with

the support of a trained intermediary, often a senior construction lawyer or even a retired judge.

Dispute boards: A dispute board is a one- or three-person board that is appointed during the project to give an opinion on a contested matter. Some boards visit the project at frequent intervals. These are privately administered, often by the Dispute Board Foundation. An advantage of a reference to a DB is the prospect of early resolution of the dispute midproject.

Adjudication: This is a short form of dispute resolution, but one that is binding on the parties. There are two forms in use: one is statutory adjudication, put in place by national statute, which grants any party to a construction contract the right to refer a dispute to an adjudicator at any time during the project. Hence, a party might refer a dispute during the works. In the UK, for example, the other party only has seven days to reply, and the adjudicator has only 28 days to produce a decision; an extraordinarily short period compared with the years that might be consumed in courts or arbitration. Under statute, the result is binding on the parties, meaning that the amount found due is immediately payable, but parties can have the dispute reviewed again before the courts. Experience in the UK, at least, shows that most parties are content to stay with the adjudication result. The second form of adjudication is contractual rather than statutory because it is found in agreements such as NEC4 or FIDIC contract forms. To determine the provisions that apply in a specific project, knowledge of the applicable legal system as well as the specific contractual provisions is required.

The array of options, noted here, can be quite overwhelming to parties in disputes. Much work of the construction lawyer today is in advising which options, and the overall dispute resolution strategy, to follow mindful of experiences with each option.

3.6.2 Provisions in forms

Where an engineer is engaged by a client to help manage a construction project, two distinct roles are potentially involved. The first is where the engineer is to act on the client's behalf providing designs and information to the contractor to enable construction work to progress. The second type of role is one whereby the engineer acts as a certifier, certifying when completion has occurred, or that defects are to be rectified, or calculating the amount due in respect of a claim for additional payment made by the contractor. The label used for that role might be one of 'engineer' (see FIDIC forms), 'project manager' (under NEC forms) or 'contract administrator' or 'employer's agent'. That latter role involves making determinations as to amounts due, or additional time awarded, and so on. Where the contractor disagrees with that determination there will be a dispute. Alternatively, where a contractor makes a claim for additional time or money, if the engineer does not accede to the claim in full, there will be a dispute. Some forms of contract, such as FIDIC, define a dispute in this way.

Most forms have clear and detailed procedures as to how disputes are to be managed towards resolution. The range of approaches available to resolve disputes is potentially very wide, ranging from an interparty discussion to long-running proceedings in Court or arbitration, but in practice parties will typically be constrained by detailed provisions relating to dispute resolution set in the construction contract.

3.6.3 Approaches to dispute resolution

It is useful to consider approaches to managing disputes in three distinct stages or groups.

First is management of the matters in dispute by the project's participants, without referring the dispute to any outside panel, board or tribunal. This can take several forms.

- A *discussion* between the parties. This might be informal and ad-hoc or may be formally required under the agreement. The NEC4 form, for example, requires the parties to list the names of their senior representatives within the contract data at the time of forming the agreement and expressly requires a discussion first before, say, a referral to adjudication.
- A *formal determination* on a matter by the engineer, where specifically requested by the contractor, is required by the FIDIC forms. A good example of this would be where the contractor and engineer are unable to agree on the appropriate rate or price for a variation. The procedure is that the contractor gives a notice to the engineer setting out the reasons for their disagreement. The engineer proceeds with the determination by consulting both parties, then makes a fair determination in detail and with reasons. If the contractor disagrees with the determination by issue of a notice of dissatisfaction within 42 days, there is formally a dispute, and it is only then that the dispute can be referred further to a dispute adjudication board or arbitration. The formality under this approach is markedly different to the requirements for a meeting under NEC4.

The second stage is where the parties refer their dispute, if it has not been resolved, to some form of adjudication or dispute board. The key characteristics under these approaches are that there will be a formalised set of rules, parties will provide their respective arguments and evidence and a decision is provided within a relatively short period. The effect is to replace the engineer's decision. Again, there are several different approaches.

- In the UK, under adjudication, a dispute is referred by either party to the adjudicator. The other party provides a response, and the adjudicator proceeds to make a decision on the matter. The adjudicator must provide the decision within 28 days of the referral, unless both parties agree more time. The decision will typically include clear declarations for example revising a completion date or ordering an amount to be paid to one party. Compliance with the decision is mandatory. No appeal is available. A party unhappy with the decision would have to start fresh proceedings in court or arbitration to have the point finally determined.
- If the UK legislation does not apply there may be a dispute adjudication board appointed with powers similar to those under the UK legislation. This may be termed a dispute avoidance board or dispute review board.

The third stage, if the dispute has not been resolved by this point, is that one or both of the parties refers the dispute to arbitration or litigation, depending on the option specified by the parties in the contract documents.

Litigation is the determination of a dispute by a national court. The UK is one of the few countries to have dedicated courts and judges that can deal with construction and engineering matters and will hence be familiar with technical details with some ease. In other countries the dispute may be determined by a general judge with little or no expertise in these areas. A major source of difficulty is that court proceedings in some countries can be exceedingly slow and formal and hence costly. Some countries have introduced provisions for expedited determination on limited issues – useful, for example, if there is a narrow dispute over the interpretation of some contract provisions.

Arbitration is a private form of dispute resolution. Advantages of its use are that the arbitrators can be selected by the parties from a pool of professionals experienced in dealing with construction disputes. Indeed, one might have an arbitral panel of three

persons where, say, two are lawyers and one is an engineer. Other advantages are that parties can select the location of the arbitration hearing and can avoid all adverse publicity by keeping the matter private. Regrettably arbitration, like litigation, can be overly formal, slow and costly.

The precise choice of dispute resolution options and procedures is typically set out in the form of contract agreed and can involve a tiered approach with several approaches. The 2017 edition of the FIDIC Red Book provides a good example of this: first, the dispute is to be referred to a dispute avoidance or adjudication board (DAAB). If either or both parties are not satisfied with the result, they serve a notice of dissatisfaction (NOD). Both parties are then to attempt to settle the dispute amicably; only after that, or after 28 days has passed, can they start arbitration. The parties define, at the start of the contract, which arbitration rules will apply and how to appoint the DAAB and arbitrators. The FIDIC form also contains a model standard form for appointment of DAAB members.

3.6.4 Avoiding disputes

At a superficial level, disputes can always be avoided by simply compensating a contractor for any additional costs incurred. In practice, few projects can be conducted on this basis because of the potentially unlimited funds required. Even where a contractor is engaged on a cost-reimbursable basis, it seems that the scope for disputes does not reduce entirely because of differences over accounting, overheads, audits and proof of expenditure. Initiatives aimed at avoiding disputes have emerged from several directions.

Government-led initiatives are typically founded on an underlying interest in seeing that public funds are directed at projects and not into the disputes that might follow them. Some initiatives in the past have been misguided. Letting contracts on a guaranteed maximum price basis, for example is plainly an approach directed at declaring, on the project's completion, that the contractor made no claims and the works were completed on budget. Yet the premium paid to the contractor to take on that level of risk may have far exceeded what the work might have cost on other bases. Interestingly, procurement of a facility under a long-term concession basis (such as a public-private partnership (PPP)) can equally risk paying a premium for other parties to carry the all-construction risks. Other initiatives directed at reducing disputes involve seeing that the government client team have sufficient experience and technical capacity to undertake the project, an approach that can involve seconding into the client team some experienced professionals from other firms. A different approach to avoiding disputes can be seen in policy briefings to government departments to seek resolution through discussion. For example, the UK Government's *Construction Playbook* (HM Government, 2020c) proposes that more work is prefabricated offsite, a way to move away from onsite work, which is more prone to disputes.

Contractor-led initiatives aimed at avoiding disputes have had a mixed reception. Working on a reimbursable cost basis, for example, can successfully change behaviours of project participants. Working on this basis is supported by NEC4 which defines how costs are measured. Target cost contracting under NEC4 Option C provides a measure of incentive to the contractor to complete within a target amount – an approach that is popular with UK government agencies carrying out infrastructure work.

Some provisions aimed at reducing disputes are already evident within standard forms. Two provisions feature within NEC4: the provision of a risk register, a tool that encourages parties to identify areas of risk and to discuss at an early stage of the works how they might be avoided; and an obligation to provide early warnings of delay or matters leading to additional cost. Both provisions are directed at the early management of issues before they

occur. Other provisions, which also appear in FIDIC forms, require prompt notification of delays or additional costs being incurred because of compensation events with claims time-barred if not notified within stipulated times. These provisions encourage resolution of issues during the works and are aimed at avoiding large-scale disputes after completion. The second edition of the FIDIC *Green Book*, published in 2022, introduces a new provision for the calculation of contractor's delay costs, labelled prolongation cost, by formula. This is a good example of a provision for resolving valuation issues during the works and thereby reducing the prospect for disputes later.

4 Contemporary issues in project management

Changes to construction contracts reflect many influences: changes with society; technological change; changed regulations; codes and legislation; new products and changes in production techniques. The causes of change may be subtle, perhaps the result of educating of a new generation of engineers, or more overt, resulting from observations of new practices of competitors or new practices in other markets. Some matters, like discussion of blockchain or 'smart contracts', may simply be the product of a marketing campaign to sell software or IT systems but are unlikely to see widespread adoption in the near future. The themes identified here ought to be viewed against that setting.

4.1 Offsite production

The move toward prefabrication of modules for assembly on site has a peculiar genesis. It is partly encouraged by end users who believe that products and components produced in a factory-type setting will have fewer defects. The greater use of prefabrication has been partially driven by contractors: it is cheaper to build entire bathrooms in Poland and to slip them into place on site than to build them entirely on site. Equally, production technology is now computer-aided to the point where timber framed structures can be preformed offsite with each section having a unique design. The benefit of offsite work is no longer one of efficient long production runs but of production-led control. Use of offsite work increases when it is harder to find labour to work on sites.

Use of offsite production may be cited as an example of, or consequence of, lean construction or a process mapping exercise. In practice, use of offsite production may be the consequence of a long and detailed plan to enable construction to proceed within very constrained circumstances. A good example of this arises with the replacement of bridges across motorways or busy rail lines where the time available to install the new bridge may be measured in hours, not weeks. Planning for such an installation can take over 12 months. The benefit to the community is that the motorway or rail line does not see prolonged closure.

The shift towards use of offsite production is not without difficulties. The timing of design information is also a factor in the event of changes: work on site can be changed instantly but changes off-site may have a two-month lead time. Further, contractors ask for interim payments to include amounts for offsite production. There is a long tradition of valuation on this basis in building complex buildings but less so for civil engineering works. It requires bonds to cover the value of work paid for and inspections at the factory, not on site. The NEC4 contracts have no provision for payment of materials or goods offsite. The FIDIC form, conversely, sets out the detailed conditions under which payment for such goods can be made, including vesting certificates and bank guarantee involved.

For an interesting commentary on modular construction in megaprojects, see Flyvberg (2021).

4.2 Building information modelling and data management

The term 'building information modelling' (BIM) describes the process of creating and managing a digital model of a building or structure. 'Model' in this case means more than a three-dimensional, computer-aided design model. The thinking behind construction of a digital model was partly to assist design processes. The theory was that clashes between different elements could be seen in the model and eliminated before construction on site. A second reason for construction of a model using BIM was for it to act as a repository of construction and asset data to assist maintenance of the facility in later years. In 2011 the UK government encouraged adoption of BIM on government-funded projects by 2016, using Level 2 BIM. That was superseded by the UK BIM Framework in 2018. The UK BIM Framework sets out the overarching approach to implementing BIM in the UK. It was developed jointly by the UK BIM Alliance, British Standards Institution (BSI) and the Centre for Digital Built Britain to implement international BIM standards within a UK context.

Adoption of BIM on projects is now commonplace, albeit experiences of the use of BIM are mixed. In principle, the main contractor shares the model with subcontractors who, in turn, add the designs of their part of the works to the model. However, subcontractors do not always have the technology platforms for two-way integration of models. If the subcontractor is using a read-only model, the risk that its designs will not integrate with others still persists.

The NEC4 form incorporates a detailed set of provisions at Optional Clause X10 for use of BIM, noting ownership and liability issues. This should not be confused with data sharing platforms or 'portals' that provide a central digital zone for accessing and exchange of drawings and data. As these are set up with protocols limiting access, use of a portal should not be seen as encouraging collaboration. It simply reduces the volume of drawing transmittals via email. The broader issue may be over which parties have access to what data and which party controls the portal itself. Issues of data security in BIM are covered in ISO 19650-5:2020 (International Standards Organization, 2020d).

4.3 Collaborative working

Over the last 15 years various UK government departments have led initiatives in which collaborative working practices on UK construction projects have been encouraged. Policy reasons for the initiatives were partly rooted in a desire to reduce the extent to which projects ended in costly disputes. Another reason was an interest in seeing greater efficiency and in reducing the total cost to the Treasury. Implementation of the policy was via mandates of approaches to contracting that involved integration of teams and moving away from fragmented approaches. The most recent iteration of these initiatives was given in *The Construction Playbook* (HM Government 2020c), a UK government guidance document launched by the Cabinet Office in December 2020. This has three overriding objectives that cut cross the *Playbook's* 14 key policies:

- *Improving building and workplace safety*. Creating safe facilities and protecting the health and well-being of the workforce.
- *Building back greener*. Taking steps towards the UK's 2050 'net-zero' commitment and driving a better understanding of whole life or whole-life carbon cost. The government hope to obtain data in a standard way to inform future decision making and performance during the life cycle of a project or building.
- *Promoting social value.* Helping local communities to develop, tackle economic inequality and promote equal opportunities.

In addition, the government is seeking to focus on the health of construction sector generally – setting up sustainable relationships, and healthy and diverse markets, and recognising that neither low margins nor low pricing by competitive tenders are sustainable for the sector in the long term.

Equally, and perhaps independently of these initiatives, the NEC forms contain many features directed at collaborative working. Some have been referred to earlier in this chapter. They include the following.

- A provision encouraging parties to act in a spirit of mutual trust and cooperation. This is perhaps short of an express good faith provision.
- Use of the programme as a proactive management tool and use of a risk register and early warnings. These features are not traditionally seen elsewhere, where the tradition was to deal with issues after they arose rather than trying to prevent them.
- Provision of an optional partnering-type clause. This provides a framework for the use of single project partnering. It includes, at Clause X12.4, a profit-sharing feature whereby savings might be divided between partners.
- Provision of a target cost form of contracting as NEC4 Option C. Interestingly, FIDIC have not provided a similar form.

4.4 New forms of contract

The publication of new forms of contract, and revision of existing forms is an issue of ongoing concern because construction firms and professionals need to maintain some knowledge of the forms available and their utility. An example may be the revised FIDIC standard form of contract for small works, known as the *Green Book*. The revised form is almost double the length of its predecessor. The revision was driven by user interest in having a form that could be used in the management of high value but short projects without having to resort to all of the features of a larger form. Maintaining the knowledge and experience of use of different forms in different markets will be a challenge for engineering firms.

4.5 Project delivery and project governance

Project management in construction is a topic that has long been a focus for textbooks and training in the industry (see, for example, Chartered Institute of Building, 2014; Harris *et al.*, 2021; Lester, 2017). There are several different approaches. First, the idea of project management seems originally to have taken hold during the USA space programme, at the National Aeronautics and Space Administration. It has developed into a set of techniques based on the idea of achieving contractual objectives related to time, cost and quality. Second, project delivery usually denotes the activities that take place after the design stage in a project, involving all onsite, offsite and supply chain management. However, caution is needed in using such terms because some practitioners define project delivery at a more strategic level, as a synonym for strategic project management. Third, project governance is an emerging theme in practice as well as in research. These terms have no absolute objective definitions, so different sources can be expected to define them for their own purposes. For many in the construction sector, these issues seem to be new and complex. Conversely, they are such well-established ideas with well-developed practices for implementation that there are numerous national and international standards available for guidance.

Many sources define project management with some key ideas. First a distinction is often made between managing different kinds of work. In the construction sector, work takes

place on a project basis requiring the constant management of change. This is often presented as distinct from the idea that 'running a functional or ongoing business is managing a continuum or 'business-as-usual" (Lester, 2017, p1). This simplistic characterisation is based on a largely out-dated comparison between proactive and reactive management. Traditionally, as Lester (2017) and many other authors are quick to point out, project management has been characterised as proactive, with the emphasis on planning and documenting all the work to be done, then controlling it to ensure that everything is executed as planned. The danger of this view is that information is rarely complete and the environments within which projects take place are rarely static. The indications are only that the project environment is increasingly unstable, and that information is always incomplete and constantly changing. In other words, one could be forgiven for wondering whether project management textbooks are based on how the world ought to be, rather than how it is. It must also be borne in mind that firms in a wide range of industries manage their work through projects. While it is obvious that a production line involves repetitive work in a controlled environment, each production line is a project for the manufacturer and is frequently managed as such. For reasons such as these, international standards on project management are drafted for use across many industries. Project management is not an industry-specific skill set, even though the technology is. Finally, the problem of focusing on proactive management has been shown to reveal that an aversion to reactive management does no favours for those who must manage projects when something goes wrong (Loosemore and Hughes, 1998). It is worth challenging the idea that there is a binary division where proactive project management is identified as 'good' and reactive as 'bad'. Project managers should seek to be able apply both proactive and reactive skills to their work. Indeed, there is an important lesson here for aspiring engineers: do not be fooled into thinking that the best projects have everything defined in advance and that no changes occur. This is simply not realistic. In practice, well managed projects are constantly responding to changes in circumstances, requirements, interests and environment as they progress.

The need for project management across all industries has led to the development of international standards that are important for construction, such as ISO 21502:2020 (International Standards Organization 2020e). One key aspect of this standard is the inclusion of material on the organisational context of projects. Other recent inclusions in widening the scope of project management include the oversight and direction activities of sponsoring organisations and the idea of benefits realisation. There is a clear trend to connect project work to its context, most explicitly in the way that governance has come into the domain of project management (see, for example, many frequent mentions of governance in BS6079:2019 (British Standards Institution 2019b)).

An additional theme that emerged during the 2019-2022 COVID-19 pandemic, was the change in supply chain arrangements. A shortage of shipping and transportation capacity highlighted the fragility of just-in-time supply chains: delivery of materials across borders or by ship took weeks longer than first anticipated. One response has been to source materials and products closer to the end destination. Another has been to put in place a number of potential suppliers in lieu of sole sourcing. In short, there seems to be an emerging trend towards prioritising supply chain resilience over cost.

Emerging issues in project governance are typically a product of, or reflect themes developing within, the wider business community or are a product of changes in government policy or of new legislation. There are dangers in concentrating exclusively on the delivery of planned work to agreed contractual objectives. Bringing the principles of governance to bear on project delivery is seen as a way of avoiding some of the mistakes

that have resulted in social and public health disasters, as well as fatalities, that have plagued the built environment for many years. Guidance is available in international standards such as ISO 37001:2016 (International Standards Organization 2016), as well as other International Standards Organization (ISO) guidance referenced in this section.

Sustainability has been a broad theme for many years, yet there has been a shift towards the adoption of sustainable practices and materials in response to climate change concerns. One key standard in this area is ISO 15392:2019 (International Standards Organization 2019a). Sustainability considerations have moved from being a desirable feature to a mandatory response to comply with legislation in relation to a wide range of issues, including energy-savings, social value, social responsibility and governance. In the UK, public sector work is covered by the Public Services (Social Value) Act 2012. This mandates that those who commission public services, including constructed assets, take account of social, economic and environmental benefits.

Corporate social responsibility (CSR) may seem to be relatively new in the construction sector. It refers to an interest that corporations express in their wider community. This is more than philanthropic. The drive for this agenda is a response to surprisingly poor practices in the past, across all business sectors. It is a response to failures in governance, both in firms and in their projects. Singh, *et al.* (2015) show how some major construction organisations report on their CSR practices and how this has developed in recent years. Not only do construction firms have responsibilities that they must demonstrably respond to, but their clients also have to be able to conform to an increasingly demanding business context in which this agenda cannot be ignored. Current guidance on incorporating CSR practices is available in ISO 26000:2020 *Guidance on social responsibility* (International Standards Organization 2020a).

Policies related to sustainability, social responsibility and corporate governance are sometimes collectively referred to as environmental, social and governance (ESG) policies. This is not a separate agenda but a convenient way of bracketing together these contemporary issues for the purposes of communication.

Closely wrapped up in the narratives around ESG are the issues of corruption and ethical conduct. As Liang *et al.* (2021) report, corruption is widespread throughout the construction industries of the world. There are two threads that contribute to such problems in the construction sector. First, construction sites, as we have seen, involve dozens, if not hundreds of companies whose work involves regular progress payments, often in cash, making it difficult to monitor financial processes. Second, the scale of such projects is often very large, attracting criminals of many types and making financial crime an apparently worthwhile opportunity. The result is a plethora of corrupt practices to guard against, including collusive tendering, wrongful certification of quality, overpricing, cartels, bribery of officials and so on (for a more complete list, see, for example, Chartered Institute of Building, 2013). This adds a huge cost to construction for the industry and for society. Thus, the processes included in the standards mentioned here are not only essential for those who wish to be law-abiding but may also pay for themselves in rooting out corrupt behaviours.

Professional institutions may be expected to be a bastion of ethical behaviours. Indeed, to be a member of a recognised professional institution, by definition, requires the individual to undertake conformance with the profession's code of conduct. Contravention of an institution's ethical code will result in expulsion. Since every professional has an obligation to conform to an ethical standard, the continuing accounts of corruption at all levels of the industry would seem to indicate that much more is needed in this respect. Fewings (2008)

provides extensive analysis and guidance of the issues around ethics in the built environment.

4.6 Lean construction and process mapping

As mentioned in Section 0, there are many who view construction work as uniquely project-based, as opposed to continuous production in factories. As is often the case with such dichotomies, the truth is somewhere in between, and it varies between types of work and project. While some projects are entirely unique and bespoke in every respect, that is quite rare. Many projects contain repetitive processes, such as the creation of many slabs of concrete, or kilometres of tarmac. It comes as no surprise, then, to see manufacturing management techniques directly transplanted into the construction arena, with varying degrees of success. Lean management is one of these ideas, translated here into lean construction, among other things.

The underlying idea of lean construction is the elimination of anything that does not add value, making things only when they are needed, and the power of any worker to stop the production process if something goes wrong. This was derived from 'lean thinking', a waste elimination process developed in the car industry, notably at Toyota, Japan. The development of these ideas was a response to the position of Japanese manufacturing after World War II, and there are those who feel that it is important to be aware of why these ideas emerged and how they became translated into the philosophy of 'lean thinking' by Womack *et al.* (1990). There are many enthusiastic supporters of these ideas in construction who are confident about using these ideas for the improvement of construction processes (see, for example, Forbes and Ahmed, 2011). There are also those who urge caution in the unquestioning implementation of processes and ideas from different cultures, industries and times (for example, Green, 1999).

Process mapping, or process value mapping, is used to describe the analysis of production processes to see how a product can be delivered more efficiently. Implicitly, this is not simply about having components at lower cost but about seeking greater value by rearranging the design or assembly process. A more recent development of this idea is value stream mapping to re-engineer production processes and supply chains. Current research in construction processes is unearthing wider application of these ideas in different construction contexts. Arbulu *et al.* (2003) undertook a value stream analysis of supply chains in construction, Lu *et al.* (2011) developed a model of production systems for a Swedish housebuilder, Wang, *et al.* (2019) examined the precast concrete component manufacturing and Wenchi *et al.* (2015) examined maintenance projects in the oil and gas industry.

The ideas underpinning lean thinking and process mapping have a significant role in construction. In many ways, site processes have been displaced by the greater use of offsite construction and modular construction which involve greater assembly offsite in factory type conditions for rapid assembly on site. Indeed, lean thinking is a part of day-to-day practice in construction planning in ways that were not evident 20 years ago. A good example of this in practice can be seen in the construction of bridges and structures that span road and rail lines. It is common today for the entire deck to be preformed and slipped into place in one day, but this is the culmination of many months of planning, manufacturing and temporary works aimed to make such a process possible. Over 24 years ago the Egan Report in the UK (Egan, 1998) encouraged adoption of lean construction, among many other ideas that were attracting attention at the time. Interestingly, the UK government's recent *Construction Playbook* (HM Government, 2020c) contained no specific reference to lean construction or process mapping, yet there was considerable support for

modular and offsite manufacturing. It appears, therefore, that lean thinking has become embedded within construction management rather than being considered an independent discipline.

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