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The Construction Industry and the Quantity Surveyor

1.1 Industry Overview

The construction industry is a generic term for a service industry forming part of the nation's economy that carries out the planning, designing, constructing, altering, refurbishing, maintaining, repairing and demolition of structures. It is a large dynamic and complex industry that plays an important role in the economy of which there are three sectors, that is, buildings, infrastructure and industrial. Building construction can be subdivided into two groups, residential and non-residential. The former requires no elaboration, while the latter encompasses commercial, institutional and government-owned/leased projects covering a range of building types such as hotels, banks, schools and hospitals. Infrastructure refers to highway and civil engineering structures, including large public works such as motorways, bridges and other transportation networks, utility distribution and water/wastewater treatment. Industrial includes chemical processing plants, warehouses, factories, power generation facilities, manufacturing plants and mills. The construction process commences with a planning stage stemming from early designs and includes financing and developing the designs for working purposes. This continues with a construction phase until the project is complete, which triggers the occupational phase when the building is operated as its intended use.

1.1.1 The British Construction Industry

The demand for new buildings and the refurbishment of existing is driven by available spending in the public and private sectors. Because of this, the construction industry is buoyant in terms of the demands it must meet, yet is susceptible to the mood of local economies and the national economy as a whole at any time. According to a House of Commons Briefing Paper entitled *Construction industry: statistics and policy* published during Q4 of 2015, the British construction industry amassed £103 billion in economic output during 2014. This represents 6.5% of the gross value added (GVA), which is the construction industry's economic contribution to the total value of the national accounts. The briefing paper advises that employment in the industry grew at a steady pace since 2010, with 2.11 million jobs filled during 2015. The paper predicts that a decade of future economic growth lies ahead based on the (then) coalition government's report *Construction 2025*, which was published during Q3 2013 and prepared from the guidance and support of the Construction Industrial Strategy Advisory Council (CISAC), an advisory body comprising members that seek, construct and issue

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advice on buildings and infrastructure. This report predicts world economic output will grow at a rate of 4.3% per annum through to 2025, which will create changes in the international economy and provide new opportunities for the United Kingdom. To embrace these opportunities and be well placed domestically, the government has pledged to work with a range of industrial bodies with end goals for 2025 that aim to:

- reduce the initial cost of construction and whole life asset cost by one-third (2009/2010 levels);
- reduce by half the overall time it takes to acquire new/refurbished buildings from inception to completion (2013 industrial outputs);
- reduce by half greenhouse gas emissions in the built environment (based on 1990 levels); and
- reduce by half the trade gap between imports and exports for construction products and materials (based on a trade deficit of £6 billion in 2013).

With such challenges ahead, the industry must be ready for change and is indeed a giant in terms of the contribution it makes to the nation's economy which creates room for interesting careers and job security in the process.

1.1.2 Equal Opportunities and Diversity

The UK is a diverse society comprising people from multicultural and multilingual backgrounds, where everyone has something different to bring to society and the workplace. The construction industry is one that requires a variety of skills and abilities to function, which means it is important for people from different backgrounds, life experiences and abilities to be suitably employed to enable the industry to achieve the high levels of skills and deliverables needed. For this reason, employers, unions, service providers, service users and industrial bodies are encouraged to endorse integration regardless of age, disability, gender reassignment, marriage or civil partnership, pregnancy and maternity, race, religion and beliefs, gender, sexual orientation or socio-economic background. This requirement is also legislated under UK labour law with the Equality Act 2010 applicable in England and Wales and, in part, Scotland and Northern Ireland. The Act makes it illegal to discriminate against access to education, public services, private goods and services or premises and employment opportunities. Hailed by lawyers as the most significant development of equality legislation in decades, the Act harmonises and consolidates previous anti-discrimination legislation, and strengthens legal rights to equality. The Act's purpose was to replace a mass of disjointed legislation with more uniform, accessible and comprehensive rights. Following its introduction, it has succeeded in setting standards and raising awareness of rights to equality, as well as tackling discrimination and, in particular, the role of the public sector with regards achieving equality.

1.1.3 Global Construction

In a report entitled *Global Construction 2030* published by Global Perspectives Ltd during Q4 2015, the global construction market is expected to grow by an average of 3.9% per annum from 2015 through to 2030. This is comparable to the 4.3% prediction through to 2025 advised in the UK Government's report *Construction 2025*. According to *Global Construction 2030*, cumulative growth through to 2030 will surpass global domestic product (GDP) (the construction industry's economic contribution to the

total value of a nation's accounts including taxes less subsidies) by one-quarter. This is primarily due to developed countries continuing to gather pace following a sustained period of economic stability, and the ongoing confidence of developing countries with industrialisation and reform. China is expected to be the largest construction market for most of the period, anticipated to level off by 2030, with the United States growing at a faster rate in second place with the financial gap narrowing during the period. India's economy is expected to surpass that of Japan to become the third-largest construction market by 2021, with the top three accounting for 57% of all growth. It is predicted that Japan's role will be notched down to fourth place by 2030 to be taken over by Indonesia.

For cultural reasons, countries tend to rely on home-grown companies to design, manage and construct projects with their residents/citizens incentivised under labour law to carry out services. This varies from country to country and region to region, and even with the local market tested, it is still possible for skill shortages to affect the servicing of projects. This is appeased with globalisation and the services of international recruitment and construction companies that seek candidates for project employers in host countries. The selection and suitability of such candidates can be endorsed with experience, qualifications and membership of trade and/or professional institutions that have reciprocal agreements with their counterparts in other countries, meaning the status can be obtained in more than one country at the same time.

Foreign recruitment and the investment in overseas schemes can lead to the expansion of a business and the opening of overseas branches. The integration of a new business with the construction industry of another country is indeed a challenge, and one that requires commitment to time and resources. A risk management strategy is therefore vital, which must be created by any business wishing to diversify its interests meaning the impact of the investment must be fully understood prior to making commitments. When appraising the possibilities for starting an overseas construction business, the investor must have an understanding of risks associated with any of the following:

- the need to invest, competition expected and the likelihood of securing contracts;
- referral from others that may have already ventured into the locality and their results;
- anticipated duration of the overseas investment (i.e. short- or long-term or permanent);
- financial stability of the overseas country;
- financial stability of the home country and foreseeable trends (e.g. currency exchange rates, existence of double taxation treaties, changes in legislation and tax breaks);
- performance of competitors on completed projects (i.e. what is normal and the quality expected);
- trade unions and their influence;
- health, safety and environmental attitudes;
- availability of suitable labour skills and material resources;
- political stability;
- cultural working practices;
- existence of corruption;
- legislation with regards planning at local and national level;
- existing industrial relations and building control;
- land and terrain;

- sources and status of infrastructure and utility service providers;
- terrorism and militants;
- communication methods, including any potential language barriers;
- climate and volatility of the scheme to natural disasters (i.e. earthquakes, hurricanes, etc.);
- decision to rent or purchase office space, including set-up costs and the need for financial loans;
- time involved to register the company and/or the need for sponsors;
- business development potential (time and money);
- relationship with local and central government regarding trade and employment restrictions (e.g. if trading overseas, the percentage of employees who must be nationals of the host country);
- procedure, processing time and availability of visas for employees who would relocate;
- cost to employ, including overheads, versus potential income;
- understanding usual credit terms which may be prolonged in the host country; and
- familiarity with law and the forms of contract used for service and services in the host country.

The above are drivers for realisation that, when combined with effective strategies, can mean involvement in an overseas investment is beneficial to a business. A fine example is the company Laing O'Rourke founded when R. O'Rourke & Son bought out John Laing Construction in 2001. Since formation, this company has grown internationally with offices in Europe (including the UK), Australasia, the Middle East and Canada that carry out an array of project deliverables including buildings, transport, power, water/utilities, mining/natural resources and oil and natural gas.

1.2 Parties Involved in a Construction Project

1.2.1 The Client's Team

A project client is an entity that seeks and pays for construction works, and is usually the party that enters into a contract with a contractor that carries out the works. A client may be an individual, partnership, group of persons, organisation or business from the public or private sector. Public sector means central and local government offices and/or facilities, and private sector means an individual(s), firm(s) as partnerships and companies that may be limited or unlimited in their legal business trading. Clients in the need of construction works stem from all walks of life, with some having none or limited dealings of the design and construction processes with others experienced enough to understand the importance of engaging teams. A client's role involves determining a suitable procurement method for obtaining a building while accepting or transferring risk in the process and for this reason, a client must make suitable team appointments for the successful delivery of a scheme.

1.2.1.1 The Design Team

The design team comprises design consultants from a range of disciplines that create concept and schematic designs from a client's brief and coordinate and develop the design so it is suitable for construction purposes. Details of the various design team

members' involvement are discussed in Sections 1.2.2–1.2.7. The design team also writes and develops specifications that comply with legislation, prepares schedules and specifies the criterion required for the client's needs. With traditional procurement, each design team member forms an agreement with the client, usually with the parties agreeing to coordinate their designs for consistency. Alternatively, under a design-and-build arrangement, the project client enters into an agreement with a contractor to complete the design and deliver the project. Typically, this involves novating the design teams' early services to the design-and-build contractor, with the services reinstated under new agreements with the contractor.

1.2.1.2 The Construction Team

The construction team is the supply side of the industry, a term used to describe the appointment of parties necessary to carry out and facilitate the works on site. This includes:

- the main contractor (builder);
- subcontractors to carry out works for the main contractor;
- material suppliers (including manufacturers); and
- suppliers of plant equipment to assist with construction operations.

The combination of design team members and the main contractor is often referred to as the building team. Under a traditional procurement arrangement, building team members enter into individual contracts with the project client that generally excludes construction team members, except of course for the main contractor that is an integral part of both the construction and building teams.

1.2.1.3 The Development Team

The development team is an integral part of the client's team, separate from the design and construction teams, and comprises members that issue advice on marketing, technical, financial, legal and business planning matters to the project client. Members of this team can also include a parent or side company that expresses interest in a project for business reasons, such as being guarantor for prospective purchasers. Other members include building maintenance and facilities managers, politicians, heritage and conservation groups, local planning authorities and members of the client's own organisation that may be accountants, lawyers, real estate practitioners and coordinators of the development process. The development team usually initiate a project's viability by creating a client's brief, which is a document created as a frame of reference to determine reasons why the project should exist as well as the pathway for procuring the scheme and rewards the completed project is expected to deliver. Figure 1.1 demonstrates a hierarchy arrangement of design, construction and development team appointments.

1.2.1.4 Client's Agent

A client may be inexperienced with the design and construction processes, and may wish to outsource the management duties. This has its advantages as it permits a project client to focus on the day-to-day running of their business without distraction, avoiding the need to commit internal resources that may otherwise lack the expertise required to oversee a construction project. The manager may be an individual project manager or

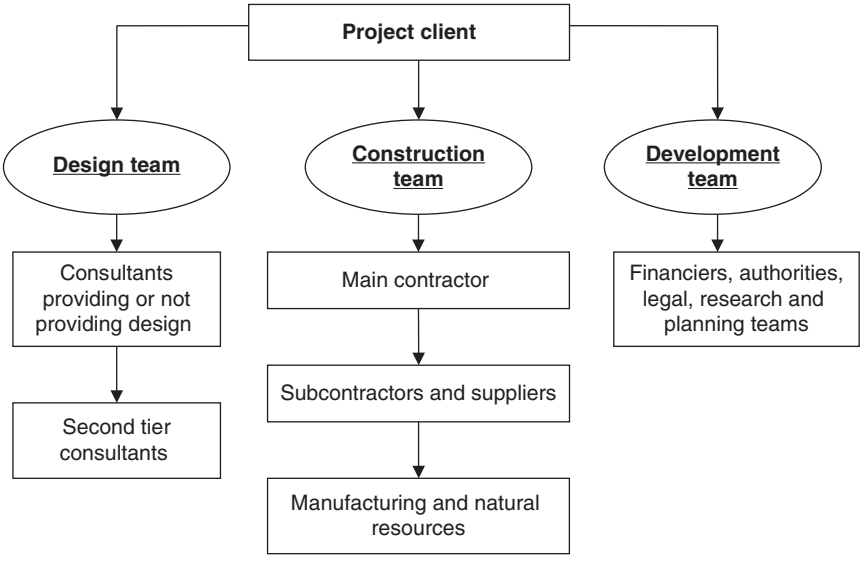

Figure 1.1 Hierarchy of appointments.

a project management company that becomes the client's agent in the process. Depending on the size of a project in terms of financial value, complexity and duration of the works, this can involve the mobilisation of a team skilled in project planning, commercial and contract management and the supervision of large-scale projects. Typically, the project manager/company becomes the single point of contact for the building team, with all communications to the client usually made via the client's agent. The client's agent may also be a member of the design team and possibly an architect or quantity surveyor, thus serving a dual role. In isolation, the development team might be sourced and engaged directly by the project client with the client's agent responsible to senior members of the development team. Where a project manager is appointed, various building team members' services are tendered. Upon receipt of tenders, a recommendation for each appointment is made by the client's agent to the client and, once appointed, each is contractually bound to the client and not the project manager/client's agent. Each member is then expected to perform in a collaborative manner to service the project and project client, a matter usually expressed in the terms of each engagement.

1.2.2 Architect

A leading project architect's services involves the development and coordination of a building design to ensure it is compatible with other consultant's designs, and reports to a client on progression of the design and documentation until it is suitable for working purposes. Services can also extend through the construction phase where the architect responds to clarification requests, attends meetings and possibly amends the design to suit a client's revised needs. Architects usually operate from a professional practice consisting of design team members who create site and block plans and drawings that show elevations, plans and cross-sections of buildings as well as the finer details of construction.

A project usually takes its first breath with a feasibility study, the contents of which steer a decision to explore the viability of the project. Once a decision is made to build, development of the design is triggered from the contents of a client's brief that initiates a concept stage outlining the requirements in sketch form, traditionally produced with ink on paper or conventionally from computer-aided design (CAD) software. The design is further developed to a schematic stage that includes setting out information and technical details of building parts to smaller scale and developing the documentation to suit. Detailed drawings include cross-sections of walls, frames, roofs, etc. showing a vertical plane through the construction details including critical dimensions. At a later stage of design development, drawings demonstrate how information shown on large-scale drawings fit together as components in the final product, for example joinery items, junctions with ceilings and walls, etc. Prior to being released for construction purposes, the detailed design is audited and certified, confirming it as complying with health and safety standards and the building regulations. An architect's services also include reviewing and approving shop drawings that show how parts are to be installed in a building which are produced by fabricators and/or installers usually inherited from the master design. This involves checking drawings and/or schedules for accuracy and quality to enable their assembly and/or installation into the works, with the architect usually empowered to reject any information supplied and request resubmissions until such time they are suitable. At the end of a project, an architect's services can involve reviewing as-built information provided by the contractor stemming from approved shop drawings to ensure they reflect the installed works and approving maintenance and operating manuals also provided by the contractor. An architect/interior designer may also design loose furnishings etc. for this stage.

Separate to designing buildings, an architect may design external works to a building and issue drawings and specifications that show requirements for: ornamental screen walling; fencing; paths, paved areas and car parking; hard landscaping schemes, including public footways, cycle paths and lighting; soft landscaping schemes that encompass turf, shrub and tree planting; irrigation schemes; furniture such as benches, litter bins, planter boxes and bollards; signage; playground equipment; security (e.g. video surveillance cameras, pedestrian gates and barriers); and water features. Alternatively, some aspects of hard and soft landscaping schemes may be designed by a landscape architect appointed separately by the client.

Independent and commercial architectural practices are usually members of the Royal Institute of British Architects (RIBA), a professional body representing architectural designers of the built environment. This accreditation is also available to individuals who complete a recognised qualification and/or may be listed on the Architects Registration Board (ARB), a statutory body for the registration of architects in the UK. The RIBA provides accreditation to schools teaching architecture in the UK under a course validation procedure, and will also validate international courses not requiring ARB endorsement yet satisfying the RIBA's criteria. There are three parts of the RIBA education process. Part I is generally a three-year first degree course followed by one years' work experience in an architectural practice. Part II is generally a two-year postgraduate diploma or masters degree course, from which a further year out must be taken before the Part III professional examinations are sat. Overall, it takes a minimum of seven years before architectural students can seek chartered status that, when achieved, permits members to use the initials RIBA after their name.

1.2.3 Geotechnical Engineer

Geotechnical engineering is an arm of civil engineering and refers to the services of an engineer engaged to carry out a site investigation (SI) which culminates with a report into the site conditions above and below ground for advice. The SI recognises topography, existing buildings, structures and greenery; ascertains the type(s) of subsoil(s) through soil mechanics; advises on the water table depth; and tests for the presence of any contamination which, if found, includes a remedial action plan that when carried out successfully can endorse the land as suitable for development. The information provided in the SI permits structural and civil engineers to write specifications and design structures that the ground can withstand. Training leading to qualifications is through the civil engineering route (see Section 1.2.5 below). Suitably qualified engineers can become members of the British Geotechnical Association (BGA) through a scheme developed jointly and supported by the Institution of Civil Engineers, the Geology Society of London (Engineering Group) and the Institute of Materials, Minerals and Mining.

1.2.4 Structural Engineer

When a new building is designed by an architect, the design is issued to the structural engineer for a structural appraisal. As part of the appraisal, the engineer creates a structural design reciprocating the architectural proposals with profiles and detailed sections to provide the building with structural integrity and stability. The design is developed further to include product specifications that give criteria such as concrete strength in building components (e.g. foundations, walls, roof, columns, beams and slabs) as well as the quality of workmanship and testing requirements needed to ensure the building is suitable for the intended use. When considering a type of foundation/substructure design, the engineer refers to the ground conditions obtained in the SI report as this can influence the concrete strength and specification (e.g. a blended concrete mix to mitigate alkaline attack from subsoils). Above ground, architecturally designed elements are analysed to confirm their suitability for the building. This involves reviewing architectural information to enable the creation of suitable structural criteria. The review process considers the size, shape and use of a building, together with health and safety practices for construction purposes and the need to comply with the building regulations. After the structural appraisal is complete, the engineer issues the information to the architect that may include recommendations for architectural modifications to suit the permanent works. For example, steel members creating walls and floors may need to be wider and deeper than the architect's proposals to withstand structural stresses imposed by external factors such as wind loading/live loads on a building. In addition to permanent works, the engineer may design temporary structures such as shoring, which is a bracing system designed to stabilise surrounding structures and avoid collapse while new works are in progress. If a building is to be refurbished with the works affecting its structural integrity, the structural engineer will also assess stresses imposed on existing building elements and design permanent and/or temporary works to suit.

As with an architect, the structural engineer reviews shop drawings but of a structural nature, and checks and approves their suitability for a scheme. Furthermore, this engineer specifies testing requirements and reviews test results submitted, and has the

authority to enforce compliance with the design and specification and instruct the removal and making good or replacement of any unacceptable works.

To qualify as a chartered structural engineer (MIStructE), the Institution of Structural Engineers in the UK requires the completion of key stages of education and training. The traditional pathway involves obtaining an accredited degree and then following a training programme to bridge any gap between the qualification and experience, known as a period of initial professional development (IPD). At the end of this period, the graduate attends a professional review interview (PRI) which must be passed together with an entry examination in order to obtain chartered status. Alternative routes apply for those who possess appropriate qualifications and have suitable experience.

1.2.5 Civil Engineer

Civil engineering involves the creation of new structures including roads, sewers and bridges and the maintenance of existing similar structures in the built environment. The title also covers non-structural works including excavations and remediation of contaminated land which can involve the services of a geotechnical engineer. When a new structure of a civil engineering nature is required, the civil engineer designs a scheme and writes a specification for a scope of works out of due concern for public safety and the environment. In addition, the civil engineer coordinates new design requirements with existing infrastructures, including roads and drainage as well as works by utility service providers (e.g. gas, water, electric and telecommunications) that may be part of master planning for a district, borough, town or city. Duties of the civil engineer include (but are not limited to):

- providing a topographical site survey and levels in relation to ground and construction items;
- issuing setting-out information for the works;
- assessing tenders from contractors for the works and making recommendations to the client;
- obtaining permits from local authorities;
- attending public meetings;
- liaising with utility service providers; and
- supervising works in progress.

During the construction phase, the civil engineer will enforce the contract requirements and can instruct defective works to be replaced so they comply with the approved drawings and specification. Once a new structure is complete, and if it is to be under the eventual ownership of someone other than the contracting parties such as a local authority, it can trigger the commencement of a maintenance period. This is a stated duration written into an agreement during which time the contractor remains responsible for defects until such time the structure is transferred to the adopting party. Under a separate arrangement to which the contractor may not be a party, the local authority may also adopt utility services forming an integral part of the works under contract on behalf of the utility services providers. For this reason, the civil engineer works closely with the contractor and adopting authority during the construction phase to ensure the design and constructed items comply with the approved design and specification, in order to aid a smooth transfer upon expiry of the maintenance period.

Where a project is engineered without the requirements for a building such as bridge or land remediation, the engineer takes the role of client/employer's agent under the title engineer or to that stated in the contract. In essence, the role of the engineer in an engineering contract is equivalent to the role of a client side project manager in a building contract.

To qualify and be employed as a civil engineer, the incumbent must possess an academic degree in civil engineering. Studies towards obtaining the degree take 3–5 years with the completed qualification being a Bachelor of Engineering (B/Eng) or Bachelor of Science (BSc) undergraduate degree. The curriculum generally includes courses in physics, mathematics, project management and design, plus specific topics of civil engineering. After taking basic courses in most sub-disciplines of civil engineering, candidates then specialise in one or more sub-disciplines at advanced levels and can obtain a masters degree (MEng/MSc) in a particular area of interest such as geotechnical engineering or façade engineering. A qualified civil engineer may be chartered, and a Member of the Institution of Civil Engineers (MICE) and must hold a degree in civil engineering which can also act as a stepping stone to other aspects of engineering.

1.2.6 Service Engineers

Service engineering includes methods of supplying, installing and commissioning systems that permit utility service providers to supply power, water and gas for distribution through a building. The term also encompasses drainage, fire protection, mechanical air systems, transportation, machinery and a range of specialist services used for fitting out a building. In multistorey buildings, building services are distributed via an infrastructure in rising mains or risers. These vertical risers run through the core of a building with horizontal branch connections at building floor levels and comprise specified pipework, cables, conduits and ducting, which are fitted off for a building's intended use. Smaller buildings such as residential properties are serviced in a similar manner without risers, but with the pipes, cables etc. secured to and through walls and/or structural timbers such as joists. The cost of building services generally runs at *c.* 30% of the total price of a project, and being this considerable, the contractor's quantity surveyor is encouraged to understand the scope driving this proportion.

1.2.6.1 Electrical Engineers

These engineers specify and design schemes that distribute electricity for power, lighting, security, heating, information technology and intelligent and communication systems in buildings. Moreover, the discipline includes the creation of design and specifications for artificially lighting external works and methods of obtaining power supplies to a building from the electric mains supply. In conjunction with an architect, electrical engineers may specify types of light fittings and design solar-controlled panels that produce energy from the sun for battery storage for use with a building's function.

1.2.6.2 Plumbing or Hydraulic Engineers

This engineering discipline designs and specifies water and gas supplies as well as heating and drainage systems within buildings. They may also seek the stamping of plans, which is endorsement of their designs from the water board and/or other authority that has an interest in the supply and distribution of water in buildings.

1.2.6.3 Fire Protection Services Engineers

These engineers author a fire-engineering report to identify potential fire, smoke and heat hazards in a completed building and/or design, and write specifications applicable to the works so the completed building complies with the fire-engineering report. Suitably designed schemes include active and passive measures with objectives of protecting the vicinity, structure, contents and building occupants from the effects of fire, smoke and heat. Active measures include sprinklers, fire blankets, hydrants, hose reels, portable extinguishers and air pressurisation systems along corridors, stairwells and lift shafts to suppress the effects of fire and smoke, while passive measures are architectural and include doors, partitions and escape routes that divide a building into parts, known as compartmentation. Hydrants for use by the fire brigade may fall under the category of water services with the design possibly part of the water supply design provided by the plumbing/hydraulics engineer. Pressurisation systems are dry systems driven by pressurised air which may fall under the scope of mechanical and air conditioning engineering (see following section). Other dry systems include clean agent fire suppression for use in equipped electrical and telecommunications rooms where gas in lieu of water is used to extinguish a fire or suppress smoke to mitigate damage to the equipment that would otherwise occur if using water.

1.2.6.4 Mechanical and Air Conditioning Engineers

These engineers provide a design and specification for naturally flowing and fan-assisted air systems to provide a building with a suitable atmospheric pressure as well as adequate heating, ventilation and air conditioning (HVAC). HVAC refers to technology that provides suitable air changes and thermal comfort of the internal environment of a building.

1.2.6.5 Transportation System Engineers

Engineers under this category create designs and specification for vertical, horizontal and inclined transportation to deal with a stream of people or products moving through or within buildings.

1.2.6.6 Other Engineers

A range of other engineers that provide designs and specifications for works of a specific nature that are often project specific includes:

- waste-disposal systems;
- solar heating;
- oil-fired heating systems;
- district heating for distributing mass-generated heat (gas, cogeneration or solar) from a source to a number of buildings simultaneously;
- district cooling where treated chilled water is provided at pressure to a building for use in HVAC systems from a central district cooling plant;
- types of mechanical plant for specific use (e.g. swimming pools); and
- building automation/management systems, which are intelligent-based systems that inform a building's facilities manager on the status of installed parts and their efficiency while a building is operational and if any malfunction has occurred; management involves monitoring from computerised central control rooms with alert notifications possible via smartphones and emails.

As with other engineering disciplines, authenticity of an engineer is gained by the successful completion of recognised courses that measures knowledge, competence and practical training.

1.2.7 The Client's Quantity Surveyor/Cost Manager

A client venturing into a construction project may engage a quantity surveying firm as a cost consultant who becomes an integral part of the design team in the process. One of the services these firms offer is *pre-contract* cost advice which involves estimating construction costs prior to the client entering into a construction contract. At the earliest stage, it is possible to offer cost advice without the need for a design, providing the client issues a statement of requirements. In order to estimate cost from such requirements, quantity surveying firms collect cost data from past and current projects where they are engaged as cost consultant to produce dynamic single-line construction costs, for example a 650 bed hospital (price per bed) or 300 pupil school (price per child), etc. Where a client provides a limited design or gives a statement of areas, cost advice can be more certain using either the functional building as a whole (e.g. by applying a rate per m^2 to the floor area of a hotel) or refining rates suitable to floor areas of parts of a building (e.g. hotel guest rooms and restaurants). Where an advanced design is provided and further cost data available, it is possible to estimate the costs of the functional elements of a building by applying rates to the areas of walls, floors etc. or suitable rates for the detailed components of each functional element (e.g. concrete per m^3, bar reinforcement per tonne and formwork per m^2 applicable to walls, floors etc.). Depending on the level of detailed design available, it may also be possible to create cost targets of the elements, the combination of which can produce a project budget. Once a budget is created, the quantity surveyor/cost manager can be engaged to monitor different stages of design development and advise the client's team of changes that impact the budget. Pre-contract services also include the preparation of trade bills of quantities for tendering purposes, once the design and documentation is fully developed; vetting main contractors' tenders; and cash flow forecast predictions by time to pay for the works.

Once a client enters into an agreement with a contractor for the works, it triggers the *post-contract* period. During this period, the quantity surveyor/cost manager may be engaged to cost-manage a construction project on behalf of the project client. Typical services include: recommending financial amounts as interim payments to the contractor while works are in progress; issuing monthly reports on the physical progress of the project; valuing changes to the works instructed by the client; assessing contractors' claims; and preparing and issuing a final account. In addition, some large-sized consultancies expand traditional quantity surveying services and offer project management and advisory services to a client that includes:

- recommending an appropriate procurement route for a type of project;
- risk management strategies, including identification and analysis of risks;
- due diligence reporting by vetting and confirming scopes of services in main contractors' tenders and the suitability of submitted offers with the client's expectations;
- selection of an appropriate form of construction contract (i.e. standard or purposely drafted);
- life-cycle costing on a building or parts of a building to demonstrate how an investment in the construction/supply and installation price and the price to maintain through

the occupational phase until replacement/removal can derive a rate of return, often called 'cradle to grave' assessments;
- advice on dispute resolution services if there is conflict on a construction project with the contractor;
- business feasibility studies to assess the viability of a scheme prior to investing in a design;
- acting as client/employer's agent under the title project manager;
- certification of buildings with Energy Performance Certificates (EPC); and
- Building Information Modelling (BIM) manager (see Section 1.8.2 below for details on BIM).

The quantity surveyor/cost manager may be a sole practitioner, in a partnership or operate as part of a large consultancy. To qualify, professionals need to hold an academic degree and/or are members of the Royal Institution of Chartered Surveyors (RICS). The RICS is the leading international body that regulates members and firms to ensure ethics and professional conduct are maintained. Professional members are termed 'chartered quantity surveyors' with the RICS having the largest network of quantity surveyors worldwide. The client's quantity surveyor/cost manager is a design team member and consultant, and may also be referred to as the professional quantity surveyor or PQS. This reference can mean a practising consultancy or individual(s) engaged on a project if the individual(s) is a chartered quantity surveyor or deemed suitably trained and holding a relevant degree. This is not to be confused with the contractor's quantity surveyor employed by the main contractor who is a commercial member for the supply side of the industry who, when accredited with a chartered building qualification or a degree holder with suitable experience, is also deemed professional.

1.2.8 Main Contractor

The main (sometimes called general) contractor carries out works in accordance with the agreement it has with the project client. The contractor will also adopt the title principal contractor when legally responsible for the health and safety duties on a construction project, as required by the health and safety regulations. The main contractor rarely carries out all of the works themselves and subcontracts, or sublets, a number of trade works in order to fulfil the obligations of the contract. Subject to the conditions of contract this is often without client input, which gives the contractor a main role to procure, manage and deliver a scheme. However, the contract may permit the client to have a say in the subletting/subcontracting process by naming or nominating certain trade contractors because of their reputation or skills, which a contractor must acknowledge if part of an agreement. Standard forms of contract generally omit the title 'main' and recognise the capacity as 'contractor' only with the main contractor's duties involving:

- establishing the site accommodation, including temporary offices and amenities for use by the contractor's staff, site visitors and operatives working on site, and any specific accommodation for the project client including members of the client's team if a requirement of the contract;
- managing health and safety procedures;
- coordinating, procuring, planning and supervising construction works;

- reporting periodically to the client and coordinating with the client's team where necessary;
- ensuring budgets are maintained; and
- implementing a method of quality control to ensure works are achieved in accordance with the drawings, specification and conditions of contract.

In order to deliver a project on time, at an agreed cost and of the expected quality, the contractor will need to commission a project team. The team must be suitably qualified and experienced to help deliver the scheme with personnel either based full time on site or are regular visitors that are assisted by the contractor's head office (e.g. accounts department). On a project valued at say £10 million which is straightforward in nature, with the design fully developed and the contractual provisions suitably captured in an agreement, the following personnel would normally be site based:

- project manager in charge, with some time spent at the contractor's head office and client's offices;
- site manager;
- structural and finishing trade supervisors;
- health and safety officer;
- quantity surveyor (possibly part time or in between other projects);
- general site operatives (e.g. labourers); and
- administration support staff and trainees who may visit site periodically.

A project of similar standing of half the financial amount may have the site-management requirements reduced by cancelling the need for finishing trade supervisors, leaving supervision to the site and project managers whose skills are appropriate. The role of the contractor's quantity surveyor involves dealing with post-contract duties on behalf of the contactor and, depending on the project in terms of value and/or complexity and the contractor's management structure, the role may require full-time commitment to a single scheme.

Normally, the contractor's quantity surveyor is answerable to a commercial and/or project manager for addressing commercial, administrative and contract matters including:

- regular cost reporting on works in progress (monthly, bi-monthly or quarterly);
- recommending awards to material suppliers and subcontractors and ensuring those in receipts of awards have binding agreements in place;
- ensuring project insurances are current and relevant;
- vetting health, safety and environmental submissions from subcontractors for compliance with the contractor's project health and safety plan;
- providing the flow of information to the contractor's supply chain (suppliers and subcontractors);
- assessing the price of contract variations and their submission for approval;
- assisting in administration of the construction contract;
- preparing applications for interim payments from the client;
- preparation of a project final account; and
- processing payments to the supply chain, administering and agreeing final accounts.

Team members may be qualified chartered building professionals and Members of the Chartered Institute of Building (MCIOB). The CIOB is the leading construction management voice in the construction industry, with its members representing a body

that has knowledge managing the building process. Team members may also be chartered quantity surveyors (MRICS), although this is usually limited to commercial and project managers and contractors' quantity surveyors.

1.3 Legislation and Control of the Building Process

Whatever the type of building project undertaken, construction operations and the final building must comply with built environment legislation which is enforced by planning control and regulatory systems. Anyone wishing to pursue and pay for building works must be satisfied it is lawful, and for this reason it is necessary to obtain permission from the local authority before commencing operations to confirm that the design and works comply with the law. When a building is required to undergo a change of use from one classification to another (e.g. a residential property to commercial premises), planning approval is required which is legislated in England and Wales by the Town and Country Planning Act 1990, in Scotland by the Planning etc. (Scotland) Act 2006 and in Northern Ireland by the Planning (Northern Ireland) Order 1991.

Obtaining planning approval is usually the responsibility of the building owner and not the contractor carrying out the works. However, if works commence without a permit, claim of a lack of knowledge by either party to a construction contract on the need for a permit could set the pathway for conflict, as it may mean the works are stopped or cancelled by the local authority. For projects which are simple in nature, the approval procedure may be straightforward with the building owner possibly seeking permission themselves. However, with large projects in terms of floor area, value and complexity, the process can be time-consuming and the entity wishing to apply for a building permit may appoint a project manager to manage the process. Ideally, the party preparing the application should be conversant with local authority requirements which may be influenced by byelaws relevant to the location where the works are to be carried out. Byelaws are parochial powers granted from central government by an Act of Parliament that empowers local authorities to make decisions relevant to the community, and can be a deciding factor in the issue of planning approval.

The building regulations (sometimes called building codes) are separate from planning approval, and are a set of statutory requirements that seek to provide guidance and define standards for the purpose of designing and constructing buildings. They are contrived with skill and care to ensure a completed building is constructed with due consideration to the environment, health and safety of occupant(s) and the public at large. The regulations are modified from time to time to reflect changes in legislation, which may apply to any part at any time. The enabling act empowering them is the Building Act 1984 (England and Wales) that underwent change to become the Building Regulations 2000 (England and Wales). In Scotland, the driving legislation is the Building (Scotland) Act 2003 that steers the Building (Scotland) Regulations 2004, and in Northern Ireland the Building Regulations (Northern Ireland) Order 1972, amended 2012.

1.3.1 Planning Permission

A minor change to a building (usually for residential purposes) is termed 'permitted development' and is usually exempt from planning approval. However, a party seeking to change or modify a building should contact the local authority to confirm if

works can proceed without formal approval before commencing the works. If approval is required, the process involves seeking clarification of the planning requirements and confirming that the design is compliant with the building regulations. In addition, whoever carries out the design and building processes must affirm a commitment to safe working practices as required by health and safety law.

The approval process commences with an applicant lodging a formal proposal to the local authority. The lodgement usually includes a set of building plans and elevations or other information as required to demonstrate the extent of the works, which activates an assessment procedure to arrive at a decision. In arriving at a decision, the local authority's assessment takes into account the building process and effect of the completed project on the built environment and existing buildings in the locality. Moreover, a decision will be influenced by any impact the proposed scheme will have on the Local Development Framework Plans as well as local amenities and infrastructure. Local Development Framework Plans outline planned changes to a district over a stated period, possibly up to 10 years (or more), which are in force at the time of receiving an application. Depending on the size of the proposed scheme in terms of building floor area, height and location, there may be a requirement to provide an environmental impact assessment (EIA); this assesses environmental consequences (both positive and negative) of the construction and occupational phases on the environment. A well-researched project will identify the need for an EIA at the earliest stage if approval of an EIA is a requirement for granting planning permission.

The length of time for issue of a response from the date of lodgement depends on the decision the applicant seeks, which can be influenced by the contents of the submission, the type of project, local authority policy and/or complexity of the scheme. If a submission is speculative and includes information which satisfies the category of the application, the decision may be to grant outline planning permission only. This means the local authority accepts the intent to develop in principle which is subject to further review, and advises what the review will entail (e.g. the submission and approval of a boundary walling design to a new residential estate). For vendors submitting a speculative application this decision provides a sigh of relief, as it means the process of developing the design can progress. An application seeking outline planning permission can be made by a landowner as a vendor that wishes to sell a parcel of land for development, meaning approval (and its conditions) would be relayed to the purchaser following the sale of the land, as without the permission the land may be worthless to a developer.

The second stage of approval is acceptance with reserved matters. This means the scheme is approved yet subject to a set of terms and conditions discharged over time, usually by the end of the construction phase. For example, an application may be submitted seeking permission to construct a high-rise office building in accordance with a set of building drawings, with the applicant failing to provide details of external works such as vehicle parking and landscaping which is not designed. Here, a local authority's response might be to grant permission for the office building to be practically complete within a stated time frame from the date of issuing the decision with a reserved matter for the whole of the works to be practically complete at the same time, which must be in accordance with an external works scheme that is to be lodged and approved.

The third stage is full planning or sometimes called detailed planning permission, which is approval to develop unconditionally or with matters the applicant can comfortably accept, which is of course the most favourable outcome for an applicant. If any

type of planning permission is refused, the applicant may lodge an appeal that can only be heard if it relates to matters governed by legislation. These include:

- legalities involving restrictive covenants, for example the existing ownership of land, buildings or parts thereof not owned by the applicant that require discharging by the owner;
- a request to review granted outline planning permission not recognised by the local authority; or
- resolution of confliction between granted outline planning permission and any existing Local and Development Framework Plan.

Until an appeal is resolved, the applicant would be unwise to commence the works as the local authority would probably instruct the demolition of anything created that goes against the expressed interest of the deciding committee and may also impose fines.

1.3.2 Building Regulations

Building regulations are divided into 15 headings, each designated with a letter from 'A' to 'Q' (with the exception of 'I' and 'O'), and covers matters such as 'structure', 'fire safety', 'ventilation' and 'security' with each part accompanied by an Approved Document. The approved documents take the form of first stating the legislation and then providing a number of means which are deemed to satisfy provisions. These provisions detail methods showing the works required to satisfy the regulations through the use of text and illustrations. The building regulations are not created to stifle innovation, as there may be ways of complying with each part other than just using those set out in the deemed to satisfy provisions. The tendency by contractors however is to consider that innovative solutions may be too hard to validate, with most following the requirements literally and adhering to the approved working design so that the works can be completed on time. Updated versions of parts of the regulations are generally not applied retrospectively, and only apply to each new change or modification of a building which does not require the retrofitting of any existing elements.

1.3.3 Building Control

A main contractor must ensure the works it carries out complies with the construction contract (the contract) and building regulations/approved documents. In order to do this, a diligent and experienced contractor will ensure works in progress (instead of when complete) are carried out in accordance with the approved design, and cross-reference the detailed designs with observations made on site and act accordingly with any deviations. In addition, a level of independent control through periodic building inspections may be carried out by other parties that may be a condition of the contract and also of planning approval.

The discipline of building inspector takes one or more forms, with each qualified in their appropriate field to make professional judgments and issue notices of compliance or non-compliance of inspected works. These judgements are based on observations and test results that when satisfactory confirm the building or part(s) of a building as meeting the requirements of the building regulations/approved documents. Independent building inspectors may be local authority representatives that inspect public and private works, and have delegated authority to instruct the correction, destruction and

rebuilding of any works to comply with the intentions of the building regulations. Depending on the discipline, an inspector may have self-regulated authority to enhance or modify an approved design in the interest of public safety (e.g. requirements of the fire brigade). Where applicable, self-regulation may be stated in a code of practice document relevant to the inspector's discipline that may also be endorsed in the planning approval, which can mean the contractor may be expected to construct something in excess of an approved design. Whether or not any change can be contested depends on the conditions of contract as too would be an increase in the price of the works that can only be addressed with a variation.

Under a separate arrangement, a clerk of works (who is usually from a trade background) can be appointed to check works in progress with the appointment independent of the contractor and other inspectors. The clerk of works is usually contracted to the client and has a duty to ensure the contractor carries out works in accordance with the contract. For this reason, the services of a clerk of works must be written into the contract and not be an afterthought. The role is not a legal requirement and one of inspector only, meaning the clerk cannot issue instructions to alter the works or certify any works as compliant with the contract. However, the clerk can enforce compliance with the building regulations/approved documents if a contractor fails in their duties to construct works that do not comply which may have gone unnoticed by a building inspector or local authority representative. Here, only the client's agent can issue an instruction to vary the works under contract, and may do so based upon advice given by the clerk of works. For example, the conditions of contract may permit the client's agent to instruct the contractor to open up covered works such as a backfilled drainage trench to see if the pipes are laid to correct falls and encased in concrete as specified, and can then direct the clerk to inspect. Any subsequent instruction by the client's agent based upon the clerk's findings is enforced by the contract because, as a matter of procedure, the parties acknowledge their legal obligations to comply with the building regulations/approved documents.

Enforcement of this requirement is not a variation, and is merely intended to make the contractor aware of their responsibilities. However, and depending on the conditions of contract, if opened up works demonstrate that they are compliant, the contractor would normally be entitled to a variation with costs and an extension of time to the project end date because they have been delayed by no fault of their own. In essence, the clerk of works inspects the works to ensure they comply with the contract, and independent inspectors or local authority representatives enforce the building regulations/approved documents. The contractor has a fiduciary duty to acknowledge these levels of building control, and has a legal obligation to comply with the conditions of contract it has entered into and the requirements of legislation.

1.3.4 CDM Regulations 2015

The adoption of a suitable and proactive health and safety system is important for the successful delivery of a construction project. The positive culture it creates has advantages to a contractor, including: improved productivity and quality of work; better working environment; lower staff absence and staff turnover; reduced insurance premiums; and promotion of a good corporate image.

A poignant piece of early legislation for the UK construction industry occurred with the Health and Safety at Work etc. Act 1974. Broadly, this Act encourages and regulates the duties of employers, employees, contractors, subcontractors and persons engaged in the workplace. The Act established the role of the Health and Safety Executive (HSE), an entity empowered to delegate authority to health and safety inspectors to ensure compliance with the law.

Health and safety within the construction industry received a further legislative boost in the 1990s following European Directive 92/57/EEC. In the UK, this saw the introduction of the Construction Design and Management Regulations 1994 (CDM 1994), revised and updated in 2007 (CDM 2007) and again in 2015 (CDM 2015). As per its predecessors, CDM 2015 has aims of improving the overall health, safety and welfare of those working in construction. The regulations affirm a responsibility on parties involved with 'construction work' and applies to those involved in the carrying out of building, civil engineering, engineering construction, home maintenance and improvement works. The regulations aim to ensure proactive health and safety issues are considered on construction projects with goals of reducing the risk of harm to those that construct, occupy and maintain buildings. CDM 2015 defines responsibilities according to particular roles for a project that affect the client, designer and contractor. Characteristics of CDM 2015 that affect the client include:

- 'construction work' which is planned to be carried out by more than one contractor and/or where the works will last longer than 30 working days with more than 20 workers working on site at one time during any part of the project, or if the project exceeds 500 person days in total (in this case the project client has the legal duty to notify the HSE of the project);
- the requirement for the client to take a lead role and appoint a principal designer to plan, manage and monitor the pre-construction phase and prepare a health and safety file;
- a requirement for the client to appoint a principal contractor for any project deemed to comply with the requirements of CDM 2015;
- the client is accountable for all aspects of health, safety and welfare of a project with the regulations imposing strict liability on the client for the performance of duty holders they appoint (e.g. the principle contractor); and
- the client is responsible for making health and safety arrangements for a construction project from inception to completion and through its whole life cycle where CDM 2015 is applicable.

Pragmatically, the principal designer will delegate responsibilities to the principal contractor for the construction phase, and in their duties the principal contractor must:

- ensure workers have the correct skills, knowledge, training and experience to fulfill their obligations;
- provide adequate site supervision and organisational capabilities;
- demonstrate how the flow of information is managed;
- create and maintain a construction phase health and safety plan; and
- develop and maintain (until the end of the construction phase) a post-construction/occupational phase health and safety plan.

To fulfill these obligations, the contractor's quantity surveyor plays an essential role by ensuring the contractor's and subcontractor's health and safety submissions are to a

suitable standard. It is not a normal role of the contractor's quantity surveyor to review, comment, reject or issue advice on the improvement of submissions. However, the role warrants assistance in seeking the information in the offset for the contractor's project manager and health and safety officer's use.

1.4 Industrial Bodies

There are a number of trade industrial bodies within the construction industry that aim to promote, support and inspire their sectors and provide best quality, for example: British Association of Landscape Industries (BALI) for those involved with landscaping and Federation of Piling Specialists (FPS) for piling works, etc. Two significant industrial bodies involved in professional construction matters are the Royal Institution of Chartered Surveyors (RICS) and Chartered Institute of Building (CIOB). The RICS and CIOB have their head offices in the UK with additional offices worldwide. Professional members of either enjoy the benefits of networking the industry at national and international levels, while agreeing to comply with the rules of membership.

1.4.1 Royal Institution of Chartered Surveyors (RICS)

The RICS was founded in 1868 and is a self-regulating body that recognises qualifications in land, property and construction. It has approximately 118,000 professional members worldwide (as of 2016), of which the largest number are members of the Quantity Surveying and Construction Professional Group. The institution has a further 16 Professional Groups including Building Control, Building Surveying, Project Management and Dispute Resolution associated with construction, with the remainder involved in land and property. Members belong to one of the following grade of classes:

- *Student*: which helps members to realise their potential and work to the highest standards at college or university;
- *Associate* (AssocRICS): suitable for those with work-based experience or vocational qualifications;
- *Membership* (MRICS): professional membership which demonstrates to colleagues, clients and peers that the Member is a Charted Surveyor; or
- *Fellowship* (FRICS): recognises an individual's achievement of being a professional member.

The traditional method for obtaining chartered status is along the graduate route, which requires candidates to complete a cognate degree and structured training programme combined with work experience. Traditionally, a postgraduate commences a structured pathway of training towards achieving the APC (assessment of professional competence), which is the measure of an acquired qualification linked with practical training and experience in a relative field of work (e.g. quantity surveying and construction). The structured training and work experience minimum timeframe is two years. At stated intervals during this time (usually every 6 months), the candidate records their training and experience in a logbook to demonstrate details of professional development. This is recorded online by the candidate for endorsement by a counsellor that must be a chartered surveyor who is usually a colleague at the candidate's place of work and qualified from the same pathway as that chosen by the

candidate. Subject to the requirements of each RICS region throughout the world, the services of a supervisor may also be required who will have frequent encounters with the candidate. Professional development is measured against benchmarked levels of competence:

- *mandatory*: competencies that are a mixture of professional practice, interpersonal, business and management skills considered necessary for all professional members;
- *core technical*: competencies in stated subjects considered to have uppermost relevance to the chosen pathway; and
- *optional technical*: competencies in additional selected subjects considered of relevance to the chosen pathway.

Assessment of competence follows a linear arrangement of order: Level 1, subject knowledge and understanding; Level 2, application of subject knowledge and understanding; and Level 3, reasoned advice and depth of technical knowledge on subjects. This allows candidates to execute specified subjects with precision by doing and not just knowing as counsellors are skilled to observe when a candidate 'walks the walk' and is not just 'talking the talk'. Once the candidate, counsellor and supervisor (where applicable) are satisfied competency levels are met, the candidate completes and issues the RICS APC submission template. As part of the submission, an APC candidate must provide a written 3000-word case study of a recent project or projects (undertaken up to two years before the assessment) from which the candidate has been involved. Subject to the submission being accepted, the candidate attends a professional interview as a final assessment with an RICS panel from the relevant professional group to discuss the submission and test the candidate's understanding of professional practicing and ethics. The panel later completes their assessment with a recommendation for membership or deferral. If successful, the candidate is invited to enrol as a professional member who, if accepted and the fee paid, receives chartered status and is permitted to use the initials MRICS.

Individuals and companies may apply for chartered status and, once accepted, are bound by rules of conduct for maintaining ethical standards. The RICS responds to the needs of the profession and, as membership routes may change from time to time, those interested in seeking membership should be acquainted with current information found on the RICS website (http://www.rics.org).

1.4.2 Chartered Institute of Building (CIOB)

The CIOB has a national and international reputation for excellence in construction matters. The institute places particular emphasis on construction management and the sharing of knowledge with companies, members and clients, influencing the way the industry operates. It was founded in 1834 as the Builder Society in London, incorporated as the Institute of Builders in 1884, changed to the Institute of Building in 1965 and was granted Royal Charter in 1980. The total number of individual members exceeds 48,000 (as of 2016), of which 20% are registered outside the UK in over 100 countries. Members belong to one of the following classes:

- *non-chartered membership* (applicant or student status): this helps realise potential to the highest standards at college or university, with the CIOB endorsing the status on a case-by-case basis;

- *membership* (MCIOB): professional corporate membership which demonstrates a Member is a chartered builder or chartered construction manager; or
- *fellowship* (FCIOB): recognises an individual's achievement of being a professional member.

The traditional route to professional membership is along the graduate route where candidates follow an educational pathway that requires graduation from a cognate degree and training following a professional development programme (PDP). PDP is the measure of a candidate's educational qualifications combined with practical learning and experience to assess occupational competence. The CIOB has established a new branch for young professionals called Novus, which links student status with corporate membership by providing peer support, mentoring and forums. Novus also liaises with educational bodies in the UK and Ireland to promote activities of the CIOB and recruit new members. A candidate's education and occupational experience is measured within a framework of support involving a CIOB-approved assessor, who may be a peer support of Novus, and who reviews, advises and eventually endorses a worthy candidate's assessment. Satisfactory completion entitles the candidate to attend a professional review with a panel, where a candidate's industrial and management competence together with a commitment to professionalism is assessed. If successful, the candidate can apply for professional membership; when accepted and the fee paid, this permits the professional to use the credentials MCIOB.

Alternatives to the graduate route are available to anyone without appropriate qualifications (e.g. company directors, contracts managers and senior managers of appropriate companies, or those from a military background with the same level of education and experience) who agrees to follow a structured training programme. Other routes to membership are available for persons who are members of affiliated organisations with the CIOB, who hold a cognate/non-cognate degree or NVQ, and are industrial professionals who have been working at a senior level with a minimum of five years of management experience. Individuals and companies may apply for chartered status and, once accepted, are bound to the conditions of membership. Changes to membership criteria can take place regularly; for the most recent information see the website of the CIOB (http://www.ciob.org).

1.4.3 Benefits of Membership

Benefits of membership of the RICS and CIOB include:

- status and respect from clients, colleagues and employers;
- invitations to seminars to learn about current industrial and business trends;
- legal advice;
- eligibility for assistance from benevolent funds;
- career advice; and
- discounts on insurances, software and financial services.

1.4.4 Continuing Professional Development (CPD)

One of the requirements for professional membership of the RICS and CIOB is a member's commitment to updating knowledge and skills and remain competent with lifelong learning (LLL). Methods of carrying out CPD include private tuition and

reading, attending courses and seminars through work, or participating in online web classes or e-learning offered by professional bodies and mentoring. To be effective, learning should aim to improve knowledge of subjects that a member considers are important to their employment and profession. Advantages of CPD include:

- the updating and refreshing of knowledge from educational courses that may be otherwise frozen in time;
- providing a catalyst for the learning of new subjects; and
- increased competence in business, which may provide enhanced employment prospects.

Variance of a work task within a normal working day is not normally considered part of CPD. However, skills gained through study or coursework to increase competence could be sufficient, for example training in the use of computer software for improved business use. The RICS makes it mandatory for members of all classes to achieve and record a minimum of 20 hours CPD per calendar year, 10 of which is informal and 10 formal. With formal CPD, the course provider may issue a certificate after an event stating the hours of CPD achieved which can be uploaded to the RICS website in the members' page as a record of completion. Apps are also available from the RICS to record and monitor CPD, meaning the process can be conducted on smartphones. In a similar fashion, the CIOB has a portal and range of subject matters for CPD events which members can complete for monitoring and recording. To create learning outcomes for CPD, it is wise to plan ahead with objectives and focus on methods of obtaining resources to achieve the objectives and logging the achievements once learnt. There are various methods of recording completed and planned activities, including the use of spreadsheets and word processing documents; recording online in the members' area section of the professional bodies' website; diaries and notebooks. To demonstrate, Table 1.1 illustrates the use of a spreadsheet for planning and logging CPD activities.

Table 1.1 Logging and goal setting for CPD events. Skill levels: 1, aware; 2, knowledge and understanding; and 3, able to apply knowledge and understanding. Learning methods: 1, day release; 2, evening course; 3, CPD event; 4, private study; 5, web class or e-learning online; 6, work base project; 7, employment training; and 8, other.

Item	Goal	Current skill level	Required skill level	Learning method	Start date	End date	Learning outcome	CPD hours
A	Understanding MS Excel for construction estimating (informal)	2	3	7				
B	Learn principles of teamwork (informal)	2	3	3				
C	Acquire knowledge of Microsoft Project workings relevant to project running costs (formal)	1	2	5				

1.5 Funding and Market Drivers

The construction industry relies on secured funding to cash flow projects which is derived from public and private sector investment. Public sector funding is generated from accrued local and central government reserves, which is obtained by income from various taxations, rates and sell-offs, whereas funds within the private sector are generated from loans, reserves, investments and windfalls. The various types of funding for spending in each are as follows.

- *Public*: government-backed schemes; issue of grants; defence and military projects; government building upgrades or new works; overseas grants (European Union/ International Monetary Fund, etc); and government stimulus packages.
- *Private*: cash reserves and equity; private and corporate loans and mortgages; company profit and investments; insurance works; profit withdrawal from the sale of stocks and shares; charities and lottery grants; religious organisations; investment strategies from businesses and individuals; land banks (e.g. reserved funds to acquire land to develop property); and government incentives.

Funding of construction projects in either sector is subject to change, which may be the result of an economic cycle or specific event impacting the national economy. When the economy expands the construction industry is usually the first to feel the impact, as the demand for building works usually increases. Conversely, it may be the first to witness decline if the economy retracts. When local authorities and central government play positive roles in the stimulus of the economy this influences output, creating interest from other industrial sectors in the process, which in turn increases socio-economic development. An increase in socio-economic development creates an abundance of funds which in turn increases spending and the output of the construction industry. However, neglect of this development leads to decline and has a reverse effect. In order for central government to monitor growth or decline, it relies on data provided by advisory bodies such as the Office of National Statistics (ONS). The supply of data from the ONS provides a snapshot of the industry at any one time, with the information generally regarded as being of a reputable source regarding the strength of the national economy as a whole. This information is often relayed in treasury reports that can act as a catalyst for the funding of public works that act as market drivers.

Market drivers are found at local and national levels that drive the supply and demand of services to the construction industry. When there is an abundance of contractors, tradesmen and professionals available without full consumer demand, this leads to lower prices and a surplus of employment requirements. By contrast, when consumer demand is high and the supply remains unaltered, prices are driven up with the need for additional resources (i.e. more employment). If the supply is increased to meet the demand, this creates equilibrium and control of prices.

Markets are driven by events or circumstances that influence the level of supply and demand available, which is linked to spending. One such event is an economic recession that triggers a reduction in spending, starving the industry of projects and giving rise to unemployment in the process. By comparison, an increase in demand and spending without sufficient supply creates over-employment which can be modified by a correction in the amount of spending (e.g. decreasing the number and value of works orders under the control of local and central governments). Recognition and suitable control of market drivers creates economic security, resilience to recession and employment stability, all of which are ingredients in the recipe for a strong economy.

1.6 Economic and Construction Cycles

Economies usually create repeat cycles, with most completing their course over a period of 7–9 years. When growth is sustained at the top of a cycle (boom), a slowdown eventually occurs which triggers a rise in interest rates leading to diminishing share values and commodity prices, tighter money and a depressed property market at the bottom of the cycle. At the bottom the economy is vulnerable, and if sustained because of a lack in consumer confidence, a recession (bust) may be activated when the economy deteriorates and retracts. A recession is normally for the short term, unless there are compelling circumstances to entrench the decline. No circumstance in recent times has been as severe as the global financial crisis (GFC) of 2008–2010 that entrenched a recession in various parts of the world, in particular developed nations. The GFC is an isolated case that had an impact on a massive scale. However, it demonstrates what can happen at the bottom of a cycle and how hard it can become for struggling businesses to survive. Low demand for building works during a time of recession can mean fierce competition between contractors, with many prepared to work to reduced profits or none at all. This creates high risk and uncertainty, with many businesses relying on short-term borrowing in an attempt to remain solvent. A recession is not permanent; in the aftermath, the climb out of recession starts with a fall in interest rates, followed by rising share values, better commodity prices, easier money available and eventual increase in property prices, back to the top of the cycle. A demonstration of this cycle is provided in Figure 1.2.

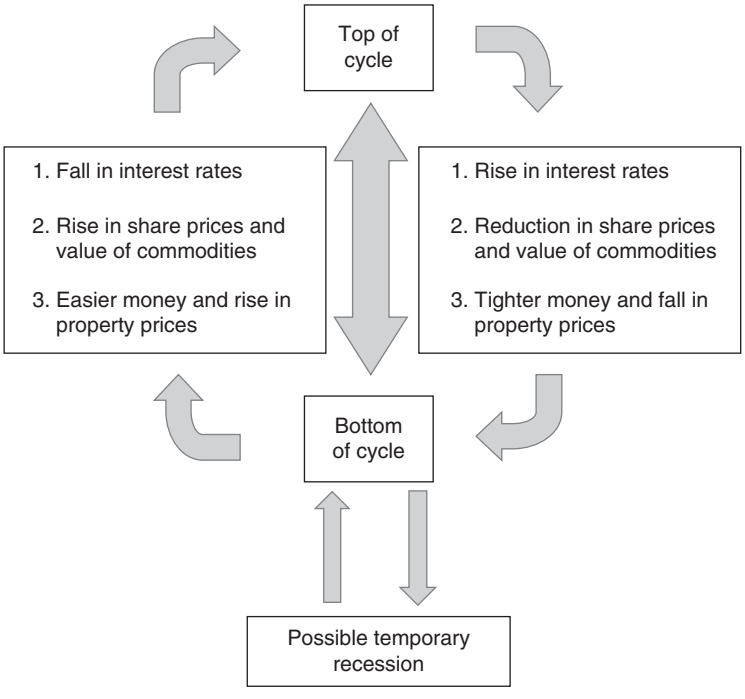

Figure 1.2 Economic cycle.

The above are characteristics of an economic cycle that impact the construction industry with the pattern of events driving or diminishing demand and the need for construction work. When interest rates fall, this encourages more lending and the possibility of an increase in tenders for construction works, with the opposite in force after a boom. Knowledge of these trends permits clients, contractors and design teams to be aware of the likelihood of changes over the long and short term to implement strategies for future planning (e.g. possibly refurbishing existing buildings instead of seeking new works during a downturn). Armed with this information, decisions can also be made regarding risks and opportunities in specific markets in order to recognise fashionable consumer demand at given times, meaning contractors must be open to diversifying interests in the type of works they undertake.

1.7 Development of Quantity Surveying

1.7.1 Background

Henry Cooper, the son of a Master Builder, set up Henry Cooper and Sons in Reading, England in 1785, and in 1799 opened a London office to deal with the costing of building works. The mid-nineteenth century saw the use of 'measurers' or 'master tradesmen' who were called upon to assess the amount of materials and labour required for building operations. At this time, clients would employ an architect to design a building and invite tenders from builders for the works, a traditional approach still in use today. The 'measurer' prepared schedules from various designs to which competing builders applied rates to create a price for the works. However, this was only suitable when the design was complete, with clients often wanting to know what price to expect before tenders were received that paved the way for the introduction of the independent quantity surveyor. This independent role involved measuring, quantifying and assessing the cost of works at different stages of the design process, and providing cost advice on changes instructed by the client during the construction phase. The demand for the service escalated during the late-nineteenth century, with the role being set up within the RICS and recognised as a client-facing profession. In the aftermath of this recognition, and mainly due to the migration of professionals from England to Commonwealth nations, the profession has manifested on the world stage, establishing quantity surveying institutions in many countries in the process. With the passage of time, and due to growth in the number of procurement routes now available to project clients, the requirement for the skills of a quantity surveyor is not restricted to client side and is also adopted by main and trade contracting businesses as part of their service to a project.

The core skills of quantity surveying have remained unchanged since the days of bolstering the profession in the nineteenth century, and are based upon a thorough understanding of construction technology, the competence to measure and quantify scope, and the ability to assess chargeable rates to determine a marketable price for the works. However, it is incorrect to perceive modern quantity surveying as a pioneering profession restricted to traditional core skills, as the role warrants additional

services sought by contractors and project clients that see quantity surveyors as competent in administering contracts and managing the commercial aspect of construction projects. Moreover, and due to the growth of innovative financing, public sector clients have the opportunity to lease or mortgage new buildings or structures that a contractor builds, owns and operates for a fixed term with the quantity surveyor involved in the whole life-cycle cost (i.e. from design through to handover and the occupational phase), with quantity surveying skills sought by end-user clients and contractors.

1.7.2 Traits and Skills of a Quantity Surveyor

For those with knowledge of the design-and-build processes or employed in a management role in the construction industry, the role of the quantity surveyor is generally understood and recognised. However, outside the industry, and indeed beyond the shores of the UK, Ireland and Commonwealth countries where the role is firmly established, it is not so familiar. So, what influences someone to become a quantity surveyor? The answer could rest with family influence from a caretaker or parent who is a quantity surveyor or other construction industrial professional. It could also stem from advice given by those aware of the role who are entrusted to provide career opinions. It may also stem from career options provided in school or college, or from information given by a friend or network of friends employed in the industry who considers it a suitable role for a certain individual. Whatever the influence, personal traits can assist individuals to cultivate the necessary skills required for quantity surveying, illustrated in Figure 1.3.

In summary:

- *Traits*: (a) A natural prerequisite to enjoy the building process as well as wanting to learn about matters that eventuate on construction projects. This can mean building techniques, management systems, as well as contractual and commercial matters that arise in the day-to-day running of operations. (b) Thriving on being an integrated team member and relied upon to perform as expected. (c) Being systematic and orderly with the ability to understand and operate systems applicable to the management of projects.
- *Skills*: (a) Good literacy and concise communication skills, including an effective command of oral and written techniques and the ability to use information technology systems. (b) An ability to concentrate for long periods and accepting the office as part of the working environment, which applies on or off the building site. (c) A flair for mathematics, figures and geometry which provides understanding of the measurement techniques and calculations used for determining quantities and prices. In addition, problem solving and logical reasoning will be of benefit.

In addition to the above, the quantity surveyor requires an understanding of contract law including reasons a construction contract exists, which is to create a formal instrument of agreement that sets out the rights, risks and obligations of the parties in order for them to understand the contract they have undertaken.

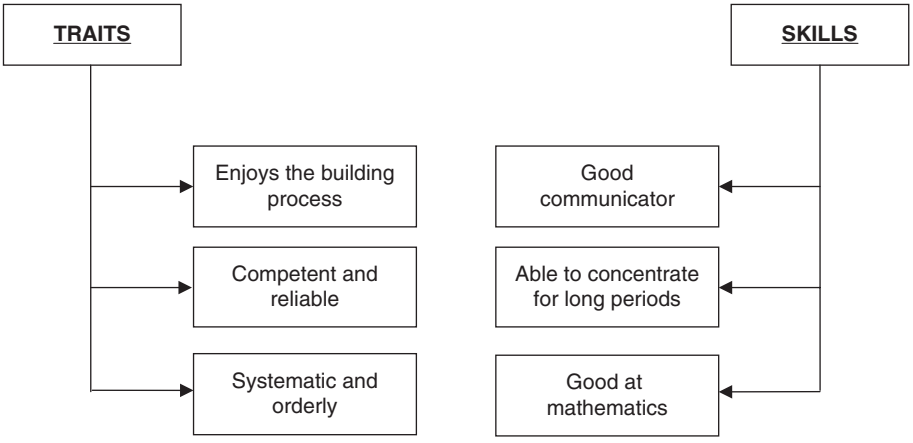

Figure 1.3 Quantity surveying traits and skills.

1.7.3 Education and Training

To acquire suitable education and training, students typically enrol and attend an undergraduate degree course in a university following a curriculum lasting four years. Early semesters involve the study of core subjects and, depending on the curriculum, typical subjects include: construction technology; industrial relations; management; building materials including composition and application; contract law; quantity surveying/estimating; and services in buildings. The combination of these provides an understanding of construction and the industry at technical level. Thereafter, training becomes in-depth dealing with the specifics of the core subjects including subtopics that leads to a series of examinations. Students may be content with completing the degree or may seek chartered status in addition to the qualification. There are abundant cognate degree courses available in the UK accredited by both the RICS and CIOB as stepping stones towards achieving chartered status. If the aim of a student is to obtain RICS or CIOB chartered status through a traditional route of education and training, students need to be aware of the accredited degree courses because a decision to transfer or leave during a semester to commence an appropriate course could be costly in both time and money. Methods for achieving chartered status with the RICS or CIOB through the traditional route and other routes are discussed in detail in Section 1.4 in this chapter.

1.8 Construction Innovation and the Contractor's Quantity Surveyor

Since the dawn of the twenty-first century, the most salient features influencing the construction industry are probably the growth of information technology and changes in environmental attitudes. As these subjects change regularly, it is in the interest of the quantity surveyor and others engaged in the construction industry to remain innovative. This is required in order to keep abreast of the continuous growth in these subjects as they influence the way we work and the buildings that are produced.

1.8.1 Information Technology (IT)

Traditional communication methods for relaying information such as post, fax, meetings minutes, courier and telephones are still in use today and will remain so in the future. However, with the growth of IT, modes of communication have expanded rapidly and in the process modified the way we live and work. The use of electronic systems means modes of communication and the methods of transmitting data can be carried out in a safe and efficient manner, expediting the flow of information on construction projects.

1.8.1.1 Document Communication Systems

Collaborative document transmission involves the distribution of project management information such as drawings, minutes of meetings, general correspondence, etc. through a host network. The process involves a sender uploading information to a selected network, with the network advising authorised recipients via e-mail when the details are available for retrieval. Recipients then log on to the host network using a password to access the information for downloading. Features of the system include: tracking and audit trails; search engines by category; calendars; diaries; contact details; and the management of formal correspondence, all with 24-hour access. The adoption of the system by a project client is discretional, and can depend on the duration and financial value of a scheme to warrant the investment. If a project client considers a collaborative system is viable, the name of the host provider is usually mentioned in the invitation to tender documents. This advises potential duty holders of the client's intention to include a communicative system for the project under tender, and for tendering companies to provide staff training in order to be competent with the arrangement, the cost of which is to be included in the tendered sum. For this reason, a collaborative system is suitable for projects where the cost of training is minor in proportion to the value of the project. A range of host providers can be found on the following websites: http://www.aconex.com; http://www.viewpoint.com; http://www.dochosting.co.uk; and, with Oracle's Primavera applications, http://www.oracle.com.

1.8.1.2 Project Management Planning

Construction project managers make use of software programmes designed to assist the planning of time, resources, budgets and tasks on a project. Probably the most commonly used format is a Gantt chart (named after Henry Gantt, American engineer and inventor of the chart), a horizontal bar chart used to identify project activities and the length of time it takes to start and complete each task. The chart can also include a critical path following the duration of each activity which must be started and completed before the next activity can start. For example, a programme of works may state a requirement for electrical wiring run within partitions and walls of a building. On the critical path, the programme may demonstrate that the wiring must start and be complete before wall boarding can commence and stipulate the start and completion dates (or number of days) of the wiring works, that is, creating the duration of the critical path.

Programmed information can be distributed to parties via hard copy or email by attaching a scanned copy of the document. A better solution for producing higher quality is to issue the programme as an electronic file created from the software programme and, depending on the file size, can be issued via email, compact disc or USB. To be effective, recipients must have access to the same software as it cannot usually be opened through any other source.

1.8.1.3 Estimating and Cost Management Systems

At the heart of producing tenders is competent estimating which involves the development of an estimate of cost to carry out the works which, in the process, relies on estimating software to produce results. There are a number of off-the-shelf estimating software systems available for purchase with varying degrees of sophistication to suit the organisation's size and value of works undertaken. A powerful top-end system has provisions for manually inserting dimensions to calculate quantities with add-on features allowing *.pdf or AutoCAD designs to be imported for scaling using polylines that determines quantities, and viewports that show the measured design results in coloured format. Other features include a viewport to calculate chargeable unit rates, with the option of importing price lists and a facility to produce a variety of reports.

Cost management systems are different from estimating systems and are used post-contract to produce reports on the status of project expenditure and cost forecasts which are recorded in the system under a series of cost codes. Main contractors use these systems as part of project management reporting which are produced with the assistance of the quantity surveyor, usually on a monthly basis.

1.8.1.4 Webcams

Webcams can be used to video-record construction activity with cameras placed in strategic locations on construction sites for optimum viewing. The use of webcams for office use has become outdated due to the high quality of modern video and teleconferencing equipment becoming available.

1.8.1.5 E-tendering

E-tendering is an electronic method of procurement that commences with an invitation to tender and concludes in an award of contract. In general, the process involves an administrator uploading tender design and documentation to a host website for retrieval and downloading by competing companies. Tender responses may be either uploaded to the host website or delivered in hard copy to a physical address, with the preference usually stated in the conditions of tender. Various levels of security and sophistication exist with e-tendering, with access to the information similar to a document communication system used in project management. A main difference between the host web provider of a project management system and e-tendering is that e-tendering is usually conducted via the client's own website instead of a collaborative online system.

E-tendering has advantages over a paper system as it is sustainable and can help reduce tender periods. It is also spontaneous and depletes the need for manually inputting receipt of tenders, saving administrative time in the process. To maintain procedural integrity, tendering companies may be requested to pay a fee or non-refundable deposit to an administrator to cover the cost of the service. The public sector is an advocate of the process, possibly because the use is seen as a long-term investment which improves services and reduces costs, benefitting the public purse. Private sector clients that frequently call for tenders may also benefit from the arrangement. However, this sector tends not to use the system as much as the public sector, probably because of the expense involved in setting up the arrangement and ongoing management responsibilities.

1.8.1.6 Cloud Computing

As a business develops, it creates data which must be stored in a compact and secure manner, which may not always be possible if saved on individual computers that are prone to system failure. Central servers mitigate this problem, yet require allocation of physical space and cooling systems to deal with generated energy, which can be costly to acquire and operate. Cloud computing is seen as the solution to this which frees up space and operates by uploading data to a cloud provided by a host service provider where information is stored in a sustainable and efficient manner. The term 'cloud' is internet-based and a metaphor that represents a cloud from which a list of providers, such as Google or Microsoft, can be accessed. To be implemented, the provider installs software and hardware in the hirer's office and upgrades existing systems as necessary. The hirer then makes use of storage space in the cloud by uploading data, which is charged by the provider under the terms of an agreement. A luxury of the system is the ease of use, as amendments to the hirer's requirements can be altered by the host with the storage upgraded or downscaled to suit. The system is also available for mobile computing including laptops, portable computer devices and smartphones.

1.8.2 Building Information Modelling (BIM)

BIM is the AutoCAD digital representation of a building in model form using three-dimensional images (3D). These images create visualisation of a building that can also be created with greater AutoCAD dimensions applicable to the design, construction and occupational phases of a building, for example:

- 4D refers to the linking of 3D components or assemblies with time or schedules of time-related information in real-time mode. This enables visualisation of the entire duration through a series of events displaying progressive activities through the construction phase.
- 5D links the components of 4D while also adding cost-related information.
- 6D refers to the linking of 3D components or assemblies to the aspects of a project's life cycle as advice for facilities managers and occupants during the occupational phase.

Tools used for BIM during the design phase set the pathway to create a computerised system storing everything from standard 2D drawings to 3D designs, specifications and the finer details of product components. This involves BIM simulating construction processes enabling various issues to be addressed, for example sustainability, including how to reduce waste and choose the most cost-effective schemes. Images and presentations include animations and a walk through of the building at different phases of construction, showing virtual construction methodology and business activities once the building is occupied and operating. For effectiveness, BIM involves logging information and data to illustrate where components are located in a building for identification and maintenance purposes. This is to aid facilities management and assist with the allocation of budgets for maintenance and life-cycle replacement costs.

Where BIM is specified as a requirement, a BIM manager provides advice to the project client and design consultants on the requirements of the system and the features it can provide. For the system to operate, suitable software is installed to each duty holders' IT system that may involve overhauling existing hardware, which is carried out by the BIM manger or an IT consultant. These changes or upgrades can be expensive, with

staff training necessary in order to understand and gain the benefits of the system. BIM has distinct advantages over traditional design approaches, as virtual reality demonstrations means there is no doubt regarding the images and function of the building once it is complete. This helps to avoid any misunderstandings if viewing traditional flat 2D drawings, which may provide misperceptions of what a building or part of a building may look like once it is complete.

The benefits of BIM to the industry and project client are: it enhances health and safety; improves communications; is collaborative and reliable; reduces the chance of errors; and mitigates design and construction risks.

Disadvantages include: the size of electronic files and storage required to retain the information; a general lack of understanding to how BIM operates, which requires training for use of the system; and incompatibility of required software with existing systems, unless users consider the cost to upgrade as a financial investment.

Advocates of BIM consider that the benefits for designers outweigh the disadvantages because, with the passage of time, financial outgoings of an early investment can provide dividends for the future if the intent is to be involved in future schemes.

1.8.3 The Environment

The impact of legislation and due concern for the environment has created a new thought process to the way buildings are designed, constructed and managed through their operational life. This attention to detail has created language that would otherwise be obsolete from industrial vocabulary such as conservation and sustainability, which refers to the capacity to protect, endure, maintain and support resources through the building process and occupational life of buildings. Poignantly, the impetus for change has been at a political level following the discovery of a hole in the Earth's ozone layer, brought about from the use of chlorofluorocarbons (CFCs) used by many industries. Fortunately, this has been controlled by suitable legislation and regulations with a degree of success. However, focus on the situation has since digressed due to the increase in global warming as a result of greenhouse gas emissions (gas, mainly carbon dioxide, in the atmosphere that absorbs and emits radiation) created by human activities, in particular industrial use. The source and quantity of these emissions and the effect on global warming has prompted radical thinking from a range of industries with the consensus to act responsibly and show consideration to the environment. The construction industry has recognised this problem, and initiated improvements by proactively promoting changes in organisational practice and customs. A number of customary influences akin to the environment and the construction industry are discussed in the following sections.

1.8.3.1 Green Business

This term expresses a company's policy of committing to cancel any negative environmental impact during its business operations at a local and global level with a view to safeguarding the community, business and society.

1.8.3.2 Green Certification

In the UK, the use of Green certification in buildings is steered by the Housing Act 2004 and Housing Act (Scotland) 2006 that implements the Energy Performance of Buildings (Certificate and Inspections) (England and Wales) Regulations 2007 and the Home

Information Pack (Nr 2) Regulations 2007. This legislation makes it mandatory to display an Energy Performance Certificate (EPC) in a new residential building (or any type for sale or rented unless used for less than 4 months per year) and a Display Energy Certificate (DEC) for any public building with a useful floor area in excess of 250 m^2. Certificates are graded as A (best energy efficiency and lower running costs) to G (least efficient and higher running costs), with the average being D. Compliance with this legislation underlines the prior accomplishments of BREEAM (Building Research Establishment Environmental Assessment Method). BREEAM was established by the Building Research Establishment (BRE), and is a voluntary measurement assessing the environmental impact on a range of building types for use by clients, developers, designers and those interested in the environmental aspect of buildings. BREEAM assessments include suggested methods for reducing running costs through the whole life cycle of buildings and providing innovative assessment tools for guidance. Certification is possible with the use of templates that have benchmarks with a scoring system for ideas and standards that can be included in the design of buildings.

Green certification schemes also exist in Australia under the control of the Green Building Council, in Qatar as the Qatar Sustainability Assessment System (QSAS) and in the USA (plus a number of others countries) with LEED (Leadership in Energy and Environmental Design). LEED was developed by the US Green Building Council, and is a private non-profit trade organisation promoting sustainability in buildings regarding design, the construction process and occupational use.

1.8.3.3 Sustainability

This broad term refers to the activity of any business participating in and promoting green business. The concept of sustainability is one that ensures work processing and product manufacturing address environmental factors while the organisation maintains a business profit. The objective here is that sustainability meets the 'triple bottom line' that refers to people, planet and profit as discussed in the Brundtland Report, published by the United Nations World Commission on Environment and Development.

1.8.3.4 Sustainable Materials and Buildings

A part of green business involves promoting product specifications that seek to control the use of natural materials used in the construction of buildings and consider recycled products instead. Recycling is possible with a number of building materials such as aggregates, metals, glass and paper that, when recycled, produce new products seen as alternatives to products manufactured from natural resources. For example, crushed and graded demolition material can be used as aggregate in the production of concrete instead of quarried products which is a drain of natural resources.

Buildings designed to be constructed with sustainability in mind are constructed to specifications that have the aims of:

- improving insulation in order to reduce heat and sound emissions;
- making use of grey water from washing machines, etc. for use as irrigation; and
- providing efficient heat exchange with heating systems by installing solar panels to create and store energy and reduce demand on the electric grid.

The additional cost for sustainable measures in new buildings compared to those that exclude the requirement is within the range of 2–5%. However, this additional cost is

variable and influenced by specification criteria and the project, as logically, the higher the price to construct a building, the more attractive sustainable buildings become due to the add-on prices becoming less significant.

1.8.3.5 Life-Cycle Costs

A client venturing into a construction project may express a need to satisfy environmental matters, yet have concerns regarding the additional cost of constructing a building and the running costs to be incurred once it is occupied. It is possible to address this concern with a life-cycle cost assessment, which is usually carried out by a consultant who may be a quantity surveyor, and is the critical analysis of a full building design or part thereof. A completed assessment will demonstrate how cost premiums included in the construction can provide benefit through the life cycle, giving a return of investment. For example, suppose lighting options are being considered for back-of-house areas to a new building undergoing design development (e.g. basement-level car parking, corridors, etc.) with the option to use either fluorescent or light-emitting diode (LED) fixtures, the latter being a more sustainable option. This could be appraised by assessing the cost of installation of each option plus the cost to maintain and replace over a given duration using the data provided by the manufacturers. In this example, a period of 25 years is assumed as the duration the areas will be used as back of house. See Table 1.2 for an analysis.

Life-cycle cost assessments provide an indication of the value of a building (or part thereof) beyond a price to build, and provide a financial awareness that can be linked to environmental issues as well as the rewards that can be delivered. If life-cycle factors are a consideration in a design, options should be addressed as early as possible because afterthoughts involving redesigns may cost time and money.

1.8.3.6 Waste Management

It is estimated that the UK construction industry produces one-third of all physical waste generated in the country as a result of demolition and the disposal of excavated material and surplus products created from the construction processes. To mitigate this and make the creators of waste aware, a landfill tax is levied by the government on waste disposal fees with the funding generated used to pay for long-term plans dealing with the impact on the environment. The levy is charged by weight or volume with different rates applying to the type of waste disposed, that is, inactive (natural soils and building fabric materials such as concrete and glass) or active (natural resource products such as wood and chemically produced goods such as plastics). For this reason, there are benefits to a contractor for managing and reducing waste during a construction project which are twofold. Firstly, a reduction in the waste allowance included in a contractor's tender will save the contractor expense on disposal fees. When a contractor submits a tender, an amount of material waste in comparison with installed quantities is allowed as the risk due to cutting to size and damage that varies with the type of product (e.g. additional 5% for wood, 15% for bricks, etc.). If a contractor purchases materials to values that exceed the allowances, it will result in a financial loss which is not usually recoverable from the client. However, it may be possible to avoid the burden by implementing waste management strategies with aims of reducing waste and saving disposal fees. This management style involves a policy of ordering materials as 'just in time deliveries' where goods are installed as soon as practically possible after delivery to site.

Table 1.2 Life-cycle cost estimates for different internal lighting options (CAPEX: capital expenditure; OPEX: operating costs).

Investment period: 25 years			Maintenance cost			Life-cycle replacement cost			CAPEX
Asset nr	Level	Installation cost (£)	Preventative	Corrective	Total (£)	Replacement frequency (years)	Nr replacements	Replacement cost (£)	Total (£)
Option 1: fluorescent fittings including lamps and ballasts (35 W)									
1001	0–3	40,000	0	2,500	62,500	4	6	240,000	342,500
1002	4–7	10,000	0	500	12,500	4	6	60,000	82,500
1003	8–11	10,000	0	500	12,500	4	6	60,000	82,500
Total CAPEX		60,000			87,500			360,000	507,500
Total OPEX/operating cost, say 1000 fittings for 180,000 hrs over the investment period = 6,300,000 kWh @ 0.10									630,000
Total CAPEX and OPEX over investment period									1,137,500
Option 2: LED fittings including lamps and drives (30 W)									
1001	0–3	50,000	0	1,000	25,000	7	3	150,000	225,000
1002	4–7	15,000	0	300	7,500	7	3	45,000	67,500
1003	8–11	15,000	0	300	7,500	7	3	45,000	67,500
Total CAPEX		80,000			40,000			240,000	360,000
Total OPEX/operating cost, say 1000 fittings for 180,000 hrs over the investment period = 5,400,000 kWh @ 0.10									540,000
Total CAPEX and OPEX over investment period									900,000

Notes:
(1) The above tables demonstrates that a higher investment for the installation can provide benefits over the long term.
(2) Figures exclude inflation or deflation in prices over the investment period.
(3) Risk from defects and damage to lights is greater at lower building levels due to the frequent use by the public and vehicular traffic. The risk for LEDs is however considered less.
(4) No provision for preventative maintenance is needed, as routine inspections deemed unnecessary.

For maximum effect, the provision of adequate storage and protection of unfixed materials is required as well as the careful planning of site activities. Secondly, the inclusion of a waste management plan on a project demonstrates commitment to the environment, helping to raise corporate image.

The contractor's quantity surveyor must show an interest in waste management as it can affect budgets and profit margins. An effective measure for limiting the disposal of waste includes compacting and breaking up bulky items and placing them into skips, thus reducing voids in bulk waste and reducing the number of skips required. Another effective measure is dealing with excess spoil generated from earthworks operations where it is possible to accommodate the material on site by spreading and levelling around low levels of land as fill material. This process is used by developers during new works on green (virgin) or brown (reclaimed) land, where the topography permits innovation with the levels. If existing levels on land are not suitable for filling, an option is to raise the level of the building(s) by a nominal height and filling the areas created. This option requires the quantity surveyor to carry out a cost exercise by assessing the additional cost for varying the construction works which can be offset or mitigated by the reserved budget allowance for loading, hauling and disposing spoil off site. If proving viable, the filling method will require approval from a person in authority to ensure any increase in building height is practical and complies with planning approval. Furthermore, any filling works are subject to approval by the engineer and contractor who must consider handling of the material and capping the fill with inert material if required.

1.8.3.7 Lean Construction

Adopted by the International Group for Lean Construction, the lean approach strives to continuously improve standards, minimise cost and maximise value while maintaining the project client's needs. The strategies commence at design stage and continue through the construction phase, with intent to limit maintenance works after a building is occupied. This can be carried out with precision by following the lean construction theme of limiting waste with the use of proactive management that actively seeks flawless behaviour by improving communication and using procurement systems with strong supply chains. It has the same aims as a 'master builder' concept, is not restricted to environmental issues and applies a lean theme for minimising time and effort applicable to the design, construction and occupational phases of construction projects.

1.9 Prospects for the Contractor's Quantity Surveyor

People from a quantity surveying background may seek to work in affiliated roles under the guise of other titles where the training and qualifications are comparable. To be effective, suitably qualified individuals wishing to specialise in certain fields of work or seek roles in countries other than the country where their education and qualification was acquired must commit to obtaining the required skill sets. In order to obtain these skill sets, there may be a need to undergo additional training; before doing this, it is necessary to understand the roles as each discipline carries different levels of responsibility.

1.9.1 Contracts Administrator

Contract administration refers to post-contract activity dealing with the commercial, contractual and cost management of projects. In the UK construction industry, qualified quantity surveyors can be engaged as contract administrators by cost consultancies, main contractors and large-sized subcontractors, responsible to a project manager or team leader for their duties. Incumbents are usually employed full time to service one or more concurrent schemes under the title of quantity surveyor, contract administrator or project administrator. For a range of duties applicable to this role, see Sections 1.2.7 and 1.2.8 earlier in this chapter.

In commonwealth countries outside the UK and Ireland, the title quantity surveyor is often restricted to client-side quantity surveying. However, procurement strategies in these countries usually exclude a project bill of quantities as a contractual document and, where produced, are used for reference only. As a result, the consensus is that measurement skills and the production of a bill of quantities is specific to client-side activities and an integral part of quantity surveying degree courses with the training included to a lesser extent in construction management and other related degree courses. Moreover, the overseas title contracts administrator is adopted by main contractors and large-sized subcontractors, which in essence is the UK's equivalent of the contractor's quantity surveyor.

Contract administration can also mean administering the contract between the project client and main contractor, which carries a greater degree of responsibility than the aforementioned and involves complying with and enforcing the terms and conditions of the agreement, as well as documenting and agreeing any changes that may arise during the period of the agreement. For the client side, the position may also be known as superintendent, client's agent, employer's agent/representative, project manager or other lead discipline suitable for the type of project (e.g. architect for buildings and engineer for works of an engineering nature). The contractor carrying out the works will also appoint a contract administrator who may be the contractor's project manager or quantity surveyor and has an interface with the client-side contract administrator. A fundamental characteristic of contract administration is that whoever administers the contract is bound by the rules, meaning the conduct involved must be free of personality. They must therefore abide by the terms and conditions of a legally executed contract, whether considered fair or not, as departure will constitute breach of contract.

1.9.2 Contracts Manager

The title contracts manager can mean contracts administrator with the added duty of being involved with the pre-contract activities of a contractor's business where the terms and conditions of any construction contract provided with an invitation to tender is reviewed to identify risks and responsibilities which may influence the price to tender. The duties of a contracts manager may extend to the post-tender period, where the terms and conditions of a pending contract are negotiated to ensure the contractor understands the risks, rights and obligations of an agreement it may elect to enter into. Contract manager's skill sets revolve around an understanding of the structure of various standard forms of contracts and the reasons for the creation of edited standard forms and purpose-made agreements as permitted by law. These managers also need to understand the process of receiving and issuing Letters of Intent, Letters of Acceptance

and Preliminary Agreements, as well as their wording. Such letters and agreements are issued in the absence of a formal contract, where a start on site is required before the formality can be concluded, and the contract manager must understand their affect until the contract is executed and the contents of the letter or agreement discharged.

1.9.3 Commercial Manager

Commercial managers have varied roles that focus on the commercial activities of a business, including:

- marketing and business development for company expansion;
- contract negotiations, including reviewing the terms and conditions of pending awards and the price involved;
- property management;
- supply chain management, including vetting and administration of their contracts;
- cost managing projects; and
- managing business overheads.

Large companies undertaking a number of concurrent projects may engage one or more commercial managers to oversee a group of people. When employed in this capacity they are usually responsible to a director for commercial activities and may have legal training in commercial law and/or contract law. With smaller companies, the commercial manager would normally be responsible for tasks themselves and be aware of the strategic functions of the business.

1.9.4 Project Manager

A project manager engaged by a client acts as an agent of the client and addresses matters required for the successful delivery of a project. On large-scale projects, a client may engage a project management company under the control of a project director. The project director does not carry the legal status of a company director for a project because a project is not usually a business. However, a project director may be a director of a project management company that supervises a team to oversee a scheme. The scope of services provided by a project management company includes:

- applying for planning permission;
- preparing a project brief of key requirements;
- tendering and recommending consultant appointments;
- setting budges for defined scopes of work;
- recommending suitable procurement routes;
- monitoring design development;
- vetting contractors and inviting tenders for works;
- negotiating the terms and conditions of a construction contract and advising the client;
- overseeing construction of the works to completion; and
- acting in capacity of contract administrator and administering the contract on behalf of the project client/employer.

A client-side project manager involved with pre-contract activity can also be referred to as contracts manager or procurement officer tasked with the responsibility of managing the scheme for the client, and at the same time be the client's agent.

Project managers employed by contractors provide working programmes, supervise staff and accept overall responsibility for delivering a scheme on behalf of the contractor. They also provide feedback from committed projects to senior management in the contractor's business to identify risks that influence commercial decisions for works under tender.

1.9.5 Cost Engineer

The title quantity surveyor is adopted by the UK and is widely recognised overseas, in particular in Ireland and Commonwealth countries. However, outside these countries, the title cost engineer is often used instead, the USA being an example. This is modified further to 'engineer' or 'eng.', as used in the Middle East, placing it on a par with engineering professions, a presumption being the qualification of a quantity surveyor is comparable with a technical engineer.

1.9.6 Estimator

It is worth understanding the difference between estimating services provided to a client for advice and estimating carried out by a contractor to secure work. The client's quantity surveyor/cost manager provides a cost planning service for a client in the capacity of consultant. In this capacity, an estimate of probable cost for the proposed works is issued with little or no design information being available, with the estimate modified at intervals of design development. This is a cost management role advising the client's team of cost forecasts until the design and documentation is suitable to invite tenders for the works from competing contractors. A main contractor's estimator prepares a cost estimate based upon the tender design and documentation, and gains a test of market pricing for the works under tender. Once the estimate is complete, a sum is added to cover business overheads and profit to convert the estimate into a tender and legal offer to carry out the works. Ideally, the client's quantity surveyor/cost manager's final estimate of probable cost should be similar to the tendered amounts. If there is a large discrepancy, it normally has nothing to do with the main contractor's estimator and is a matter for the client and client's team.

1.9.7 Independent Roles

People may seek flexibility and diversity in their career if not wishing or are unable to work full time, which can be accommodated by employers offering short-term contracts. These contracts benefit employers when tasks require completing in order to fulfil short-term needs which may suit independent contractors. For example, a main contractor may require a quantity surveyor to prepare variations or assist with the award of trade packages when permanent staff members are on leave. Individuals may also seek supplementary fields of work and make use of short-term employment opportunities to provide income while undergoing training for roles, such as in:

- dispute resolution, including being on a panel of arbitrators, expert witness or dispute boards;
- contract and commercial aspects of facilities management;
- BIM manager;
- BREEAM assessors of quality assurance certification; or
- book writing.

The key to the success of independent working is an individuals' reliability, effective communication skills and self-organisation, together with qualifications, proven experience and marketing skills. The downside is a lack of permanent job security, no entitlement for holiday leave and no career progression within the company.

The role of quantity surveying has expanded from one of traditional core skills involving measurement and the pricing of building works to one of broader involvement in the construction industry. There is a demand for quantity surveyors and the requirement to diversify into various roles as discussed in this chapter, and individuals are encouraged to seize the opportunity and work in their chosen field. The construction industry changes at a fast pace and, with the growth in information technology, environmental issues and management arrangements, there is a need to share ideas that benefit employees, employers, peers, clients and the industry. Although the profession has strong traditional values that have stood the test of time, it is encouraging the future appears to warrant the continuous need for the quantity surveyor, albeit in a variety of forms.