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# A Comparative Study of Construction Cost and Commercial Management Services in the UK and China

中英工程造价管理产业比较研究





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# Report for Royal Institution of Chartered Surveyors

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## List of Abbreviations

<b>ADZ</b>	Accelerated Development Zones
<b>AACE</b>	American Association of Cost Engineers
<b>APC</b>	Assessment of Professional Competence
<b>APM</b>	Association for Project Management
<b>Assoc RICS</b>	Associate RICS
<b>BCIS</b>	Building Cost Information Service
<b>BEF</b>	Building Employers Federation
<b>BIM</b>	Building Information Modelling
<b>BoQ</b>	Bill of Quantities
<b>BOT</b>	Build Operate and Transfer
<b>CCCM</b>	Comparative Cost and Commercial Management
<b>CDM Regulations</b>	Construction Design and Management Regulations
<b>CE</b>	Cost Engineer
<b>CECA</b>	China Cost Engineering Association
<b>CESMM</b>	Civil Engineering Standard Method of Measurement
<b>CIBSE</b>	Chartered Institution of Building Services Engineers
<b>CIOB</b>	Chartered Institute of Building
<b>CMP</b>	Cost Management Process
<b>CPD</b>	Continuing Professional Development
<b>CQS</b>	Contractors’ Quantity Surveyor
<b>CVR</b>	Cost Value Reconciliation
<b>EC</b>	Engineering Cost
<b>EC</b>	Engineering Cost
<b>ECP</b>	Engineering Cost Process
<b>EPSRC</b>	Engineering and Physical Science Research Council
<b>FIDIC</b>	International Federation of Consulting Engineers
<b>FIG</b>	International Federation of Surveyors
<b>FRICS</b>	Fellow RICS
<b>HR</b>	Human Resources
<b>ICE</b>	Institution of Civil Engineering
<b>ICEC</b>	International Cost Engineering Council
<b>ICT</b>	Information and Communication Technology
<b>IMI</b>	Innovative Manufacturing Initiative

<b>IPMS</b>	International Property Measurement Standards
<b>IT</b>	Information Technology
<b>JCT</b>	Joint contracts Tribunal
<b>MoC</b>	Ministry of Construction
<b>MoHURD</b>	Ministry of Housing and Urban-Rural Development
<b>MOU</b>	Memorandum of Understanding
<b>MP</b>	Major Project Construction Contract
<b>MRICS</b>	Member RICS
<b>NAO</b>	National Audit Office
<b>NDRC</b>	National Development and Reform Commission
<b>NEC</b>	New Engineering Contract
<b>NRM</b>	New Rules of Measurements
<b>OGC</b>	Office of Government Commerce
<b>PAQS</b>	Pacific Association of Quantity Surveyors
<b>PF2</b>	Private Finance 2
<b>PFI</b>	Private Finance Initiative
<b>PP</b>	Process Protocol
<b>PPP</b>	Public Private Partnership
<b>PQS</b>	Professional Quantity Surveyor
<b>QS</b>	Quantity Surveyor
<b>RIBA</b>	Royal Institute of British Architects
<b>RICS</b>	Royal Institution of Chartered Surveyors
<b>SBC</b>	Standard Building Contract
<b>SMM</b>	Standard Method of Measurements
<b>TL</b>	Tendering Law
<b>UK</b>	United Kingdom
<b>VE</b>	Value Engineering
<b>VFM</b>	Value for Money
<b>VM</b>	Value Management
<b>VoIP</b>	Voice over Transfer Protocol
<b>WLC/LCC</b>	Whole Life Costing/ Life Cycle Costing

# Executive Summary



## Introduction

Cost and commercial management processes and practices in different parts of the world vary significantly. In the UK and the British Commonwealth these practices are mainly market oriented and matured over several centuries. The effects of globalisation and impact of foregoing recession have led most UK based cost consultancies to expand overseas. In contrast China, the modern world's economic powerhouse is still transforming its construction industry from a communist quota based system to a market based system. UK-China cooperation agreements foster greater economic cooperation and professional mobility. This requires better understanding of systems and processes in both countries. There is a significant level of lack of common understanding of construction cost and commercial management systems of these two countries. Therefore, this research aims at mapping the UK Cost and Commercial Management systems to Chinese Engineering Cost Systems.

## Methodology

A three phase methodology was adopted to develop the CCCM Framework.

- 1. Phase 1:** Detailed review of China and the UK cost and commercial management operations resulted in the formulation of a conceptual cost and commercial management system model that classifies project stages and services delivered in each stage for both countries.
- 2. Phase 2:** Detailed review of the structure and operations of CECA and RICS.
- 3. Phase 3:** Business Comparison through a detailed questionnaire survey and business case analysis using three cost and commercial management practices each from the two countries.

## The State of Development of Cost Management Practice

### Cost Management System – The UK

Cost and commercial management of construction projects are the key functions of the UK quantity surveyor. Quantity surveying profession has been an integral part of the UK construction industry for around 170 years. Conventional quantity surveyor offered cost advice on alternative design solutions and advice on the cost implications of the design morphology and procurement (Kirkham, 2007). They assist the design team on all cost implications of construction projects. As the industry evolved, more value added services were expected from quantity surveyors which widened the scope of cost and commercial management services. Therefore, traditional role of QS has changed immensely and are responsible for achieving the long-term vision of building projects, assessing alternative options and providing clients with valuable information to make informed investment decisions and sustainable development (Ashworth & Perera, 2015). On the other hand, QSs are increasingly developing better client focus to be aware of the ways in which a particular client perceives or even measures value (Cartlidge, 2011). Moreover, the new paradigm of software-centred service delivery has irrevocably changed the way that cost planners work in professional QS and cost consultancy practice (Kirkham, 2007; Potts, 2008, Ashworth & Perera, 2015). The NRM suite of documents (RICS, 2012a; 2012b; RICS, 2014) spanning from early stage cost management to maintenance and facilities management stages published by the RICS formally defines the total process. Hence, cost and commercial management systems in the UK stand out globally as exemplary.

## Engineering Cost System – China

Under the old planned economic system project clients were the various state-owned organisations and their management staff had no responsibility for the overruns of budgets and construction time (Shen and Song, 1998). There was no competition where all contractors were state-owned construction companies, the government guaranteed construction cost reimbursement. Performance indicators (such as those normally used to measure project time, cost and quality) were not rigorously employed. Within this state-managed industry, the Chinese Government was solely responsible for providing construction works finance and appointing contractors. The most commonly used project procurement system was the traditional state assignment where the price was agreed by the contractors through a direct government assignment, rather than through competitive or negotiated tendering (Smith, et al, 2004). With the implementation of the “open-door” policy from the beginning of the 1980s, the Government gradually transferred its planned economic system into a market-oriented economic system (Fan, 1988; Chen and Wills, 1999). In turn, new procurement methods used in developed nations have been introduced to supplement and gradually replace the past “centralised” government assignment system (Smith, et al, 2004). The traditional procurement method is widely regarded to be the most suitable approach. In fact it has been used in mainland China for many years and is likely to remain the preferred choice for the immediate future (Smith, et al, 2004).

The Ministry of Construction promulgated The Code of Valuation with Bill of Quantities of Construction Works from 1st July, 2003 (CVBOQ) (Chen, et al, 2011). This code led to a revolution in the history of Chinese construction industry and ensued in the transformation from the traditional mode of standard rates based valuation, in which engineering cost and quantities are indistinguishable from each other, to the modern mode of Bill of Quantities (BQ) based valuation which is market-oriented (Chen, et al 2011). Now contractors in construction industry are facing a new operating system in which engineering cost depends on market rates instead of the traditional standard rates set and totally controlled by the government. During the past decade the competitive tendering system based on the bill of quantities method, mainly following the British systems, became the predominant system in China. Now the quantities take-off for generating bill of quantities plays an important role in tendering and bidding, progressive payment and final accounting. The CVBOQ code is reviewed and revised every five years, and the latest version was launched in 2013. The industry has achieved significant progress in developing national standards towards approaching international practice (Shen and Song, 1998).

## Professional Bodies

The RICS has a very long history over 140 years and a broad spectrum of membership categories and specialisations with a global profile compared to CECA which is about 25 years old. However, CECA is more authoritative and have powers to regulate the Chinese construction industry. For instance, the Enterprise license system that regulates the business scope of consulting companies and its service quality in China (namely, Jia Ji (Grade A) and Yi Ji (Grade B)) are administrated by CECA. However, both RICS and CECA have the power to influence and regulate the industry standards of the cost and commercial management systems. The RICS governance structure is a mature structure compared to organisational structure of CECA, which reflects its long history. More importantly, the qualification pathways for Quantity Surveyors and Cost Engineers of the two countries are distinctly different; RICS has a competency assessment known as APC facilitated through document submission and a final viva voce examination whereas CECA conducts a qualification examination annually on four subjects – project cost management, project cost estimating system, technology & measurement and case study analysis. Further, RICS offers three different membership categories namely, Associate, Chartered and Fellowship as well as different routes to memberships which provide multiple options for the graduates and non-graduates to achieve different levels of professional membership through different pathways. Its flexibility and adaptability has helped in its expansion worldwide.

Furthermore, there is a core set of professional guidance developed by RICS available for Quantity Surveyors (the ‘Black Book suite’ of guidance documents). The NRM suite is another important standard developed by the RICS. In addition to that RICS disseminates knowledge through an extensive series of CPD programmes. Both institutions actively involve in education and research with universities and also fund research projects. In terms of internationalisation, RICS’ strategy is four fold: Standardisation of measurements, Memorandums of Understanding, Reciprocal Agreements with other international professional bodies and Joint events with other professional bodies. On the other hand, CECA is also very keen on internationalisation and supports the companies that embark into international markets. However, two key obstacles that identified by CECA to internationalisation remains the language barrier and variation in cost and commercial management systems and standard between different countries.

**Figure 1**

**Single Scale Comparison of Core Cost Management Services**



## Cost and Commercial Management Practice

Industry surveys were conducted to capture and compare businesses in both the countries. Respondents' profile represented majority of medium to large companies in the UK as opposed to small to medium in China. Half of the respondents in the UK companies were over 50 years old compared to majority of the companies in China were less than 30 years old. UK represented a wide range of firms from sole trader to Limited Liability companies and subsidiaries. In contrast most firms in China are Limited Liability companies (LLC) reflecting the recent origins of firms in China following 21st century business trends. Most cost management firms (respondents) in the UK have international operations compared to none in China. Further, all of the three professional fee strategies (percentage, fixed rate and on a negotiation basis) are equally popular in the UK while in China the Percentage fees and Negotiated fees are significantly more popular than Fixed fees. Range of professional fee in the UK is in the region of 0.5% to 2.0% whereas much lower level of fees reported in China. Intranet and internet are used heavily in the UK with less than half using Extranets. Firms in China use technologies significantly differently with high usage of Intranet and Extranets while significantly lower use of internet reflecting the barriers and limitations imposed by the state on the use of the Internet.

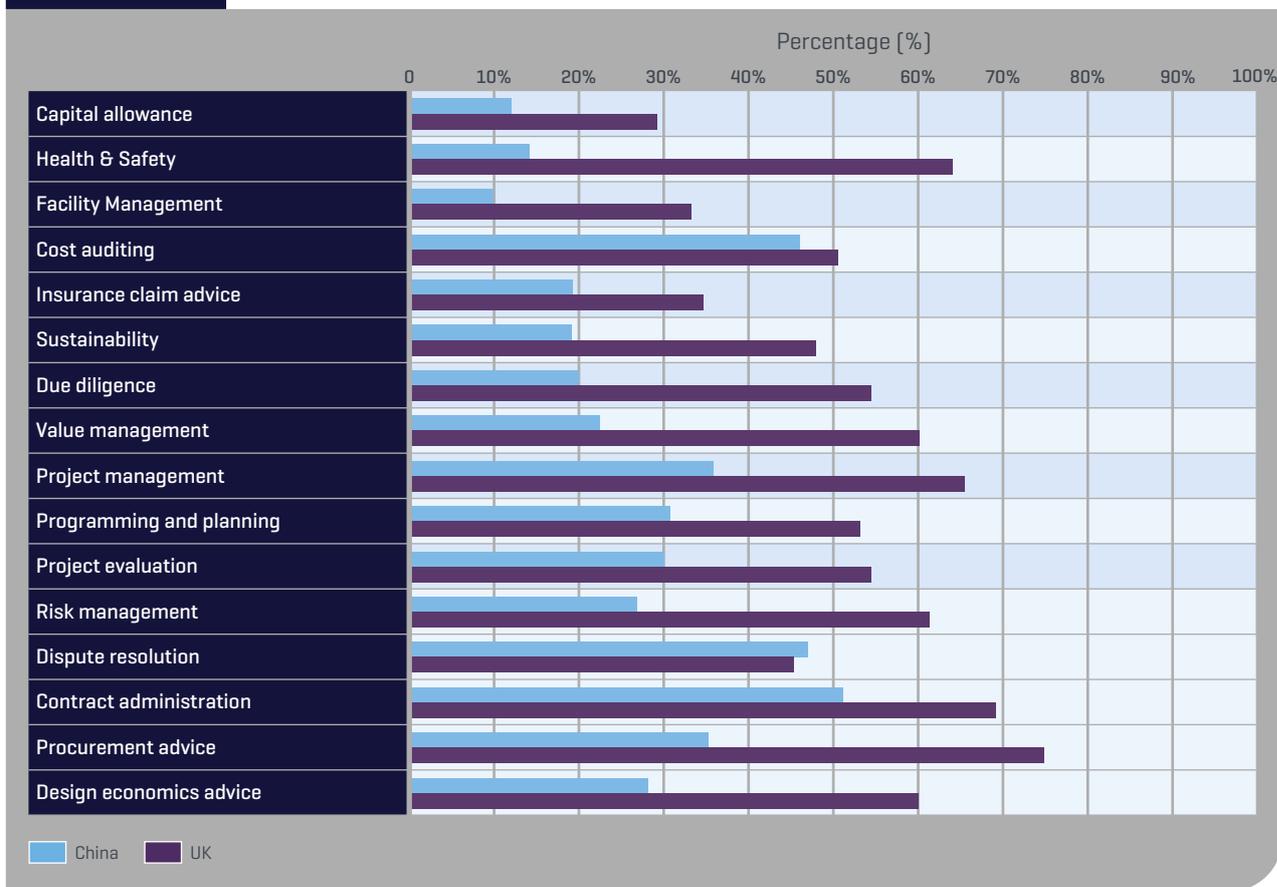
Moving on to cost management service in the UK, The result indicates that all 12 identified services are always or frequently used. This does not come as a surprise because these services are the core cost management services. EC service profile looks significantly different from cost management profile of the UK. The prominent use is indicated in Measurement & Valuation, BoQs, Tendering and Final accounts. These services are then followed by Interim Valuations, Valuing Variations and Claims. The significant minimal provision is primarily in early stage estimating, feasibility studies and cost planning. A single scale comparison of the different type of core cost management services provided by organisations is provided in Figure 1.

A revelation here is the use of BoQs in China, which is becoming hugely popular mimicking the practice in UK 20 year ago.

Out of the 16 identified supplementary services, contract administration is the most commonly used service while insurance claim advice is the least used. Most of services classed as supplementary services in the UK QS service profile are not included in the China EC service profile. However, services related to Contract Administration, Dispute Resolution, and Cost Auditing are somewhat provided by some firms in China. The single scale comparison of these services between the two countries is indicated in Figure 2.

**Figure 2**

**Single Scale Comparison of Supplementary Cost Management Services**



In early stages, superficial area method is most used preliminary estimating techniques followed by Unit method. On the other hand, most of the respondents indicated that they have never used or have limited use of the Storey Enclosure Unit method and the Cube method in the UK. Whereas many firms in China do not use most of the preliminary estimating methods mentioned above as most EC consultancies are not involved in cost management activities at early stages. It is also due to the fact that budgetary allocation is carried out using quota based and resource based methods in China. During Design Development stage detailed cost estimating techniques such as Approximate Quantities and Elemental Estimating techniques are commonly used in the UK. These techniques have low usage in China as most of estimating activities still rely on the legacy of the Quota based System and resource based estimating techniques. Further, in terms of cost planning it is interesting to note that NRM 1 usage has been significant although it was recently introduced. This indicates that NRM1 has fulfilled a true industry need. There is no cost planning activity in China at this stage and estimates are based on in-house formats by way of refining resource based estimates as design develops. In terms of whole life costing, majority of responded indicated limited use of the technique but more than one third of the respondents indicated that they

frequently use the technique. However, WLC/LCC is not much used in the China and it is still in its early stages of introduction to the EC service profile. Risk Registers were identified as the predominant technique used to manage risk along with considerable usage of Brainstorming. Risk management is in its early stages of introduction to the construction industry in China resulting in less very low use of the service.

During the detail design stage, BoQ is used as the main method of detailed estimating in the UK. However, it is seen to be supplemented with detailed cost plans in other situations. In China, there was high usage of BoQs, resource-based and quota-based estimating. However, the use of BoQ is gaining heavy popularity. This indicates that China is in a stage of transition from the legacy of centrally planned Quota Systems to a market oriented BoQ based estimating system. Cost planning results coincide with design development stage results, reporting high usage of NRM 1; this in turn backs up cost analysis reflecting same results for the UK. However, there are also in-house formats that are used for cost analysis. While cost planning is not practiced in China in the way it is practiced in the UK the practice is changing with British influence and cross fertilisation of techniques from foreign trained or experienced EC consultants returning to China.

Further, findings in respect of usage of cost analysis formats were unsurprisingly similar to the use of cost planning techniques. The latest NRM1 have harmonised the elemental layouts with BCIS and hence there will be greater uniformity expected in the UK industry. Due to the absence of a clear elemental format and lack of usage of historical cost data cost analysis is not used in China. Whole life costing and Life Cycle Costing are not heavily used in the UK industry but gaining popularity due to increased emphasis on sustainability while in China it is recently being introduced.

During post contract cost control, majority of the respondents use actual measurements for valuations along with BoQs. It is also noted that there is still considerable usage of percentage based valuations in the UK industry. Usage patterns for Interim Valuation techniques in China matches with the UK. In terms of post contract cost controlling techniques, cash flow forecasting and value of work done evaluations are closely followed by Project Programme Tracking in the UK. On the other

hand, cost control in China predominantly uses Value of work completed as the basis of cost control with limited use of Cash Flow Forecasting in comparison to the UK practice. However, there is an even spread of use of the other two techniques indicated. BoQ rates and Pro rata are predominantly used as the main methods for valuing variations followed by New rates in the UK. The use of BoQ rates and New rates have been indicated as equally important in valuing variations in China.

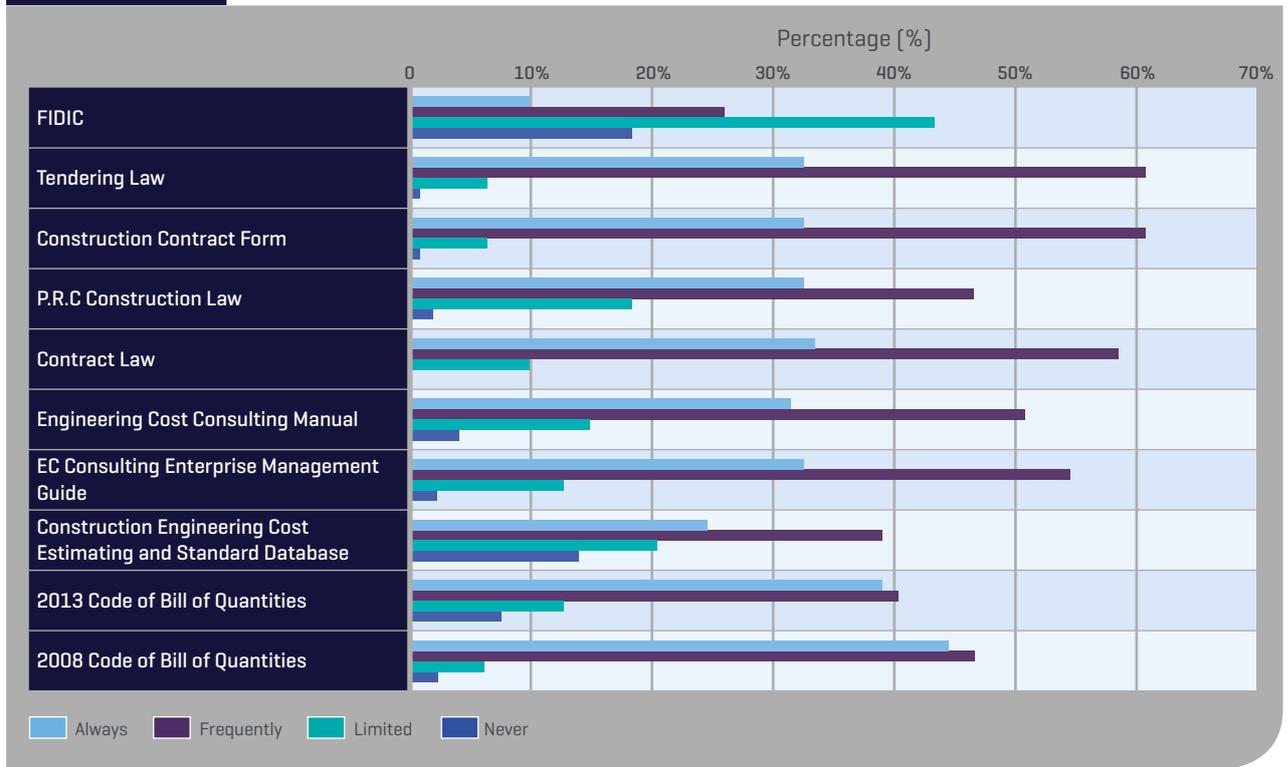
Traditional tools such as BCIS and Price Books, as expected are clearly heavily used. It is interesting to note the increasing levels of popularity of the recently introduced NRM suite of documents. The Black Book series published by the RICS have yet to penetrate the practice adequately. This might be due to lack of awareness. It is also noted that Embodied Carbon estimating data book CapIT has limited usage among respondents. The standard forms stack up in order of JCT, NEC and FIDIC in terms of popularity in practice (see Figure 3).

**Figure 3**

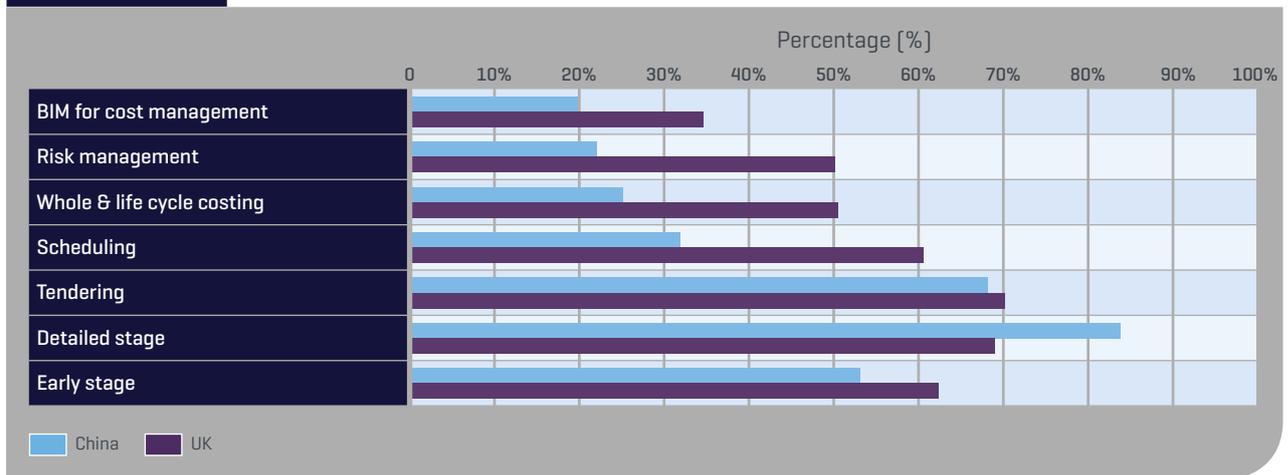
**Tools And Document used for Cost Management Services in the UK**



**Figure 4** Tools And Documents used for Engineering Cost Services in China



**Figure 5** Single Scale Comparison Software Usage by Design Stage



Ten different tools and documents used for cost management practices were surveyed in China. The analysis indicates a prolific use of almost all surveyed except FIDIC conditions of contract. This could echo upon the limited interest in internationalisation from the EC firms in China (Figure 4).

Software usage for cost management services during various stages of design were analysed (Figure 5). It is clear that there is greater usage of software at early stages of design in the UK. Software usage for cost management at early stages of design was limited in China due to lack of involvement of EC firms in cost management at these stages. Consequently, software usage significantly increases during detailed design stage. It is also interesting to note that the limited use of BIM in the UK despite heavy government push (35%) and a

similar and even lower usage in China (20%). Furthermore, Excel is identified as the most popular software for most QS functions in the UK. It also indicates that Excel is the predominant software for WLC/LCC and Risk Management. However, some of the contemporary tools such as BIMMeasure, CostX are also being used.

Analysing future trends, BIM was identified to be the most relevant future trend for both UK and China. Issues related to sustainability such as Green Buildings, Carbon Estimating and Environmental Assessment are also identified as important for the QS profession in the future in the UK. Both the UK and Chinese firms agreed that internationalisation is challenging for construction business; internationalisation can increase profit margin and greater importance of e-business implementations.

**Table 1 Comparison of Case Studies – UK and China**

	Case Studies	
	UK	China
<b>Small</b>	Adair Associates	Wanlong Construction Engineering
<b>Year of establishment</b>	1994	2007
<b>Total number of employees</b>	20	250
<b>Total number of offices</b>	3 [2 International – Dubai and Gibraltar]	14
<b>Business strategy</b>	Excellent client service	Expand business from regional to national level
<b>Core services</b>	Quantity surveying, building surveying, contract services, dispute resolution, project management, project monitoring, party wall surveying	Cost engineering, consulting, agency, judicial, supervision, and procurement
<b>Cost and commercial management services</b>	Cost advice, cost planning, tendering, cost control, valuations, final accounts, expert witness, claims support, adjudication, contractual advice, arbitration, feasibility studies, due diligence, analysing developer costs and programmes, evaluating contract conditions and advising on inherent risks, preparing/executing collateral warranties, authorising valuations to facilitate drawdown of funds, monitoring the whole construction process, ensuring a structure is built to the necessary standards, statutory requirements and relevant specifications, reviewing final accounts and performing completion checks	Project pre-feasibility studies, project estimates, tendering, BOQ preparation, preparation of base price estimates, the whole process of cost control and project management, completion of the audit of the accounts for settlement, acting as the government procurement agency, feasibility study reports writing, project proposals, energy assessment, fire tests and analysis
<b>E-business</b>	Uses measurement software to facilitate bill preparation though not intended to move to BIM environment right now	Not active, however, estimating software, internal office automation systems are in place
<b>Internationalisation</b>	Considers internationalization is an important part of their business.	Focus is on the domestic market

continued

continued

	Case Studies	
	UK	China
<b>Medium</b>	Summers-Inman	Shanghai Shenyuan Property Consultants
<b>Year of establishment</b>	2002	1995
<b>Total number of employees</b>	120	100
<b>Total number of offices</b>	8 [1 International – Doha]	4
<b>Business strategy</b>	Take care of the existing clients to ensure smooth running of the business and look for emerging markets to expand the business into different sectors.	Delivery of high-end services to blue chip clients in China, mainly government invested super complex project
<b>Core services</b>	Quantity Surveying, Building Surveying, Health & Safety, Development Monitoring, Heritage Surveying, Digital Surveying, Project Management.	Business Plan, Marketing Report, Project Appraisal, Feasibility Study, Project Management & Development Consultation, Investment opportunity study, Tendering Services & Consultation, Government Procurement Agent & Services, Value Engineering, Overall Project Cost Control Services, Project cost checking and valuation, Final Account and Claims and Dispute Resolution, Project Finance and Accounting
<b>Cost and commercial management services</b>	Project Quantity Surveying, Employers Agent, Employers Agent, Mechanical and Electrical Quantity Surveying, Builders Quantities, Technical Reports and Audits, Feasibility Studies and Life Cycle Costing, Contract Claims, Expert Witness, Insolvency, Administration, Receiverships	Whole process project [cost] management from the conceptual stage to the final account, to mainly help the clients manage the budget, co-ordinate and support negotiation with local authorities for project approvals, prepare the detailed design briefs, manage the design process, procure consultants, contractors and equipment suppliers, quality control, monitor project programme, manage contracts, issue interim certificates, coordinate with other consultants, contractors and suppliers and organizing operational tests, final acceptance and hand-over.
<b>E-business</b>	Revit™ and Vico™ software are used for cost management functions. In addition to the core services, Summers-Inman uses Commission Manager™ for financial management of the business. IT services are outsourced to improve efficiency.	Working to develop a new e-business platform integrated with BIM.
<b>Internationalisation</b>	Summers-Inman has a presence in Doha, Qatar for a specific research project, there are no international construction projects in their portfolio at present. Summers-Inman feels that internationalization is not a mandatory criterion for the business to be successful.	Very keen though faces difficulty in venturing in to the international market due to language barriers, lack of suitably qualified staff with international experience and, lack of knowledge on international practice and procedures. There is also lack of client side demand for such enterprise
<b>Large</b>	EC Harris	Beijing Jinmawei Consultation of Engineering Co
<b>Year of establishment</b>	1912	2001
<b>Total number of employees</b>	22,000	150
<b>Total number of offices</b>	19 regional branches & many international branches	6
<b>Business strategy</b>	Client centric capabilities, employee skills development, shift from traditional business to meet present world's needs	Aims to transfer the new knowledge in developing new product and services

continued

continued

	Case Studies	
	UK	China
<b>Core services</b>	Planning - programming & planning, work place strategy, and so on, creating - cost management services, whole life costing, value management, earn value management, project programming, taxation and dispute resolution, health & safety, grant design management, operating - facilities management, asset management, built management, building surveying, energy demand management, workplace planning, reinventing - mitigation of issues around environment and sustainability, repositioning of asset resale and redevelopment of the site	Whole construction process cost control from early stage cost estimate to the final account cost checks and auditing
<b>Cost and commercial management services</b>	Commercial Management & Quantity Surveying, Whole Life Costing, Cost & Value Management, Risk & Opportunity Management, Taxation & Capital Allowance, Strategic Procurement & Contract Strategy	Audit of Investment Estimation, Project Economic Evaluation, Establishment & auditing of approximate estimate, construction drawing budget and approximate estimate adjustment, advise on quota design, Draft bidding documents and agreements, auditing of BOQ, regulated bidding price, tender offer and construction contract, Cost plan and cost analysis, Quantities calculation and issue payment, Negotiation and investigation of variations, Investigation of quantity deviation and omission, price difference and temporary estimation adjustment, written Confirmation of Site Instructions and engineering claims, Investigation and auditing of final accounts for completed projects, final accounts, auditing of final building cost
<b>E-business</b>	Leading implementers of ICT and an early adaptor of project intranets, has a standalone capability called Technology Solutions, actively working towards integrating cost and project management services with BIM. Software used includes BIM machine tool, take off applications, primavera [P6] among others	Whole process investment management software developed by the company to facilitate e-business
<b>Internationalisation</b>	Internationalisation is critical because of having a client focused strategy to work with large global clients. Well established in Europe, Asia, Middle-East and America.	Very keen and partnered with CECA and actively involved many international events and conferences to learn international practices of cost management from other countries, but perceived high cost in such operations limits the process for the company. The company also has the view that foreign projects are less profitable due to high costs. Further, issues of finding and dealing with international clientele inhibit its ability to internationalise



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## Cost and Commercial Management Process

Cost and Commercial Management Process model and Engineering Cost Process model developed through this research are presented in Figure 6 and Figure 7. The main highlights of the differences between the two systems are given below:

- The manner in which cost and commercial management services are provided is different. It is common practice in the UK that the cost management consultancy services are delivered by single cost management practice also known as Professional Quantity Surveying (PQS) firm while in China it is heavily fragmented and regulated through a service specific licensing system for the Engineering Cost firms such as Engineering Consulting, Engineering Cost, Tendering Agent, Public Procurement and Construction Supervision. Accordingly, if a company possesses all the licenses then they can be the sole company who delivers the entire Cost Engineering services to a project, otherwise more than one company will be involved in the cost management functions.
- There are two parallel cost control processes exercised within the Cost Engineering system; one by project consultant/QS and the other by an independent consultant/QS company – which is known as project auditing. Often the client has their in-house team to deliver the Engineering Cost (EC) services and then it will be audited by another independent EC company to make sure due process.
- Many Cost Engineers in China are still using the traditional pricing method: the quota system to price BQs and for estimating, which is akin to resource based estimating. In contrast, UK utilises a risk based market oriented estimating and pricing system supported by well-defined cost management processes such as NRM facilitated through cost information systems such as BCIS.
- The procurement process classification has some similarity though the numbers of stages are different. In China the early stages are more broadly classified indicating the limited involvement of the EC professional at early stages of a project compared to UK. In the UK, the QS is often involved from the early inception of a project.
- Construction, Handover and Closeout and In-Use stages are very similar where interim valuations, cash flow forecasting, claims management, and final accounts are the major service delivered in both the systems.

## Conclusions

The UK-China CCCM framework will bring about several benefits to the surveying profession in the UK and the Engineering Cost profession in China. It will facilitate cost consultancies of both countries to explore markets enhancing bi-directional professional mobility. Professionals who wish to expand their business operations can achieve a good understanding of the cost management operations of both countries enabling them to bid for work or move between countries and regions where similar practice exists.

The CCCM framework will facilitate surveying practices to penetrate the fast growing construction industry of China. It will enable the RICS to further expand operations in China and to collaborate with CECA for mutual benefit. It will also help CECA and EC firms in China to better understand the advanced and mature cost and commercial management practices of the UK.

It is anticipated that this research will provide huge benefits for all stakeholders. The key benefits can be summarised as:

- Better understanding of differences between UK Quantity Surveying System and China Engineering Cost System
- Provide the basis for the mutual recognition or articulations of the qualifications of the two institutions (RICS & CECA)
- Mutual understanding of the scope and range of core cost and commercial management services in the two countries and to promote exchanges and cooperation of professionals of both countries
- Cost and commercial management business case studies (three each from both UK and China) showcase service profiles and business models of companies providing and in-depth understanding of the levels of operation
- Provide opportunities for cost consultancies in both countries to expand and enhance their global competitiveness.

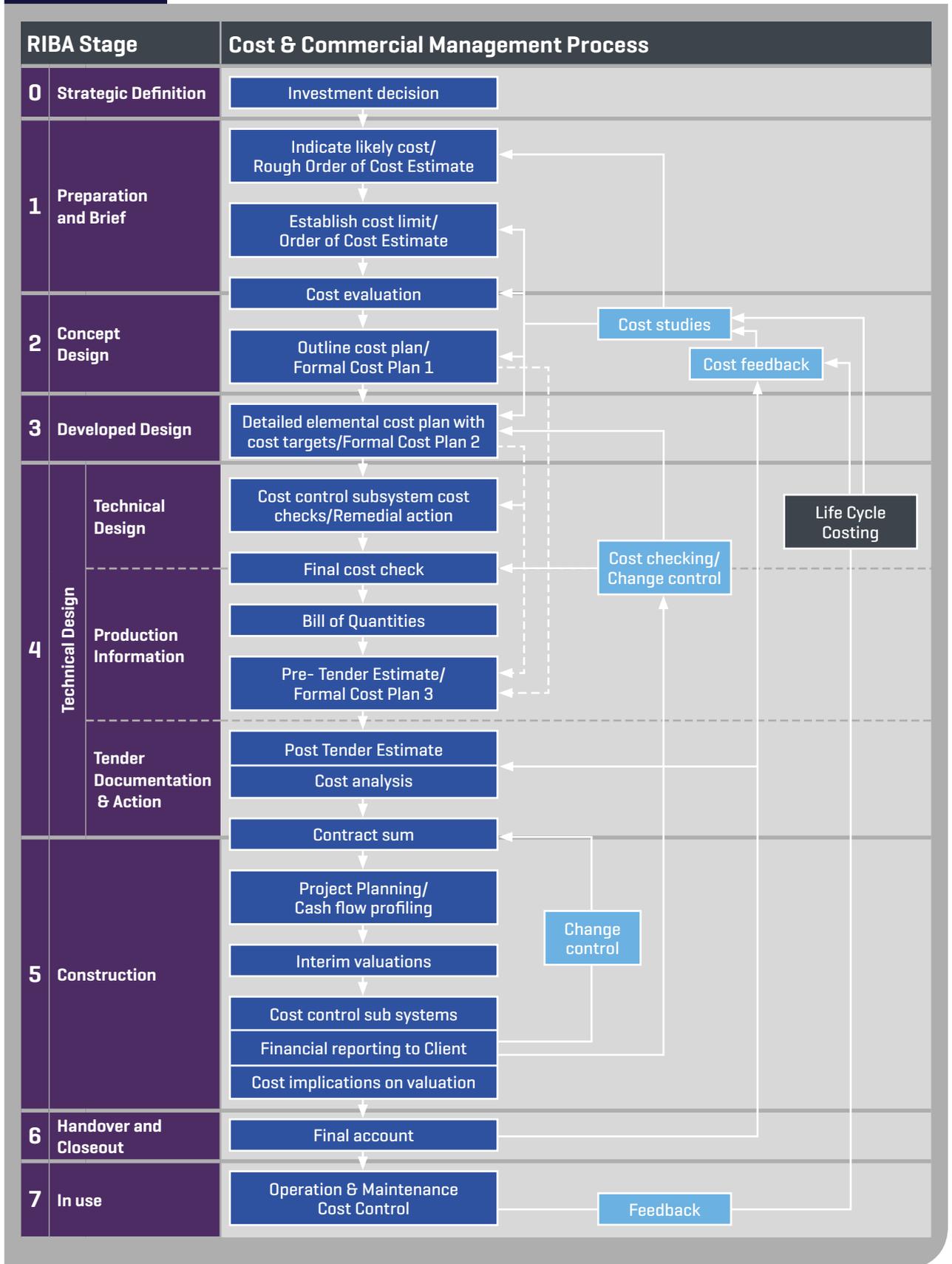
## Final Recommendations

This research compares the two of the most popular mainstream cost management systems in the world promoting construction cost management consultants to better understand complex client needs. It helps them to increase their global competitiveness and business proves. It will be a catalyst for sustainable development and effective cost management innovation in both UK and China construction industries.

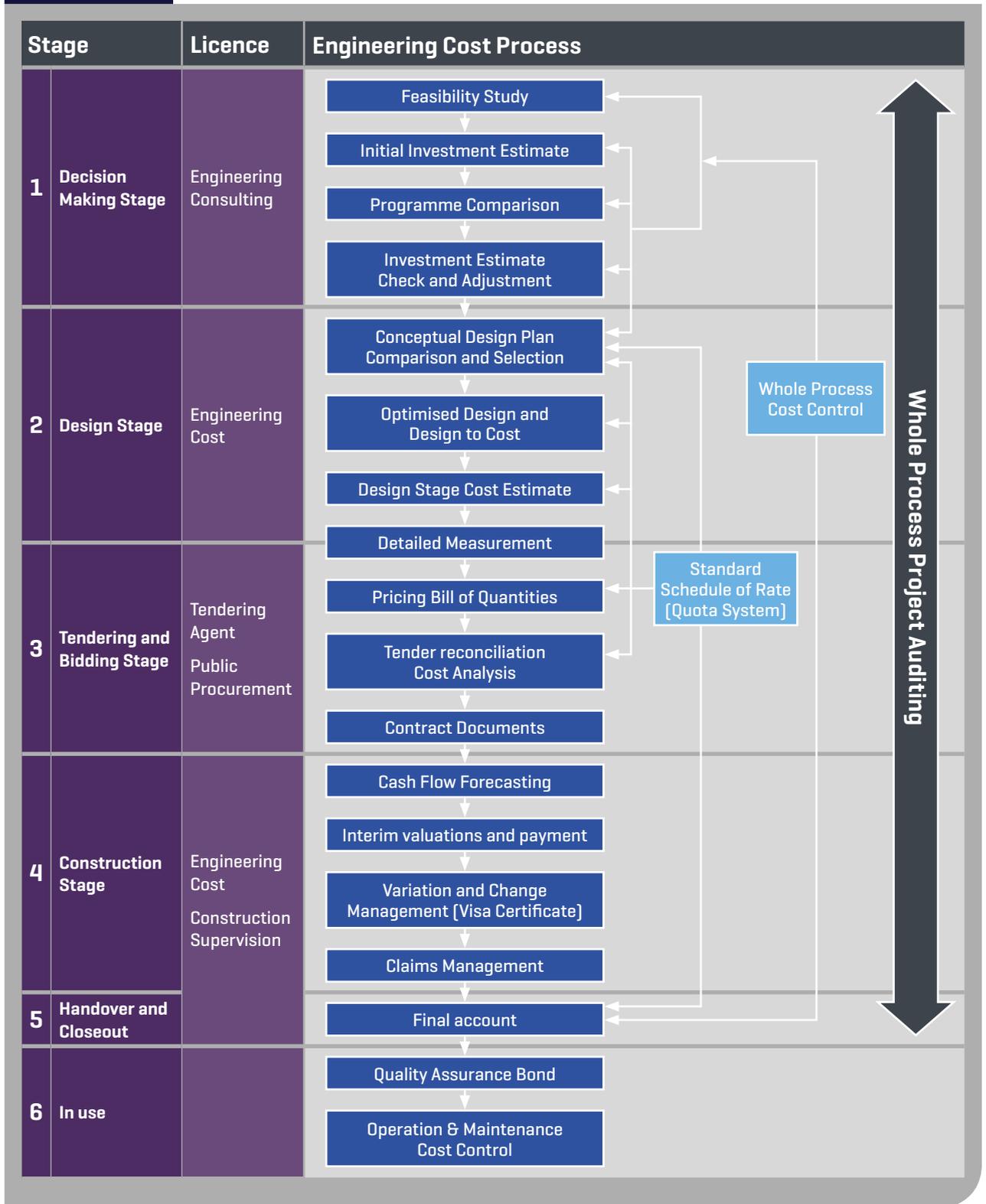
The report clearly indicates that there are significant differences in the practice of cost management services in the two countries. As such it is recommended that there should be greater in depth studies of the two systems. There are a plethora of publications documenting the UK quantity surveying systems both within RICS and in terms of accepted standard text. However, there are a limited number of such documentation or English translations of such documentation on the Engineering Cost system of China. Therefore, it is highly encouraged that there should be greater research and publication of the EC practice in order to increase awareness of processes and operations of the Chinese construction industry.

It also strongly recommended that there should be closer cooperation and knowledge exchange between the RICS and CECA as two world leaders in cost management. There is much to gain for both institutions through collaboration in understanding respective practices and processes. This would lead to better mutual understanding and greater economic collaborations between cost management practices of the two countries.

**Figure 6** Cost & Commercial Management Process (CCMP): UK – Overview



**Figure 7** Engineering Cost Process (ECP): China – Overview



# 1.0 Introduction

## 1.1 Background

The role of the Quantity Surveyor (QS) has evolved over the years since its origins in the mid-19th century and the development of the QS service profile is well documented in Cartlidge (2002). Quantity Surveyors play a key role in the construction industry, and deliver construction cost and commercial management services to clients in both public and private sectors (Lowe and Leiringer, 2006). Other proponents (Perera and Pearson, 2011) in this area have suggested that competent quantity surveyors must have a range of skills, knowledge and understanding which can be applied in a range of contexts and organisations. Consequently, the roles and activities of quantity surveyors have now become extremely diversified and the skills have been enhanced to meet the needs of a diversifying and eco-conscious clients (Ashworth and Hogg, 2007). However, Quantity Surveying in its name exists mainly in the British Commonwealth whereas in Europe they are known as Construction Economists. In the US, China and Russia, Cost Engineers perform the core functions of the British QS.

The Chinese Engineering Cost system evolved from the former Soviet Union with the introduction of a fixed price system. The establishment of the market economy in 1978 resulted in a boom in construction. In order to better regulate and standardise the market-oriented cost engineering profession the China Engineering Cost Association (CECA) was established in 1991. Influenced by the successes in British QS systems the Ministry of Construction in China launched a Bill of Quantities System in 2003. Since then, there has been significant growth in cost management consultancies catapulting the Chinese engineering cost profession to the forefront of the construction industry.

Although there are a few QS consultancies opened their branches in China, the rest of the industry has limited knowledge about the developments in the Chinese construction industry. The recent RICS research led by Ding and Smith (2012) concluded that Chinese cost management services are shifting from Russian Cost Engineering system to British Quantity Surveying format and that the RICS could play a key role to influence this change. However, Ding and Smith's study did not examine the difference between UK and China system and their current practices. The absence of such a process comparison limits the ability of UK construction companies to penetrate the vast Chinese industry. The underlying business models of construction organisations in the two countries are not well understood making it an unavoidable barrier for the entry into the market and professional mobility.

## 1.2 Aim & Objectives

In response to the knowledge gap identified, this research aims to further explore and develop a comparative cost and commercial management framework for UK and China providing vital information for market penetration and professional mobility. The research aim consists of the following key objectives:

1. Review the profile of the Engineering Cost profession of the Chinese construction industry;
2. Develop a detailed procurement process protocol, mapping the cost and commercial management operations of the two countries throughout the procurement cycle;
3. Compare RICS and CECA's professional body structures, qualification pathway, accreditation, education and training systems;
4. Compare and analyse the business models and professional service profiles of cost consultancy and commercial management practices in UK and China;
5. Review and forecast the latest development of cost and commercial management trends in both countries;
6. Develop a construction cost and commercial management services mapping framework to enhance the mobility of Quantity Surveyors and Cost Engineers.

A three-phased research approach was employed which consisted of detailed literature review of cost and commercial management operations followed by a review of professional body profiles and a final phase of reviewing the business models and operations of the two countries. The culmination of the research is the development of a comprehensive UK – China comparative cost and commercial management framework.

## 2.0 UK Quantity Surveying System



### 2.1 Construction Procurement

#### 2.1.1 Introduction

Construction outputs are one-off finite pieces of work with fixed start and end dates; clear objectives (Ried, 1999); said to be unique in nature; range from simple to complex and from small to large. Hence, forms an infinite range of combinations which require appraisal to evaluate the most appropriate procurement route and the establishment of a project management infrastructure (Hamilton, 1997). The total development of a project normally consists of several phases requiring diverse ranges of specialized services (Clough and Sears, 1991). The activities pass through successive and distinct stages that demand inputs from organisations and professionals like financial organizations, government agencies, engineers, architects, surveyors, lawyers, insurers, contractors, suppliers and tradesmen. During the construction process, the relationship and sequence of these activities are presented in the form of a network. Each activity requires a certain amount of resources which may include time, labour, material, or

money (Woodward, 1997; Hamilton, 2001; Hughes et al., 2006), as well as information. It is necessary to divide the total project into a number of identifiable phases in order for it to be manageable and understandable. There are two main ways of defining phases of construction projects in the UK: RIBA Plan of Work and OGC Gateway Review Process. However, this research focuses on the RIBA Plan of work as the most established process classification in UK construction procurement.

#### 2.1.2 RIBA Plan of Work

RIBA plan of work was first developed in 1963 and has been used as the most popular model in the UK for delivering the design and construction process of a building project (RIBA, 2013). It has been widely used in building projects as both a process map and a management tool, providing important work stage reference points for contractual, appointment documents and best practice guidance (RIBA, 2013). The latest version of the RIBA plan of work has just been recently released (i.e. RIBA, 2013) and it supersedes the RIBA Outline Plan of Work 2007.

Figure 2.1

RIBA Plan of Work 2013



Although the two might initially appear to be different; the use of stages and task descriptions has not been altered fundamentally.

RIBA plan of work 2013 was developed as fit for purpose document for the construction industry in the 21st century to help deliver capital and operational efficiencies, carbon reduction and better briefing. The RIBA plan of work 2013 brings together the briefing, designing, constructing, maintaining and operating in a continuous cycle (see Figure 2.1) into a number of key stages (RIBA, 2013). The idea of the continuous cycle is to help improve feedback from completed projects and to inform subsequent projects. It is argued that this version recognises the processes that a building project goes through and promotes the importance of capturing and reusing information/knowledge about completed projects. RIBA (2013) further reports that the new version brings together the tasks and outputs required at each stage, which may vary or overlap with specific project requirements. The current version improves on

the previous versions by incorporating issues addressing; all sizes and types of projects, all forms of procurement, usage by the whole project team and the flexibility of using planning procedures. The current version also addresses the 21st century challenges of integration of sustainable design processes and the use of BIM processes. It can be deduced that the current version is simple, adaptable and has been developed to be used both online and manually.

The RIBA plan of work 2013 is made up of eight stages numbered from 0-7. It also consists of eight task bars of which some of the task bars are fixed and some are variable or selectable. Although, the RIBA plan of work 2013 might initially appear different to the old version, its use of stages and task descriptions are fundamentally the same. It is argued that these project stages and tasks are vital because the stages act as milestones for agreeing deliverables, establishing fee agreements and determining the activities of the many parties involved in the briefing, design, construction and supporting activities of the project.

## 2.2 Procurement Strategies

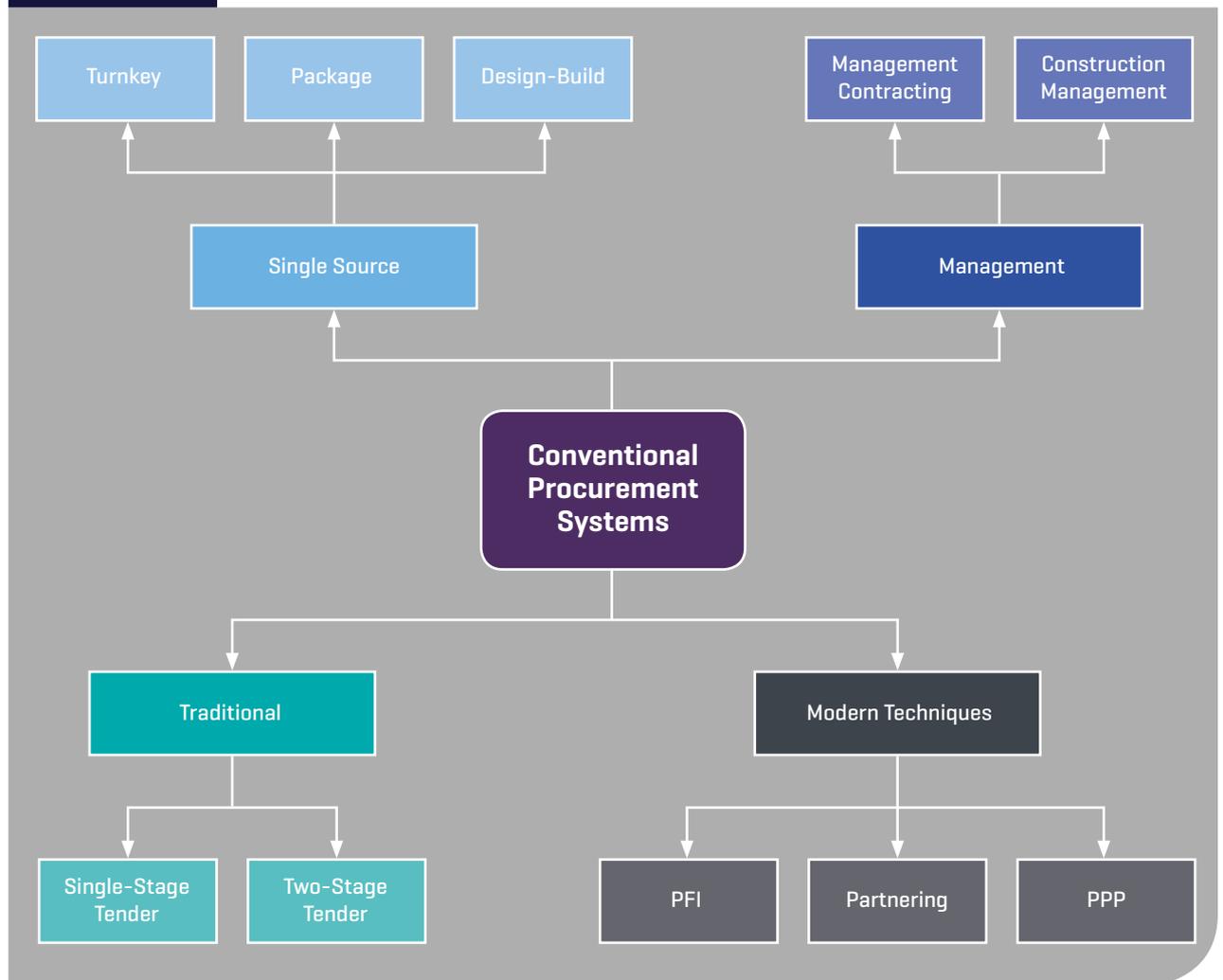
The term procurement can be defined as the process by which the necessary contributions of the various stakeholders in the supply chain are secured. It reflects the different organizational and contractual arrangements, which can be made to ensure that appropriate contributions are properly commissioned (Franks, 1984). Choosing the procurement system is a fundamental decision, which determines how roles, responsibilities and risks are shared between stakeholders involved in a project.

There are several types of procurement options; the key is to gain sufficient understanding to be able to recognize what is appropriate for a particular business situation. These methods vary from traditional single-stage selective tendering, where a client uses a designer to prepare drawings and documentation on which contractors are

invited to submit competitive prices, to schemes where a single construction firm will provide the design and build service, the turnkey project. Some methods have been devised to get the contractor on site as quickly as possible, such as two-stage tendering and fast tracking, with the anticipation that the contractor will also complete the works sooner than by using the traditional approach.

Other methods have recognized the contractors improved management skills and their influence on the whole construction process. Some methods have brought about private sector finance to large scale public sector projects through framework and partnering agreements, the Private Finance Initiative (PFI), Public Private Participation (PPP), Joint Ventures and Build Operate and Transfer (BOT) have emerged. The most common classification includes: traditional, design and build, management methods and novel techniques (i.e. PFI, PPP, etc.) (see Figure 2.2).

**Figure 2.2** Conventional Procurement Options



## 2.3 The role of the Quantity Surveyor in the UK

### 2.3.1 History of the Quantity Surveyor

The first reference to the modern day role of Quantity Surveyor (QS) could be found in the Bible in the book of Luke 14:28 which says: *“Suppose one of you wants to build a tower, will he not first sit down and estimate the cost to see if he has enough money to complete it”*.

Prior to the first recorded usage of the term “quantity surveyor” in 1859, the terms “measurer”, “custom surveyor” or “surveyor” were used. Quantity surveying profession has been an integral part of the UK construction industry for around 170 years. It evolved from the middle of the seventeenth century (Seeley and Winfield, 1999; Ashworth, Hogg and Higgs, 2013) and officially established as a profession as part of the establishment of Royal Institution of Chartered Surveyor in 1864.

Historically, the QS was often not appointed until the architect designs the building and prepares the drawings. The QS will commence work on the Bill of Quantities and other formal tender documentations. However, today, the QS is generally appointed before any other professional consultant accepts responsibility for the client’s financial interests in the projects (Kirkham, 2007). Quantity surveying became an important function within the construction industry as it enabled to achieve value for money and where budgetary control expertise was the core duty of a quantity surveyor (Seeley, 1997).

There are several reports which have examined the role of a QS and the core competencies. The Future Role of the Quantity Surveyor (1971) was based on a questionnaire sent to all firms in private practice together with a limited number of public sector organisations. The report identifies the quantity surveyor as, primarily a producer of bills of quantities; indeed, the report concluded that the distinct competence of the quantity surveyor of that time was measurement (Cartlidge, 2013). The challenge for change: QS Think Tank (1998) was drafted in a business environment driven by information technology, where quantities computation regarded as a low-cost activity and the clients seemed demanding added value from quantity surveyors in addition to traditional role of measurement (Cartlidge, 2013).

Cartlidge (2011) described that the golden age for quantity surveyors was the period between 1950 and 1980, when bills of quantities were the preferred basis for tender documentation and the RICS scales of fees were generous and unchallenged. Today, Quantity surveyors are recognised as professional cost consultants in the construction industry. They are the industry’s experts on building costs and assist clients/employers to make a range of economic decisions. The role of the quantity surveyor (QS) has also changed dramatically and many have moved on from contractual and financial management of projects to embrace the key role as the client’s construction manager/project manager (Potts, 2008).

### 2.3.2 The Traditional Role

Conventional quantity surveyor offers cost advice on alternative design solutions and advice on the cost implications of the design morphology and procurement (Ashworth and Hogg, 2007; Kirkham, 2007). Further, quantity surveyors are expected to be assisting the design team on all cost implications of the project under consideration. In addition, cost planning is another important role of a quantity surveyor where he plans the cost of the project by breaking down cost into major elements and sub-elements consecutively based on historical data from cost library records. Later on, the tender and contract documents may also be prepared which in turn facilitates easier preparation of the cost analysis (Ashworth and Hogg, 2007).

Traditional quantity surveying activities listed by Ashworth and Hogg (2007) includes: single rate approximate estimates, cost planning, procurement advice, measurement and quantification, document preparation, especially bills of quantities, cost control during construction, interim valuation and payments, financial statements, final account preparation and agreement and settlement of contractual claims.

Preliminary estimates (order of cost estimate) of projects are prepared based on single rate estimating methods at the initial stage and if the estimated cost lies within client’s budget then the project progresses and detailed designs will be prepared. Subsequently, the quantity surveyor will produce bills of quantities for tendering purposes. Works are measured and paid progressively having bills of quantities as a benchmark and on completion final accounts will be prepared (Ashworth and Hogg, 2007). During the 1960s, cost planning duties performed by the quantity surveyor ensured that the tenders received were not overpriced. The contractor’s quantity surveyor is expected to work in conjunction with the PQS on the preparation of interim payments and final account safeguarding financial interest of the contractor (Ashworth and Hogg, 2007). Occasionally, contractors forward additional claims for the works carried out in addition to what is in the contract (Ashworth and Hogg, 2007).

### 2.3.3 The Developing Role

As the industry evolved, more value added services were expected from quantity surveyors. For instance, whole life costing, value management and risk analysis and management emerged as other roles of quantity surveyor which add value for the client (Ashworth and Hogg, 2007). Today, quantity surveyors are viewed as financial managers of the construction team who add value by monitoring time and quality while achieving budget. Therefore, traditional role of QS has changed immensely and now QS is responsible for discovering a long-term vision of building projects, assessing alternative options and providing clients with valuable information to make informed investment decisions (Kirkham, 2007).

The RICS identifies that Quantity Surveyors may be working as consultants or working for a contracting or engineering company in the following areas (RICS, 2002):

- Preparing development appraisals for different sites, assessing the effects of capital and revenue expenditure, life-cycle costs, grants and taxation implications;
- Advising clients on the project brief, preferred procurement routes, costs and cash flow;
- Analysing the whole-life costs of a project;
- Planning the construction process;
- Monitoring and control of cost during the pre-contract stages;
- Preparing tendering and contractual documentation, leading to tender selection and appraisal;
- Following the letting of the contract for the project, advising on payments to contractors and post-contract cost control, settlement of final account;
- Controlling a project on behalf of their employer;
- Negotiating with the client or subcontractors;
- Reporting on programme and financial matters;
- Risk and Value Management (RM and VM);
- Giving contractual advice for either party in the case of dispute.

On the other hand, Quantity Surveyors are increasingly developing better client focus to be aware of the ways in which a particular client perceives or even measures value (Duncan, 2011). Moreover, the new paradigm of software-centred service delivery has irrevocably changed the way that cost planners work in professional QS and cost consultancy practice (Kirkham, 2007; Potts, 2008).

Cost management is embedded into the whole development process, which is necessary to ensure that the planned development of a design and procurement of a project is such that the price for its construction provides value for money (VfM) and is within the limits anticipated by the client (Potts, 2008).

The forthcoming sections examine the quantity surveyor’s role in pre-contract and post-contract stages and compare the different roles between professional quantity surveyors and contractor’s quantity surveyors.

### 2.3.4 Pre-Contract Cost Management

Pre-contract estimating sets the original budget – forecasting the likely expenditure to the client. The budget should be used for the purpose of ensuring that the design stays within the scope of the original scheme (designing to cost) (Potts, 2008).

According to Potts (2008), cost control tasks and deliverable required from QS within the RIBA plan of work stages presented in Table 2.3.

#### 2.3.4.1 Feasibility Stage

Traditional cost planning begins at the conventional outline design process. In a practical sense, the cost planning process starts with the development of an initial cost figure to help the client to decide whether the project is feasible (Kirkham, 2007). This feasibility estimate is usually calculated on a unit cost method (e.g. cost per bed for a hospital, cost per student for a school). The estimate is then refined using the elemental method: the building is broken down into its major component elements and sub-elements, usually using the Building Cost Information Service (BCIS) cost structure.

**Figure 2.3**

**Cost Control Tasks and Deliverables Required from QS**

Stage		Tasks
Stage B	Feasibility	Prepare feasibility studies and determine the budget
Stage C	Outline proposals	Consider with client and design team alternative strategies and prepare outline cost plan
Stage D	Scheme design	Carry out cost checks and finalise cost plan
Stage E	Detail design	Carry out cost checks
Stage F	Production information	Carry out cost checks
Stage H	Tender Action	Prepare reconciliation statement

The technique of elemental cost planning on buildings was established in late 1950s. The technique enabled the client to obtain a more reliable pre-tender estimate and gave the design team a yardstick to control the cost during the design development stages. The technique is well established in the building sector and has been further developed by the Building Cost information Service of the RICS (BCIS) to include a national database of elemental cost analyses, which can be accessed using online computer techniques (Potts, 2008). The NRM1(2012) published by the RICS has further refined and standardised this process with starting the process with Order of Cost Estimate followed by Cost Plans at different stages of design.

### 2.3.4.2 Design Stage

In the design stage, the QS assists the design team on cost rather than costing a design (Ashworth and Perera, 2015). It is also recommended that value management and risk management are also carried out throughout the design process (Potts, 2008). On D&B schemes, the client's QS is responsible for the cost plan at outline proposal stage and the D&B contractor's QS is responsible for developing the cost plan with the contractor's design team to prepare the tender (Potts, 2008). However, at the design stage the quantity surveyor needs to be aware of the drivers for sustainability and the impact these have upon capital and life cycle costs, as well as the technical requirements of sustainable buildings, so that these are developed into realistic costs and not arbitrary percentage additions.

### 2.3.4.3 Cost Checking

All estimates should be communicated to the client and the design team clarifying what is included and excluded in the estimate. Such estimate should be a discussion document for design optimization (Potts, 2008). In order to confirm the accuracy of the cost plan, as well as to ensure the developed design is within the established budget, cost checking is deployed. Cost checking is the execution of the cost-control component in the design process (Potts, 2008).

### 2.3.4.4 Measurement & Bill of Quantities

The UK standard Method of Measurement of Building Works has been used as the basis for methods of measurement and preparing bills of quantities. The seventh edition (SMM7) was published in 1988 as a joint publication between the RICS and the Building Employers' Confederation (BEC) and was revised in 1998. This is now superseded by the NRM2 published in 2012.

## 2.3.5 Post-Contract Cost Management

The post contract phase marks a change in the cost management process where the emphasis moves from planning to control. Cost management means understanding how and why costs occur and promptly taking the necessary action based on all the relevant information available (Potts, 2008). The successful execution and completion of the post-contract procedures and the final account very much depend on cooperation between the client's quantity surveyor and that of the contractor (Ashworth and Hogg, 2007).

### 2.3.5.1 Valuations

The construction industry survives on cash flow where quantity surveyor plays a vital role in maintaining the required flow. JCT 2005 makes clear the duty of the client's quantity surveyor in this respect (clause 4.11). Interim valuation shall be made by the quantity surveyor whenever the architect/contract administrator considers them necessary for the purpose of ascertaining the amount to be stated as due in an Interim Certificate.

### 2.3.5.2 Valuing Variations

The traditional method of valuing variations, both on building and civil engineering works, is to base the valuation of the variation on the rates or prices contained within the BoQ or schedules of rates. The rates may be pro-rated only when there are no other options available for a fair valuation. The approach of valuing variations often lead to disagreement between the parties where the client's QS wishing to strictly adhere to the rates in the bill and the contractor wanting the rates to reflect the true cost as incurred or likely to be incurred. Variations are inevitable on building and civil engineering projects and if not managed properly, may range from small changes having little consequential effects to major revisions having major impact on budget, which result in considerable delay, and or disruption to the project (Potts, 2008).

### 2.3.5.3 Claims Management

Claims are inevitable on most large scale construction projects. Claims are usually initiated by the contractor or subcontractor in anticipation of spending or where they actually have spent more than they expected as a consequence of actions beyond their control. In such case, the client's quantity surveyor needs to quantify the claim in terms of: on site establishment costs, head office overheads, interest and financing charges, increased costs, profit, loss of productivity/winter working and cost of claim preparation.

### 2.3.5.4 Final Accounts

The culmination of all interim payments to the contractor is the final account. The client's quantity surveyor needs to finalise the submitted final account with the agreement of the main contractor. This settles all project related costs.

### 2.3.5.5 Audit

It is believed that the main outcome of an audit is, whether it is of a company balance sheet, profit and loss account or the final account of a construction project, is to detect errors or more importantly fraud. An audit of a final account, or any account, involves the examination of the account and the supporting documentation and more importantly the designated procedures involved. This enables an auditor to report that the account has been prepared to provide a true and fair view of the account (Ashworth and Hogg, 2007). The auditor will compare the final account with contract bills, examine the records available, discuss aspects with relevant staff, examine the procedures used and prepare a report on the findings.

## 2.3.6 Commercial Management

Commercial Management is defined as 'the management of contractual and commercial issues relating to project, from project inception to completion' (Lowe and Leiringer, 2006). It is believed that commercial management is a bridge between traditional project management and organisational theories and focuses more on the business and financial management of the on-site construction process. In the UK construction industry, most authors (Cottrell, 1978, Walkers and Wilkie, 2002, Lowe and Leiringer, 2006, Towey, 2012) agreed that Contractor's Quantity Surveyors have graduated into commercial managers' role. RICS also has defined the commercial management of construction (T10) in its competency definitions (RICS, 2010). They consider it as financial management of construction projects including regular monitoring and reporting on cash flow and profitability, evaluate and advise on financial implications and appropriate management action.

### 2.3.6.1 Role of Commercial Manager

In comparison to professional quantity surveyor as the cost consultant for the client, the contractor's quantity surveyor have diversified their career more into the management role of post-contract activities (Towey, 2012). Generally, the role of commercial management can be described as project valuation, change management, financial accounting, and financial control of the project and subcontractor administration (Pearson, 1996, Lowe and Leiringer, 2006). Walker and Wilkie (2002) categorises commercial management in construction into budgets and forecasting, interim valuations, subcontractor management, cost value comparisons, contract management, and teamwork and partnering.

In a similar way Towey (2012) lists the roles of a commercial manager in commercial activities of a business as below:

- Marketing and business development for company expansion
- Contract negotiations including reviewing conditions of pending awards
- Property management
- Supply Chain management include vetting and administration of their contracts
- Cost management projects and
- Management of business overheads

Lowe and Leiringer (2005) investigated the role of commercial managers cross three industry sectors: construction, telecommunications/ICT and defence/aerospace and found that the commercial manager in the construction sector is mainly in charge of the contract administration activities and project execution. Their study identified twenty eight functions as the potential competencies of commercial management and confirmed that the main attributes of commercial management includes: Contract formulation and negotiation, Dispute resolution, Bidding & price formulation, Cost management: CVR, cash flow, payments & claim formulation.

### Contract Formulation and Negotiation

Ramus et al. (2006) suggested that Quantity Surveyors have to demonstrate their expertise in use of standard forms of contract, and provide advice on contractual matters. When working with the contractors, QS need to prepare the contract documents, represent the contractor at the bidding stage and be ready for the execution of the contract.

### Dispute Resolution

Disputes and conflicts on construction project are inevitable. They are time consuming, expensive and unpleasant. However, it is the duty for quantity surveyor's to manage the conflicts and deal with any dispute resolution.

### Bidding & Price Formulation

One of the key roles of commercial manager is to win new contracts, thus they need to prepare effective and competitive tendering documents while being familiar with the bidding process, estimating and price formulation. In order to do that, quantity surveyors need to price a bill of quantities or a specification by using a unit rate. The estimates need include labour, material and plant costs, overheads and profit.

### Cost Management

The application of Cost Value Reconciliations (CVR) or comparisons is an important element in cost management of construction projects (Walker and Wilkie, 2002). This is a main task for contractor's quantity surveyor. It deals with comparison of project profitability and turnover against budget and forecast figure; as well as monitoring of project performance in terms of labour, plant and material

costs against original tender figures. It is important to be in line with general performance and tender levels of other similar projects. The quantity surveyor also needs to look after the cash flow, conduct interim valuation and manage any other payments and claim formation.

### 2.3.7 Difference Between PQS and CQS

A QS who represents a client organisation is often known as a professional quantity surveyor (private practice QS or PQS), and a QS who work for construction companies is known as contractor's quantity surveyor (CQS) (Kirkham, 2007).

### 2.3.8 Contractor's Estimating and Tendering

Contractors generate small percentage of profit margins between 2% and 7%, from large annual turnovers. This would result in substantial risk to any contractor with thin margins and without an effective company-wide cost control system (Potts, 2008). The three main types of contractor's project cost-control systems are as follows:

1. Cost-value reconciliation (used by building contractors)
2. Contract variance – unit costing (used by civil engineering contractors)
3. Earned value analysis (US approach/used on major projects)

The contractor's surveyor will be representing their own employer's interests. Sensible contractors have always employed quantity surveyors to look after their commercial and financial interests, and have particularly relied upon them in the more controversial contractual areas (Ashworth and Hogg, 2007).

Contractors employ quantity surveyors to ensure that they receive the correct payment at the appropriate time for the work carried out on site. In practice the quantity surveyor's work may embrace estimating and the negotiation of the new contracts, site measurement, subcontractor arrangement and accounts, profitability and forecasting contractual disputes and claims, cost and bonus assessment, site costing and other matter of a management and administrative nature. The Code of Estimating Practice the Chartered Institute of Building (CIOB) defines estimating as 'the technical process of predicting costs of construction' and tendering as 'a separate and subsequent commercial function based on the estimate' (CIOB, 1997).

#### Stage 1 – Decision to Tender

The first stage in the tendering process is the decision to tender. As soon as the tender documents are received the estimator should quickly skim through the document in order to review and complete a pre-tender data sheet, grade the tender based on the interest of the company and recommend whether to tender for the project. Then, prediction of the net cost of the works is carried out by a well-equipped team comprising the estimator, planning engineer, materials estimator, estimating technician,

together with possible contributions from temporary works designers and an experienced construction manager. At the end of the process, the team will produce the cost estimate. The estimate will be the prediction of the cost to the contractor (Potts, 2008).

#### Stage 2 – Determining the Basis of the Tender

During this stage, the estimator will disseminate and assemble the key information and generally become familiarise with the documents. The estimator's tasks can be summarised as: examine key documents: drawings/specification/BoQ (work information, site information, contract data); send enquires to major subcontractors and materials suppliers; check significant quantities in the BoQ; Plan the method of construction and the outline programme of the works: examine more economical alternative designs, design temporary works and any necessary permanent works; identify inherent restrictions; visit engineer's office – examine core samples; visit site – compile site-investigation report.

#### Stage 3 – Preparation of Cost Estimate

During this stage the estimator will incorporate information on the net cost of the works including calculating the following: the current rates for labour, materials and construction equipment, the unit or activity rates, the preliminaries or general items and finally the summaries.

#### Stage 4 – Commercial Appreciation

Following the production of the cost estimate, a small management team, comprising the chief estimator and proposed contracts manager, will make a separate comprehensive evaluation of the estimate to ensure that the bid is both feasible and commercially competitive.

#### Stage 5 – Conversion of Estimate to Tender

The second task of the senior management team at the tender committee meeting is to convert the estimate into the tender bid. The items that are considered and agreed upon includes: the financial adjustment to be made following the commercial review; the allowance for discounts on subcontractors and suppliers; late quotations, these could be included as an adjustment item at the end of the tender; the contribution for head office overheads – usually between 4-8%; profit, normally on what the market can stand; and qualifications to the bid, if any.

#### Stage 6 – Submission of Tender

Finally, the tender should be submitted to the client in accordance with the forms specified in the invitation letter, arriving at the correct address at the right time.

The BoQ system had been in use for over one hundred years and if correctly used may have many positive features. It demands that the works were substantially designed prior to tender. However, in practice, the BoQs were often prepared based on incomplete information creating a false sense of security for the client who carries the risk for any errors or omissions in the original measurement (Potts, 2008).

## 2.4 Tools and Techniques in Cost Management

**Table 2.4** Cost Management Techniques through Different Stages of Design Development

Stage	Tasks
Preparation and Brief	Preliminary estimating Interpolation, Single rate estimating – unit, area
Concept Design	Cost planning Single rate estimating – unit, area, cube, storey enclosure
Developed Design	Cost planning, checking & controlling Multi rate estimating - Approximate quantities estimating, elemental estimating
Technical design	Cost checking & controlling, cost analysis Elemental cost planning, Bills of Quantities, Elemental cost analysis [BCIS]

### 2.4.1 Early Stage Estimation

#### 2.4.1.1 Traditional Cost Management Process

There exist various cost estimation and management techniques at early stages of a project. The Table 2.4 lists the traditional cost management techniques throughout different stages of design development.

From Table 2.4 it can be noted that preliminary estimating and cost planning are used as early stage cost estimating & management techniques. Preliminary estimating is done at the very beginning of the project where only less information is available. The method used will vary depending on the intensity of the information available which is depicted in Figure 2.3.

On the other hand, cost planning is done from the beginning and it is ensured through constant cost checks that the developed design is well within the established cost targets and remedial actions are taken as necessary as shown in Figure 2.4.

BCIS Standard form of cost analysis is used as a guideline for cost planning though it was not revised for nearly forty years. Therefore, it failed to aid modern procurement systems (RICS, 2014). However, some organisations have their own formats for developing cost plans for a project.

Latest BCIS standard form of cost analysis could be accessed from (BCIS, 2012). This version which is NRM1 compliant is expected to aid pre-contract cost control functions within modern procurement systems as well (RICS, 2014).

#### 2.4.1.2 New Rules of Measurement (NRM)

The NRM suite of standard documents for cost management was introduced as a measure to standardise and regularise the cost management processes used in the construction industry.

It integrates measurement and procurement to maintain consistency following a cradle to grave approach (Cartlidge, 2013; RICS, 2012). NRM suite consists of the following three parts:

- NRM1:** Guidance on cost estimating and cost planning at various stages of the project
- NRM2:** Set down rules for measuring construction projects and preparing Bills of Quantities
- NRM3:** Assists measurement of maintenance works to prepare initial order of cost estimates and also aids in procurement and cost controlling of maintenance works

NRM1 prescribes a comprehensive and systematic approach to early stage cost management. It guides the estimator on how to carry out detailed cost planning and control for a project from inception to completion. The Table 2.5 illustrates the NRM1 process of cost estimating and planning throughout design development.

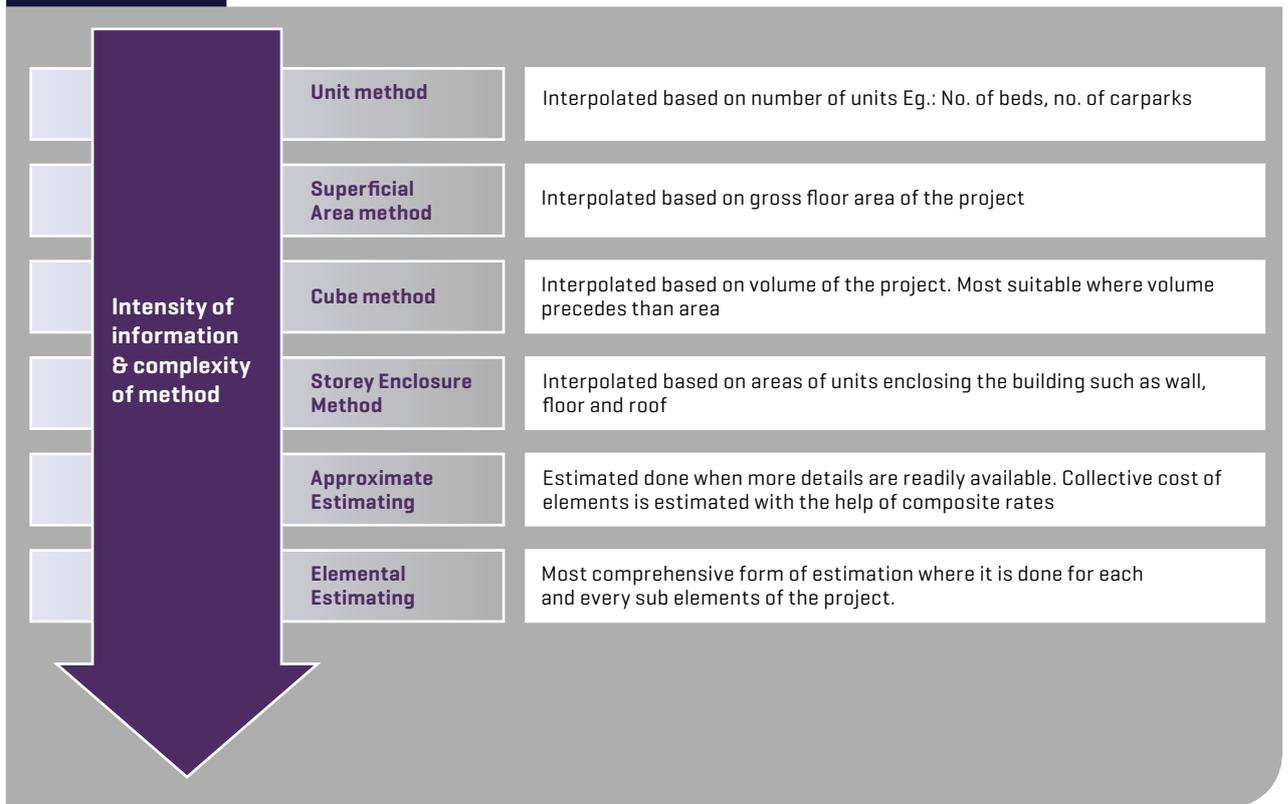
NRM1 categorise cost estimates and cost plans into five cost centres as follows:

- Work cost estimate
- Project/design fee estimate
- Other development/project cost estimate
- Risk allowance estimate
- Inflation estimate

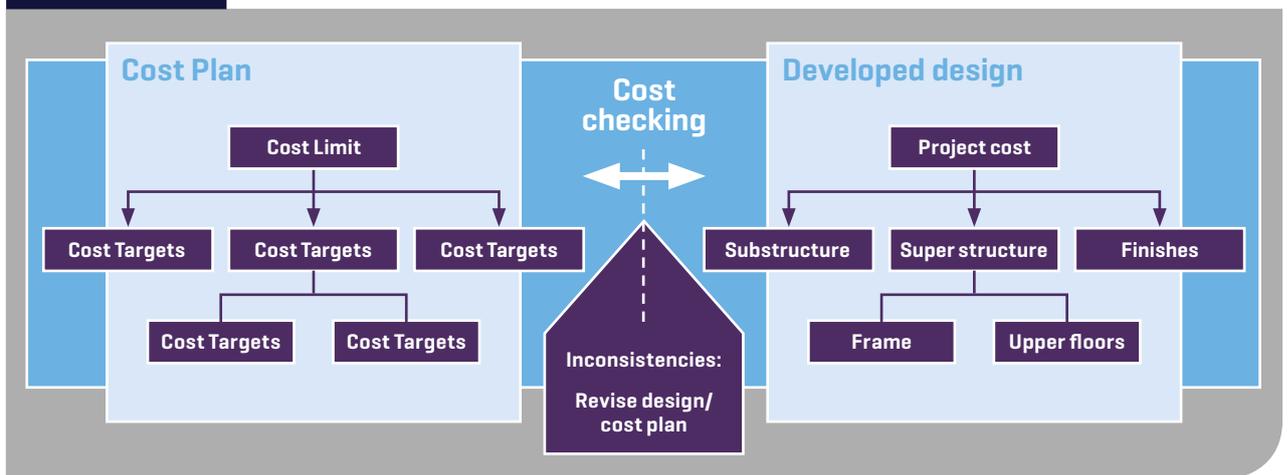
**Table 2.5** NRM1 formal estimation and cost planning stages

Stage	Techniques
Preparation and Brief	Order of cost estimate
Concept Design	Formal cost plan 1
Developed Design	Formal cost plan 2
Technical Design	Formal cost plan 3
	Pre-tender estimate
	Post-tender estimate

**Figure 2.3** Preliminary Estimating Tools & Techniques



**Figure 2.4** Traditional Cost Planning Process



## 2.4.2 Cost Management at Design Development

### 2.4.2.1 Method of Measurements

Method of measurement originated from the need for a standard approach to measurement of quantities for the production of Bill of Quantities. It is the backbone of any bills of quantities and the major cost management tool during design development. The aim of method of measurements includes:

- Uniformity
- Eliminate ambiguity
- Consistency
- Quicker preparation of BOQ
- Easy pricing
- Avoid cost insignificant items

Standard method of measurement (SMM) remains as the prototype to all other method of measurement such as civil engineering measurements (CESMM) which emerged subsequently and recently, New Rules of Measurements (NRM).

### 2.4.2.2 Standard Method of Measurement (SMM)

The first SMM for Building Works was introduced in 1922 based on the practice of leading London based Quantity Surveyors' and through seven versions, was widely used by the industry for nearly 100 years. The latest was the SMM7, the seventh edition which was published in 1988 as a joint publication of RICS and Building Employers Federation (BEF). Controversies between RICS and BEF paved the way for RICS to introduce NRM2 to supersede SMM7 and to retain the sole ownership for NRM2 (Cartlidge, 2011; Cartlidge, 2013).

### 2.4.2.3 New Rules of Measurements 2 (NRM 2)

As discussed above, NRM 2 aids measurement and production of BoQs. NRM 2 was first published in 2012 with effective from January 2013 and formally replaced SMM7 from 1 July 2013.

#### Structure of NRM2

- **Part 1: General** – Introduces the standard – purpose, use and structure; explains measurement of works in context of the RIBA Plan of Work and the OGC Gateway Process; and explains the symbols, abbreviations and definitions used in the rules.
- **Part 2: Rules for detailed measurement of building works** – provides comprehensive information on BoQ; addresses non-measurable works, risks, overhead and profit, cost data and cost management and controlling areas.
- **Part 3: Tabulated rules of measurement for building works** – outlines the tabulated rules for the measurement and description of building works in trade order (41 trades).
- Appendices: additional information and templates are provided as follows:
  - Guidance on the preparation of bill of quantities
  - Template for preliminaries (main contract) pricing schedule (condensed)
  - Template for preliminaries (main contract) pricing schedule (expanded)
  - Template for pricing summary for elemental bill of quantities (condensed)
  - Template for pricing summary for elemental bill of quantities (expanded)
  - Templates for provisional sums, risks and credits
  - Example of a work package breakdown structure.

Table 2.6

Table 2.6 Comparison of SMM7 and NRM2

SMM7	NRM2
Simple and easy to understand	Simpler but overall or composite measurements for some items
No direct link with procurement/cost planning, however, link is provided through Coordinated Project Information document	Integrated with procurement/cost planning
No any additional templates included	Includes useful templates
Limited information about BoQ	Detailed information about BoQ
Less emphasis on trades/sub section	More trades/subsections
Special package contract not identified separately	Special package contract identified separately
Less emphasis on contractor designed work and managing risk	Contractor designed work and managing risk are explained in detail
Less focus on cost management/control functions	Integrated with cost management/control functions through NRM 1 and NRM 3



From Table 2.6 it can be concluded that NRM2 reflects a more comprehensive and cost management oriented version of method of measurement which can aid construction industry professionals, especially Quantity Surveyors, to exercise their cost management functions throughout the lifecycle of a project in a consistent and systematic way. However, the UK construction industry is slow in adopting NRM2.

## 2.4.3 Post Construction Cost Management

Post contract cost management is being one of the prime roles of quantity surveyors in order to ensure that the expenses are in line with the established cost estimates and plans. The following tools are used to manage cost in post contract stage:

- Interim valuation
- Variation accounts
- Claims
- Final accounts

### 2.4.3.1 Interim Valuation

An interim valuation will consist of the components listed below. However, not necessarily all of the following will be present in any valuation (RICS, 2000).

- Work Executed (Measured Work, Approximate Quantities, Preliminaries, Sub-Contracts – Nominated, Sub-Contracts – Domestic, Suppliers)
- Dayworks
- Materials – On Site
- Materials – Off Site
- Fluctuations
- Loss and Expense
- Special Payments
- Deductions

### 2.4.3.2 Variations

There are no specific forms for variation account where the basis for variation account is often derived from BOQ rates or build-up of new rates. It consists of an analysis of unit rates and total cost depicted in BOQ format.

### 2.4.3.3 Claims

There are no standard forms of claims though there are guidelines to be followed when preparing claim documents. Generally a claim should constitute following three sections (Sharma, 2009):

- **Introduction** – provide brief contract particulars, description of the claim, reference to relevant correspondence and notices
- **Ground of claim** – give reference to relevant contract clauses or contract laws which relate to claim
- **Substantiation of claim** – provide supporting evidence such as site records, correspondence, meeting minutes, progress report etc.

This document will be a separate document submitted along with the interim valuation.

### 2.4.3.4 Final Accounts

Final account is the final valuation of a project which includes all expenses incurred by the contractor after deductions. The major difference between interim valuations and final accounts is that it includes payment of retention to the contractor in full or partially (depending on the situation). Final account consists of various elements which need to be presented clearly and systematically including: statement of final account, final account summary, adjustment of variations account, prime cost sums, provisional item and provisional sums, and adjustment for fluctuations and contractor's claim (Cartledge, 2013).

## 2.5 Forms of contract

### 2.5.1 Standard Forms of Contract

A contract is a legally binding agreement to representing two or more parties' obligations and duties (Towey, 2013). Under the Housing Grants, Construction and Regeneration Act 1996, construction contract is defined as *'the carrying out of construction operations; arranging for the carrying out of construction operations by others, whether under sub-contract to him or otherwise; and proving his own labour, or the labour of others, for the carrying out of construction operations'*. The construction contract is a formal agreement between a client (termed as 'employer' in the form) and a contractor for the execution of the works. The contractor may have separate agreement with sub-contractors or other professional services providers.

The participating parties are generally free to choose their own terms of contract. Generally, a standard form of contract is used as the legal basis for a construction contract. Those contracts are normally written by industrial professional bodies and comprised as 'family' or 'suites' of contracts. There are many reasons to adopt a standard form of contracts rather than a 'bespoke' form of contracts, among which most important is the stability and unambiguous nature of interpretations they bring about.

The selection of suitable forms depends on the procurement routes used and the level of risks accepted, this will be suggested by the professional quantity surveyor to the client. Alternatively, experienced clients may select based on their own choice.

The most popular standard forms of contracts used in the UK include the Joint Contracts Tribunal (JCT) forms, New Engineering Contract (NEC) forms, and Fédération Internationale des Ingénieurs-Conseils (FIDIC) forms among others. The latter is mainly used in international construction contracts.

## 2.6 Due Diligence and Auditing

### 2.6.1 Due Diligence

The term 'due diligence' probably came into common usage as a result of the US Securities Act of 1933. The Act included a defence that could be used by broker-dealers when accused of inadequate disclosure to investors of material information with respect to the purchase of securities. Investors and funding institutions seek more independent scrutiny of the major projects (Cartlidge, 2011). Today, Due Diligence becomes a new skill for quantity surveyor and is often appointed as a due diligence coordinator: that person responsible for briefing the teams, controlling and directing the process and acting as a funnel for all information. Equally, it is vital to brief all team members properly on the business objectives, the standards required and the timetable involved.

### 2.6.2 Value for Money

The evolving role of quantity surveyors is shifting from cost plan and control of construction projects to adding value for their clients (Ashworth and Hogg 2000). The concept of Value for money (VFM) is not new. Principally, it requests that the construction project is delivered under budget and to provide a good quality of performance. The basic principle of VFM can be applied to any public and private sector's projects, but it has been stressed in the public sectors in the UK and been set as a primary driver of the public procurement (OGC, 2008) Technically, it means to develop the building or infrastructure with the lowest 'whole life costs', 'fit the purpose' and meet the specification. Best Value (DETR 2001) as an extended concept of VFM means that the Government should achieve continuous improvements with a combination of economy, efficiency and effectiveness (so-called 3Es).

The two techniques commonly used by the quantity surveyor to achieve value for money are Value Engineering/ Value Management (VE/VM) and Whole Life Costing (WLC). VE is a specific technique developed in USA during 1940s and has been extensively used in many different sectors, such as defense, manufacturing, and business sectors. It aims to remove unnecessary costs before, during and after construction (Ashworth and Perera, 2015). It has been introduced to the UK construction industry and rebranded as value management with in-depth function analysis as its core (Kelly and Male, 2000). Today, VM has been seen as a key competence for quantity surveyors in the UK.

Whole life costing (WLC) is another important appraisal tool for quantity surveyors to estimate the total whole life cost of the project considering a cradle to grave approach for its entire life span. A government's procurement guide called 'Whole Life Costing and Cost Management' was published in 2003; it provides the guidelines on the usage of whole life costing in all public projects (OGC, 2003). In recent years, WLC has been widely adopted in PPP/PFI projects and those sustainable building projects (Ashworth and Perera, 2015, Cartlidge, 2013).

## 3.0 China Engineering Cost System



### 3.1 History of Engineering Cost System in China

China established the sectorial legislation of cost engineer qualification system in 1996 (Wu, 2014). During the past two decades, Chinese engineering cost consulting industry has been developing rapidly, embedding Chinese legacy systems and characteristics. Through the Ministry of Housing and Urban-Rural Development, Department of Standard Quota and China Engineering Cost Association (CECA), as well as industry-wide joint efforts of colleagues, China has established a community-wide recognized cost engineering industry and cost engineer qualification system.

Under the planned centralised economic system, China did not have competitive bidding system until 1985; which implemented a fixed budget pricing based on standard price norms published by the Government (Shen and Song, 1998; Ding & Smith, 2012). With the implementation of the “open-door” policy from the beginning of the 1980s, the Government gradually transferred its planned economic system into a market-oriented economic system (Fan, 1988; Chen and Wills, 1999). During 1985-2003, at the planning stage of transition to a market economy, China continued using the fixed budget quota system (Wu, 2014). In order to adjust labour, materials, machinery price changes, a project valuation guideline consisting of “fixed quantity, guide price and competitive fees” were introduced. It still maintained the characteristics of government guiding price system. In 2003 the Code of valuation with Bill of Quantities of construction works (GB50500-2003) was first published by MoC and AQSIQ (2003) and the code has been regularly amended and improved every five years, in 2008 and 2013 (Lu & Wu, 2014). The implementation of this resulted in the spirit of ‘government macro-control, corporate self-quotation,

the market formed price and strengthen market supervision’ as the cost engineering management principles (Zhou & Yin, 2013). The implementation of the Bill of Quantities changed the pricing format, more importantly it has changed the price attributes of building products, and successfully transcending from government quota system to a market oriented pricing system (Zhou & Yin, 2013; Wu, 2014). As Chen, et al (2011) highlight that this code has given birth to a revolution in the history of China construction industry and indicated the transformation from the traditional mode of rating valuation, in which engineering cost and quantities are indistinguishable from each other, to the modern mode of Bill of Quantities (BoQ) valuation which is market-oriented.

The business scope of the cost engineering management has been greatly expanded. For more than 30 years, along with Chinese national reform and opening up of the economy, the changes of national economic system and price attributes, and the main activities of cost engineering professionals transformed from a planned economy (totally depending on the quota system) to an engineering cost system guided by the market economic system, and actively participating in the market competition. Cost Engineers, through their hard work and their achievements, has been fully affirmed by the building owners, who are playing an increasing important role, by using cost management as the core aspect of total project management. On the other hand, the cost engineering professional body has transformed from single responsibility of preparing and management cost to multiple aspects, including: drafting of cost engineering management laws, regulations, regulatory documents, cost engineering management standards, pricing information on the preparation and management of the project, and the management of the cost engineering consulting industry.

These achievements are of epoch in the expansion and development of the engineering cost management in China. They are inseparable with the rapid growth of China's fixed assets and ensuing investments. The main business scope is relatively simple, small and limited. Most of cost engineers are still engaged in the most basic measurement and cost estimating activities; personnel management theory and skills system is still in its infancy (Zhou & Yin, 2013). With the increasing demand for large-scale, systematic, and internationalization of Chinese construction projects, it is critical that cost engineers expand their role to carry out more in-depth and comprehensive construction cost engineering management services. These help to strengthen their business capabilities to carry out total cost management research and practice and put engineering cost management as a prerequisite for all projects. The cost management processes are not yet mature enough to address issues such as quality, schedule, safety, environmental and technological impact, and life cycle analysis to create the best value in construction projects. This requires the traditional cost engineering management system to undertake research and transformational development to build a system which adopts the existing legal framework and new business environment.

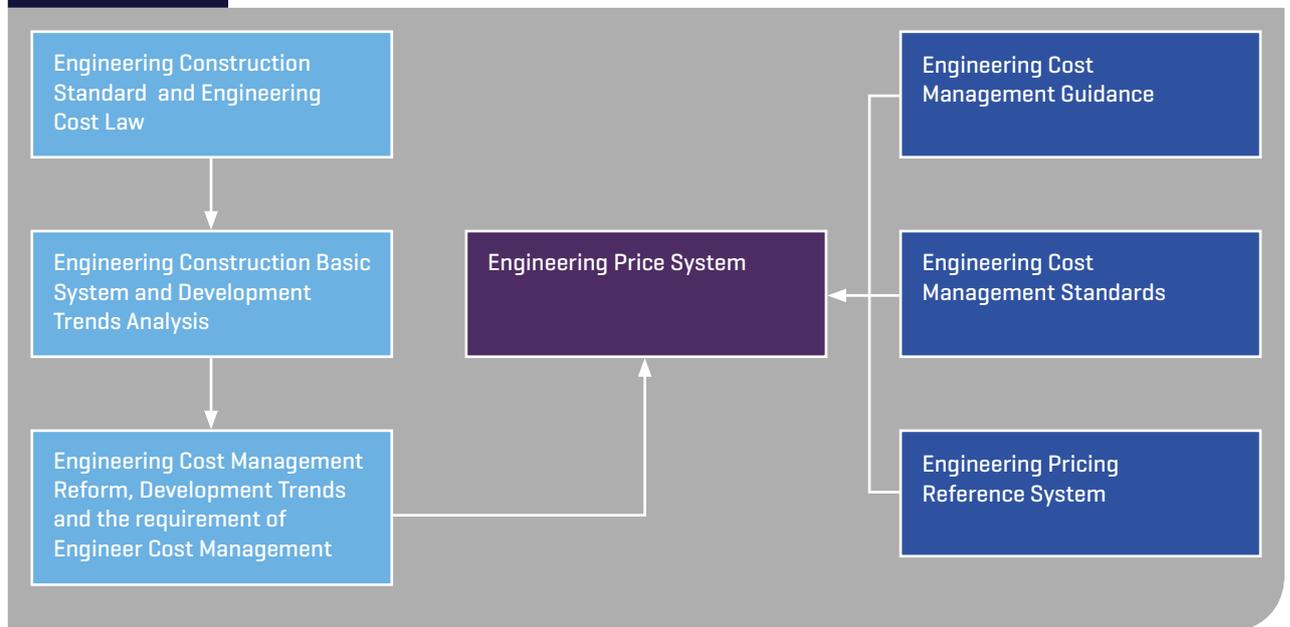
### 3.2 Background and Implementations of Engineering Cost Management System

The engineering cost system refers to the laws and regulations, standards, quotas, and information interrelated, as a whole. Chinese current engineering cost management system at the technical level consists of (excluding the organizational level), relevant laws and regulations of cost engineering management regulations, standards, project valuation and pricing information (Wu, 2014; Zhou and Yin, 2013).

The system is based on relevant documents of engineering cost management and project management experience so as to build the system suitable for the development of engineering cost management system that consists of the technical pathway is illustrated in Figure 3.1.

The cost engineering management system can be divided into four parts: the legal system for cost engineering management, cost engineering management standards, quota system and information system.

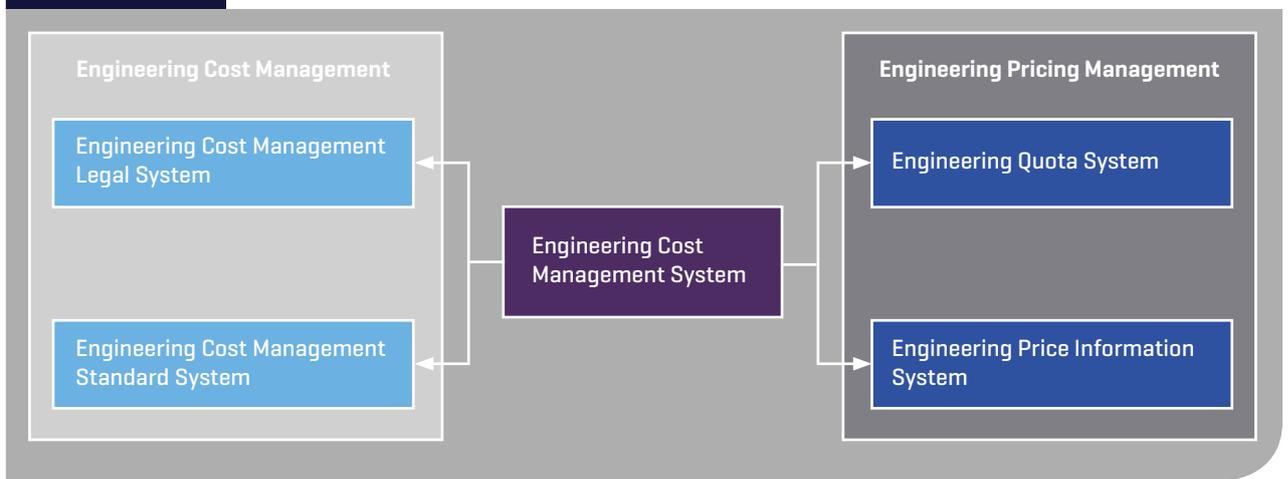
**Table 3.1** Technical pathway of the system design



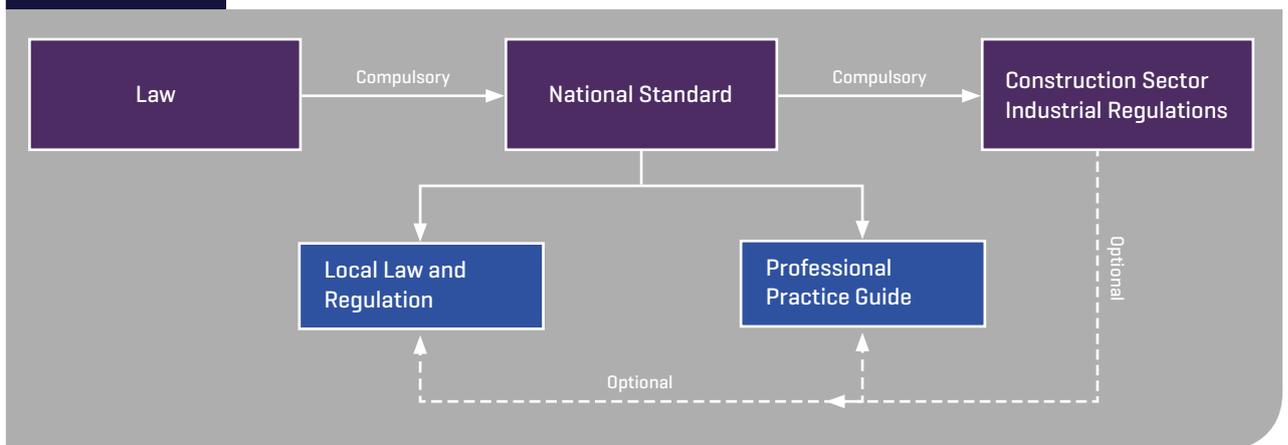
The first two areas are defined as in the category of engineering cost management; the latter two are defined as in the category of engineering pricing management. The first two are for the purpose of project management and need to be supported by regulatory and administrative authority, which is in the scope of macro-management. The latter two are at the national or local agency level authorized for the preparation and management of construction projects that are micro-pricing services. The overall framework of engineering cost management system is indicated in Figure 3.2 (Zhou and Yin, 2013).

Engineering cost management legal framework includes laws, regulations and guides for engineering cost management. It focus on two aspects: first, the macro level's regime of project investment system, which is more about the content of infrastructure investment management norms, the second is about the construction cost project management related systems. The project construction cost management regulatory system should gradually establish a multi-level legal framework, including national laws and regulations, local and departmental legislation (Wu, 2014; Zhou and Yin, 2013). The cost engineering management legal framework is shown in Figure 3.3.

**Figure 3.2 Overall Cost Engineering Management System Framework**



**Figure 33 Engineering Cost Management Legal Frameworks**



### 3.2.1 National Laws and Regulations

At the national level engineering cost system comes under the purview of national legislative enactments of the National People's Congress such as "The People's Republic of China Construction Law", "The People's Republic of China Contract Law", "The People's Republic of China Tendering", and the "People's Republic of China Price Law" (Chen, et al, 2011). Meanwhile, the Construction Law determines the basic system of the engineering cost management system. Contract Law is the basic principle of contract management, and construction contract management principles and contents. Tendering Law establishes the tendering and bidding procedures and price formation mechanism. Price Act clearly states price management principles and properties. The first public procurement legislation enacted in 1999 is titled Tendering Law (TL) which applies to tendering activities of both public and private sectors, and lacks many features of modern public procurement legislation such as a clear definition of public procurement and procurement methods other than competitive tendering procedures.

### 3.2.2 Administrative Regulations

Central governmental departments are allowed to develop their own Bidding Regulations. Construction Market Regulations and other relevant regulations and guides are based on enactments such as The People's Republic of China Construction Law, and other higher legislation to further clarify the project management system implemented within the relevant industry. Sound legislation is a basic requirement for the development of the market economy. From a project's cost management point of view, engineering and construction cost are the focus of attention on various elements of construction, which plays a significant restraining effect. Hence, it is crucial to develop a "Construction Quality Management Regulations" and "Construction Safety Management Regulations" along with "Construction Cost Management Regulations", in order to have a clear definition of engineering cost management principles, content and related systems (Wu, 2014).

### 3.2.3 Industry Regulations

Ministry of Housing and Urban-Rural Development (MoHURD) as construction administration department of the State Council have overall responsibility for the governance and advancement of the engineering cost management sector. Currently they have developed several normative documents such as Building Construction on Contract Pricing Management Approach, Construction Settlement Management Approach, Project Cost Consulting Qualification Management Approach, Cost Engineers Registration, Project Cost of Construction and Installation Composed, among others. These enable regulation and standardisation of the practice of engineering cost management and the function of engineering cost consultancy businesses (Zhou and Yin, 2013). These documents help to regulate delivery of services such as preparation and use of Bill of Quantities, state-owned investment project tender price control, engineering review and record the settlement, engineering economic dispute mediation system. They are designed to stabilize and broaden the scope of the project cost consulting services industry and provide a legal basis.

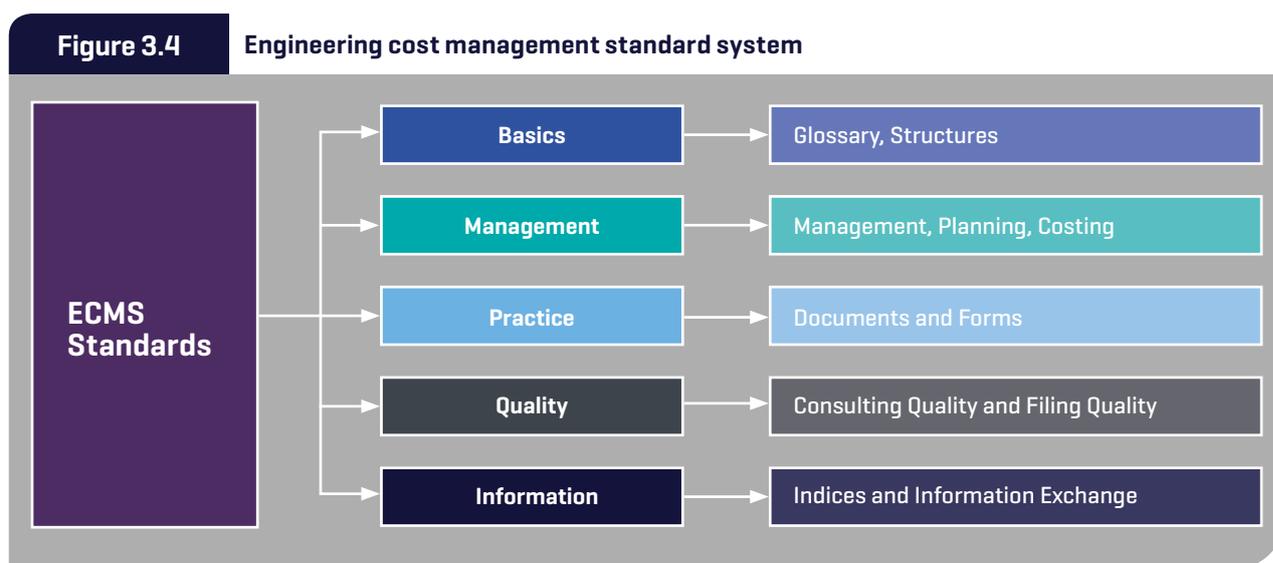
Railroad, transportation, electricity, water and other relevant State Council departments are based on professional engineering and construction industry laws and regulations of the construction administration department of the country. They enable to improve trade rules within the scope of their business management.

### 3.2.4 Local Laws and Regulations

The local relevant engineering cost law or regulations are launched through local provinces, autonomous regions and municipalities on behalf of the Assembly and its Standing Committee or legislation promulgated by the People's Government. Currently, 23 provinces or areas have issued appropriate regulations or codes, which improved their local administrative area rules and regulations, hence, improving national standards.

### 3.3 Engineering Cost Management Standards System

Engineering cost management system refers to the laws, regulations and norms for content management in addition to the traditional system, but based on national standards and industry standards so as to achieve a standardized project management and engineering cost consulting behaviour, and the quality of the technical content. These include: Unified Engineering based on the standard cost management basic terms, fee structure, specification of engineering cost management, project management division and measurement rules, norms; standardised various project cost outcome document preparation procedures; quality standards and quality engineering cost consulting archives; specification construction cost index published standards and the exchange of information among others. Engineering cost management standard system shown in Figure 3.4.



### 3.3.1 Basic standards

#### 3.3.1.1 Engineering Cost Glossary Standard

“Standard Glossary of Project Costs” (GB/T50875) is a set of unified terminologies based on engineering cost management processes and relevant regulation documents. It is the foundation of standardized engineering cost management system. The specification was made in 2009 by Construction Standards Department and now has been officially launched.

#### 3.3.1.2 Standard of Valuated Building Services and Components’ Classification

The construction project valuation (pricing) criteria for the classification of equipment and materials are known as the ‘Standard of valuated building services and components’ classification’ (GB/T50531). It is a division of engineering equipment and materials for the valuation of the cost of equipment, construction and scientific classification of installation costs. It is also the referencing documents for computation of taxes. The standard was issued in 2009 and since implemented.

#### 3.3.1.3 General Principles of Construction Cost Structure

The “General principles of construction cost structure” is a classification of construction costs and forms the most important basis for valuation of the construction works. The purpose of the standard is to standardise the classification of project costs in the form of the composition and meaning of these types of costs. Currently, the cost of construction and installation works consists of “cost of construction and installation project components” to form a more agreeable construction and installation costs.

### 3.3.2 Management Standards

#### 3.3.2.1 Bill of Quantities [BoQ]

The existing Code of valuation with bill of quantities of construction works (GB50500) is not only a single volume inventory of project valuation norms, it covers the main elements of project valuation. The valuation should be an integrated parent specification for the project on its basis, in order to unify the management of project valuation.

#### 3.3.2.2 Code of Valuation with Bill Quantities of Construction Works

Pricing for the BoQ should be carried out in accordance with the Code (GB50500). It should only use to prepare the BoQ and avoid unnecessary information beyond the requirement.

#### 3.3.2.3 Construction Cost Consulting Standard

The Standards of Construction Cost Management is for the regulation of Engineering cost consulting businesses and their practice. It primarily specify the required codes of practice for engineering cost consulting, its service activities, project management and organizational requirements, various outcome documents, forms and the like. The standard has been improved and re-launched in the first half of 2014.

#### 3.3.2.4 Standard Measurement of Construction Area of Building

“Standard measurement of construction area of building” (GB / T 50353) is the first standard in the form of engineering cost management area measurement published as a national standard, approved and launched in 2005. It is based on a 1982 amendment of the 70s “measurement rules”. The standard is also part of engineering cost measurement rules, which is incorporated into a unified national engineering measurement.

#### 3.3.2.5 The Bill of Quantities Rules [Volumes]

The construction project should be divided into different features and design phase of the project, using different valuation methods for different projects. The unit may be a single or multiple projects. It can also be used for some parts of the works. It should be based on the characteristics of the construction project formed as a set of hierarchical divisions of a BoQ.

#### 3.3.2.6 The Bill of Quantities Measurement Rules [Volumes]

It contains unified measurement rules for construction projects and describes the same document as above. Bills can be presented as a single volume or in multiple volumes as required.

#### 3.3.2.7 The Bill of Quantities Project Characterization Rules [Volumes]

It describes the characteristics of the project specifications, with a list of standardised description of quantities required to provide the necessary foundation for the project based on the bill of quantities.

### 3.3.3 Practice Standard

#### 3.3.3.1 Construction Project Investment Appraisal Code

Outcome document is prepared and reviewed base on the requirements for specification construction project investment estimate, this code was established by China Engineering Cost Association (CECA/GC-1) in the form of a trial in 2007.

#### 3.3.3.2 Construction Initial Design Estimates Procedures

Outcome document is prepared and reviewed based on the requirements for the construction and engineering design specification estimates, the procedure was established by China Construction Cost Management Association (CECA/GC-2) in the form of a trial in 2007.

#### 3.3.3.3 Construction Detail Designs Estimate Procedures

Outcome document is prepared and reviewed based on the requirements for specification construction engineering diagram of the budget, the procedure was established by China Engineering Cost Association (CECA/GC-5) in the form of a trial in 2010.

### 3.3.3.4 Construction Interim Valuation Procedures

Outcome document is prepared and reviewed based on the requirements for the clearing of standardized construction projects. The procedure was established by China Engineering Cost Association (CECA/GC-3) in the form of a trial in 2007, subsequently revised in 2010. The latest version was published in 2014 and has been included in the national standards for the preparation plans.

### 3.3.3.5 The Final Account Procedures

Outcome document is prepared and reviewed based on the requirements for completion of construction final account. China Engineering Cost Association (CECA/GC-9) in the form of a trial and established the procedure in 2013.

### 3.3.3.6 The Tendering Price Control Procedures

Outcome document is prepared and reviewed based on the requirements for specification construction project bidding price control. The procedure was established in 2013 by CECA (CECA/GC-6 procedures). The outcome document preparation and review requirement for specification construction progress payments is to be incorporated to complete the review.

### 3.3.3.7 Construction Economic Disputes Identification Procedures

Outcome document is prepared and reviewed based on the requirements for the construction specifications and related economic disputes. The procedure was established by CECA (CECA/GC-8) in the form of a trial in 2013. The standards were included in the national standards for the preparation of plans in 2014.

## 3.3.4 Quality Management Standards

### 3.3.4.1 Project Cost Consulting Achievement of Quality Standards

The document deals with quality standards applicable for the engineering cost consultation. The procedure was established in 2013 by CECA (CECA/GC-7) in the form of a trial.

### 3.3.4.2 Cost Engineering Management Consulting File Specification

This outcome document stipulates file management process specific requirements, specifications for engineering cost consulting enterprise records management. The specification will come in to force in 2015.

## 3.3.5 Information Management Specification

### 3.3.5.1 The Bill of Quantities Data Interface Standard

This stipulates data exchange standards for the production of BoQs and the pricing of BoQs using software.

### 3.3.5.2 Construction Materials Coding

This standard aims at achieving uniformity and consistency in data storage and retrieval of construction work items including installation of materials. It provides detailed set of codes and coding system for this purpose.

### 3.3.5.3 Construction Engineering Equipment Coding Standard

This standard provides a classification system and coding for data storage and retrieval of construction engineering equipment.

According to "People's Republic of China Standardization Law", Chinese standards, including national standards, industrial standards and local standards and corporate standards apply to all engineering cost management systems. These standards can also be issued by the MoHURD and can be published by the CECA as a form of industry self-regulation standards of trial.

China's engineering measurement rules are more comprehensive, but the system needs to be managed, and gradually refined and improved.



### 3.4 Pricing Code and Index System

The use of quota system is still the core of Chinese cost estimating methods. It involves the use of pricing codes and index as the main method for project cost estimating. Two adjustments need to be made to estimated project cost. First, determine the unit price to suit the project (the project may be a single project, building components, or sub-division of a multi-faceted engineering project). Secondly the basis for valuation for fixed price project and construction of different periods can be adjusted.

The quota system is based on engineering construction projects at different stages of vertical division for estimating indicators and budget estimates for the fixed quota. These are classified according to the type of the construction project as: unified national housing construction and municipal engineering, general engineering denominated fixed installation. Also includes railways, highways, metallurgy, building materials, and other professional engineering denominated fixed, local housing construction and municipal engineering, general engineering denominated fixed installation. Engineering denominated fixed system is shown in Figure 3.5

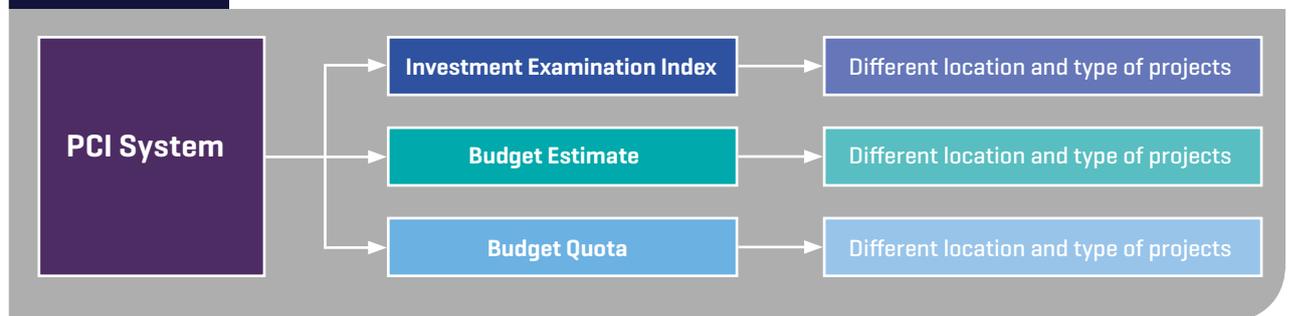
#### 3.4.1 Investment Estimation Index

In the decision making stage, investment estimation is indispensable part of feasibility study (Wang and Xun, 2010). The investment estimate is based on construction price index; however, the investment estimate is an indicator of the provisions of the project cost (the entire construction programme, individual project, and building units) or a combination of prices. The main investment estimate includes the consumption of materials and engineering materials and labour.

Project investment estimation indicators generally include comprehensive index of construction programme and individual project and its units. In order to increase usefulness and timeliness of investment estimating, it is important to estimate the resource used in each project and thereafter list the details of elemental costs as much as possible (CECA, 2011).

Index construction project investment estimate is an early stage investment estimate and is based on the preparation of the construction project proposals, feasibility study reports, etc. It can also be prepared as a construction project investment plan or the construction project comparative economic evaluation.

**Figure 3.5 Pricing Code and Index System**



### 3.4.2 Budget Estimate System

Budget estimates are made in order to achieve a fixed budget. It involves determining required quantity of standard labour, materials and equipment. It differs in the unit cost measurement, which is to expand to a part of the project or a combination of several sub-projects. Therefore, estimates are combined with the expansion of the fixed budget quota. It will have a fixed budget in contract of several sub- projects integrated into a fixed budget item. It is mainly used for the preparation of a fixed budget for the project design estimates. It was initially designed to identify and determine whether the preliminary design provide economic rationality and considered all important means of preliminary design optimization.

It facilitates quick completion of the preparation of project budget, facilitates comparison of the preliminary design, and encourages the introduction of new technologies, new materials, new technology and other factors caused by lack of a fixed budget for the project and to facilitate the preparation of the project budget.

### 3.4.3 Budget Quota System

Budget quota is an important technical and economic document, which details the required units of measurement/ quantities of labour, materials, and plant in line with standard design criteria and specifications. It is useful where certain constraints of technological progress and economic development in a given period are relatively stable. Budget quota is the basis for the preparation of construction drawings and also represents designing to cost approach. Construction budget is not only designed to determine the reasonableness of the important methods to optimize the design and construction cost control; but also to determine the price of construction and installation works on contract basis.

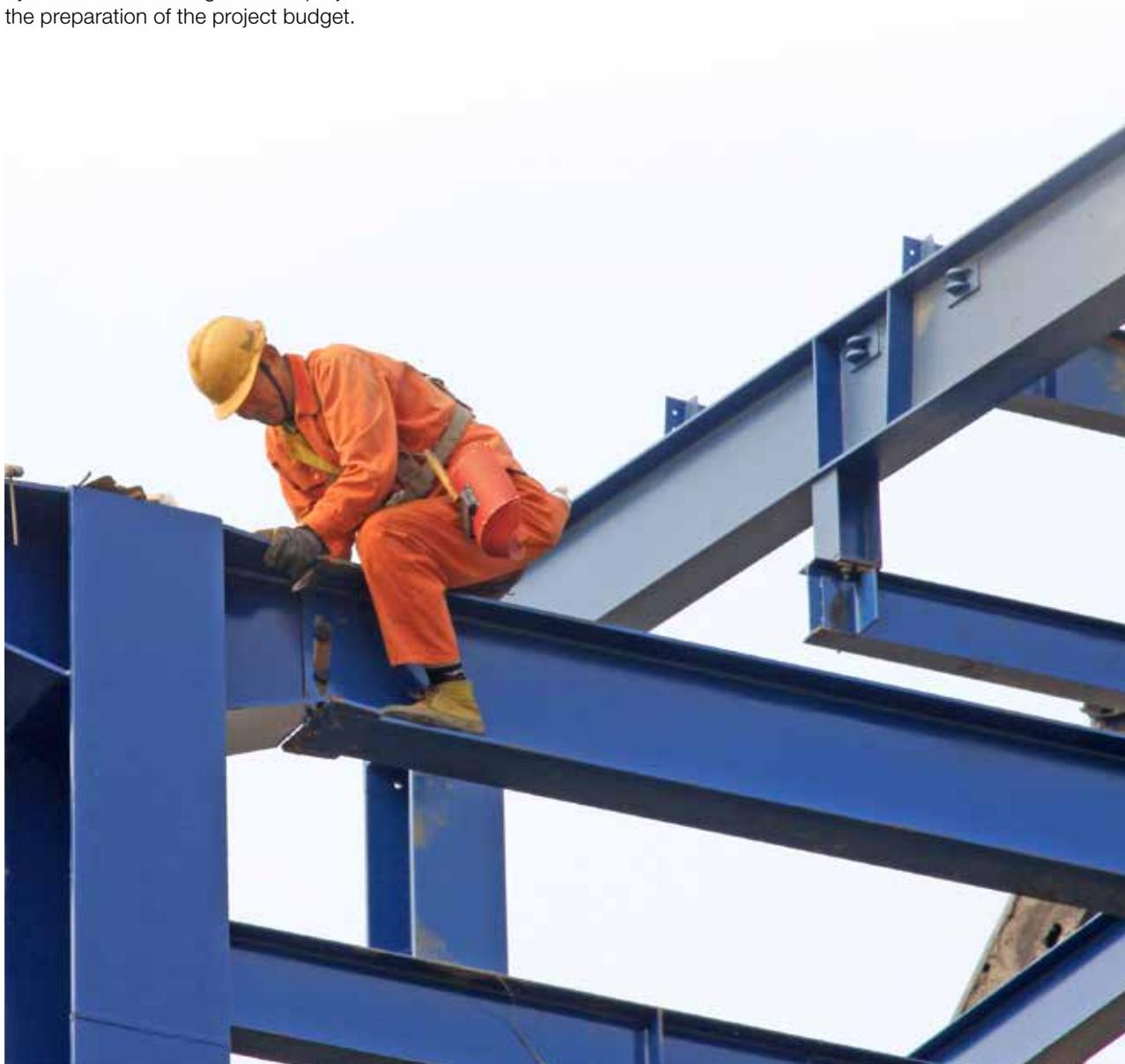


Image source: Yuangeng Zhang - Shutterstock.com

### 3.5 Cost Engineering Information System

The engineering cost information support system includes the construction cost index and construction labour, equipment, materials, construction machinery and pricing information. Pricing information system is shown in Figure 3.6.

#### 3.5.1 Construction Cost Index

Construction Cost Index includes: national or local housing construction, municipal construction cost index, as well as professional engineering industry cost indices.

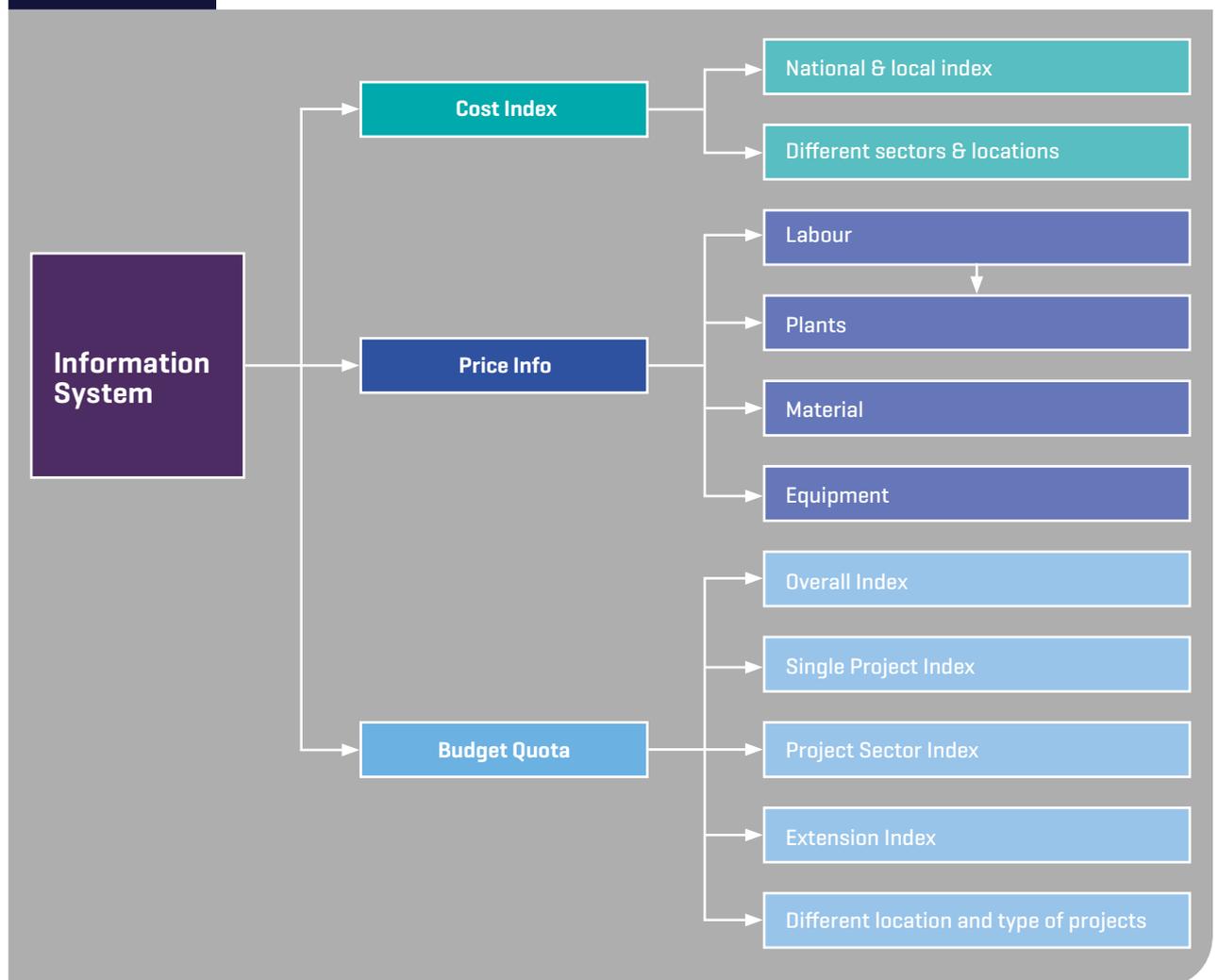
#### 3.5.2 Construction Engineering Factor Price Information

Price information includes the construction elements: construction and installation pricing information, materials prices, construction machinery rental price information.

### 3.5.3 Construction Engineering Comprehensive Index Information

The comprehensive index information includes: comprehensive cost index, individual building index, building unit index, extension index and element index. Timely and accurate information is a certified project valuation basis for all cost engineers, with the development of information communication technology (ICT), internet and big data was based. Development of ICT helps capture indices; engineering data collection and sharing of information; makes the project more accurate and faster; and facilitate effective control of the project cost. These in turn promote scientific decision-making through the whole project process (Zhou and Yin, 2013; Wu, 2014).

**Figure 3.5** Information Systems

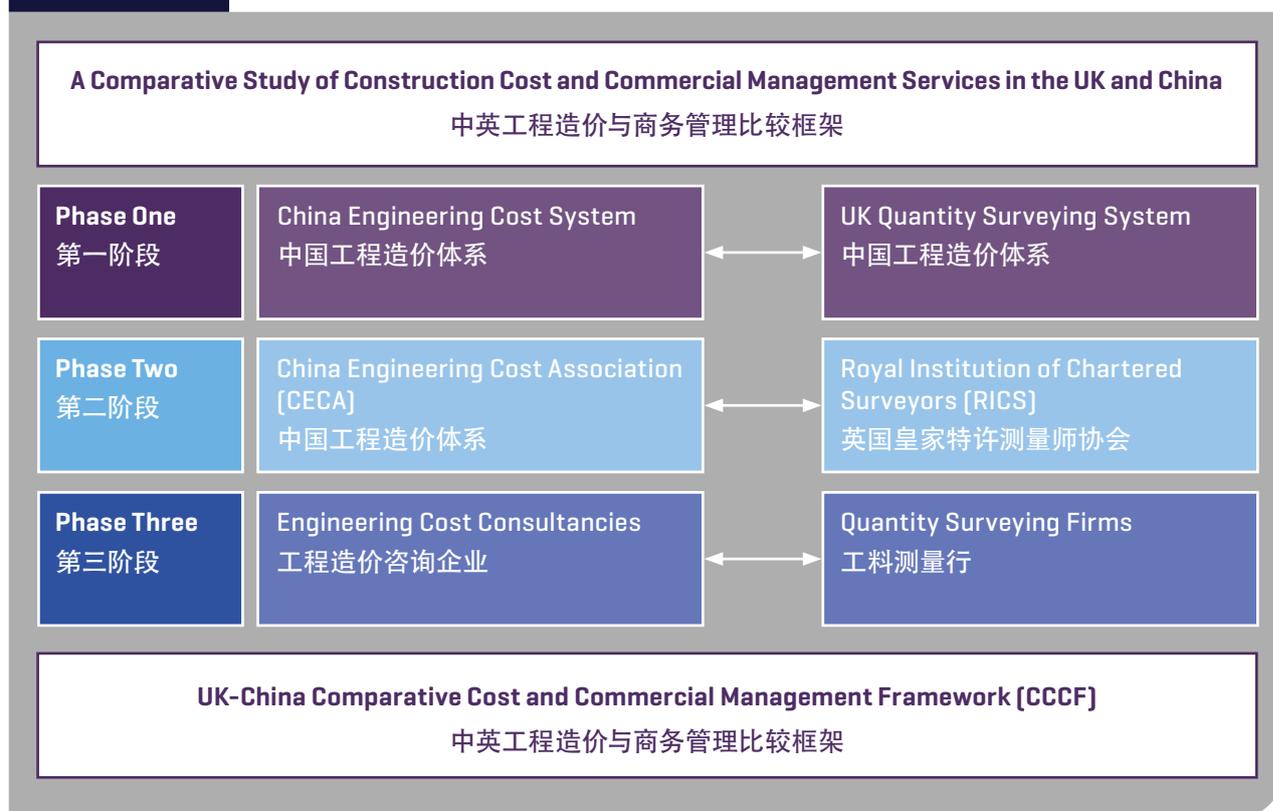


## 4.0 Research Method

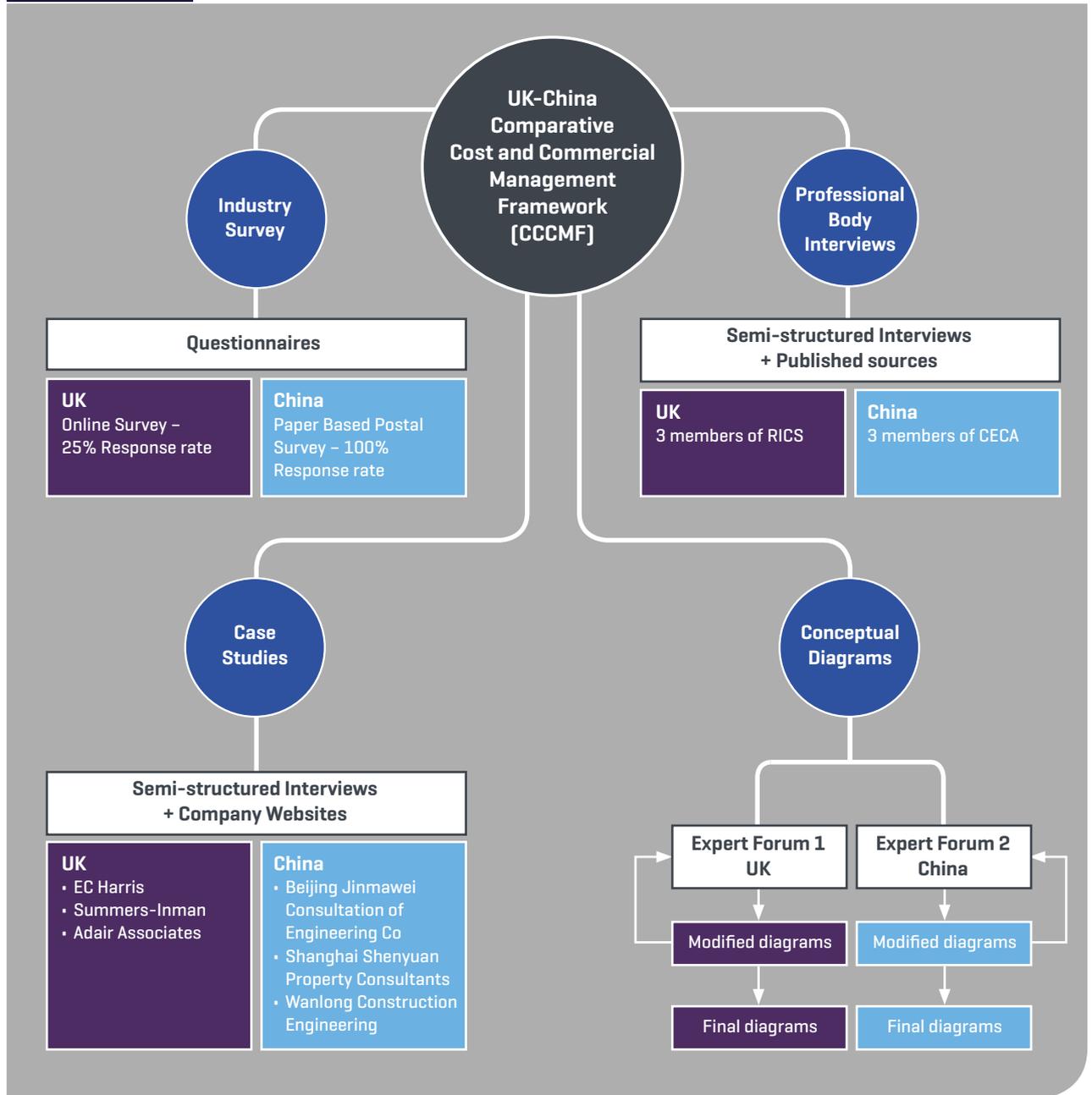
The research process consists of three main phases as indicated in Figure 4.1. Phase one comprises of a detailed literature review of both Engineering Cost System of China and Quantity Surveying System of the UK. This is followed by phase two in which the respective professional bodies of the two countries; China Engineering Cost Association (CECA) and Royal Institution of Chartered Surveyors (RICS) which regulates the Engineering Cost and Cost Management professions in the respective countries were analysed. The final phase is aimed at exploring Engineering Cost Consultancies and Quantity Surveying Firms to gain an in-depth understanding through conducting both a questionnaire survey and practice case studies.

Figure 4.2 illustrates the detailed methodology adopted in the study to synthesise the three phases of research to develop the UK-China Comparative Cost and Commercial Management (CCCM) framework.

**Figure 4.1** Proposed Research Methodology



**Figure 4.2** Development of UK-China CCCMF – Detailed Methodology



## 4.1 Phase 1 – Literature Review & Model Development

A detailed literature review of the QS practices in the UK and China led to the development of a conceptual cost and commercial management system model that classifies project stages and services delivered in each stage. The conceptual model for each country was subsequently reviewed through a detailed Delphi method based expert forum. Two expert forums were formulated consisting of three members for each country. The UK expert forum consisted of a senior academic; a senior industry practitioner; and a senior practitioner of a large QS practice who is a member of the QS and Construction Professional Group of RICS. The China expert forum consisted of an academic, a senior industry practitioner, and a leading expert from CECA. Models were then improved by incorporating the suggestions of the experts in two iterative rounds of consultation and improvement to produce the final model for each country.

## 4.2 Phase 2 – Professional Body Review: RICS and CECA

The key objective of this phase was to explore the background of the professional bodies, organisational structure, functions, qualification pathways, accreditation processes, education and training systems. This was achieved through a series of semi-structured interviews with key personnel of each professional body. This phase consisted of three interviews each in the UK and China along with additional literature review and survey of websites of the organisations. The results are reviewed in section 5 of this report.

## 4.3 Phase 3 – Business Comparison

This phase involved analysing and exploring business models and service profiles of cost management practices in both the UK and China. The main outcomes of this phase are: comparison of business models, profiles and services of cost management practices in both countries which were captured in two ways as described in the following subsections.

### 4.3.1 Questionnaire Survey

A comprehensive survey of UK quantity surveying firms and China Engineering Cost Consultancies was conducted in June to November 2014. An online survey was set up in the UK for this purpose while in China printed paper based questionnaires were circulated. Response levels for the two countries varied significantly. In the UK, a total of 25 responses were received whereas in China there were 99% response rates with 101 responses. The survey investigated the nature and scope of the professional practices, enterprise management models utilised, and the future development and trends of cost management practices and engineering cost practices of the two countries. The survey was also used to examine their key cost management elements for different stages of the project life cycle. The results are reviewed in section 6 of this report.

### 4.3.2 Case Studies

A total of six case studies representing three in each country were conducted. The three consultancy companies selected represented large, medium and small companies for both countries. Semi-structured interviews, website reviews and document analysis were conducted for each case study. Interviews involved one key senior representative of the organisation (Managing director, senior partner and the like) for each organisation to gain insights of the Quantity Surveying and Engineering Cost practices and business models adopted by the respective organisations in both the countries. The results are reviewed in section 7 of this report.



## 5.0 The Professional Bodies

### 5.1 Royal Institution of Chartered Surveyors (RICS)

#### 5.1.1 Background

##### 5.1.1.1 Origin and History of RICS

RICS (Royal Institution of Chartered Surveyors) is a professional body acting in the public interest. It accredits professionals in the land, property and construction sectors throughout the world. Any individual or firm registered with RICS is subject to their quality assurance. RICS' approach to promoting and enforcing standards aims to bring confidence to consumers and markets.

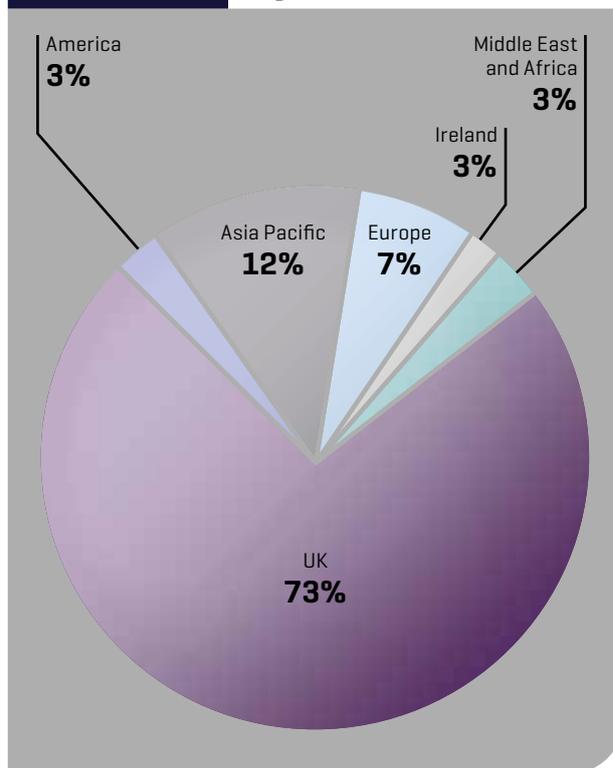
The origin of the RICS can be traced back to 1792 when the surveyors club was formed. There was a railway boom in the Victorian time and railway surveyors wanted to improve standards of the works where 20 surveyors met at the Westminster Palace Hotel and appointed a sub-committee to draw up resolutions, bye-laws and regulations, under the chairmanship of John Clutton. This group then expanded to 49 members by 1868, met again to approve the resolutions and elect the first Council. John Clutton was elected as the first president of the Institution of Surveyors, which was the formal establishment of the RICS. Then the Royal Charter was granted to RICS in 1881. The RICS was developed and extended reaching, in particular, to the property industry and valuation and then into commercial property areas. Later, the RICS stepped into the construction arena as the Institute of Quantity Surveyors joined with the RICS. Now the RICS operates as a leading professional body which standardise practices and procedures in land, property and construction sectors across the world. Table 5.1 lists the milestones in the history.

Professionals holding RICS qualifications may use the following designations after their name: MRICS (Member), FRICS (Fellow) and AssocRICS (Associate). Those with the designation MRICS or FRICS are also known as chartered surveyors. All are required to abide by a code of core professional and ethical standards and to keep up to date with current practice through a programme of lifelong learning. RICS regulates and promotes the profession; maintains the highest educational and professional standards; protects clients and consumers via a strict code of ethics; and provides impartial advice and guidance to governments, regulators, business and the public.

**Table 5.1** Milestones in the History of RICS

Year	Event
1792	Surveyors Club formed
1834	Land Surveyors Club formed
1868	Institution of Surveyors founded
1881	Royal Charter granted
1888	Provincial committees established
1891	Membership by examination becomes compulsory
1899	Completion of new building at 12 Great George Street designed by Alfred Waterhouse
1921	Royal Patronage granted by George V
1922	Quantity Surveyors Association amalgamates
1930	Institution of Surveyors becomes Institution of Chartered Surveyors
1946	Granting of the title Royal to become Royal Institution of Chartered Surveyors. RICS Coat of Arms with motto 'Est modus in rebus' (There is measure in all things) adopted
1953	Institute of Mining Surveyors amalgamates
1966	RICS sets up Divisions: Agricultural; General Practice; Land and Mining Surveying; Quantity Surveying
1970	Chartered Auctioneers and Estate Agents Institute and Chartered Land Agents Society merge with RICS
1973	Building Surveyors Division established. Tests of Professional Competence became mandatory
1975	Planning and Development Division established
1983	Institute of Quantity Surveyors merges with RICS
1998	Richard Lay launches Agenda for Change initiative
	The future role of the RICS (Harris Report) Society of Surveying Technicians joins RICS. Class of Technical member created
2000	Merger with Incorporated Society of Valuers and Auctioneers
	RICS Foundation for leading-edge research established
	UK regional network established
	University partnerships launched
	Former Institute of Building Control members join new RICS Building Control Forum
2001	16 specialist faculties replace seven divisions and new regional structure adopted
	International Governing Council, with representatives from all world regions, replaces General Council
2003	RICS membership reaches 110,000
	RICS-accredited university courses total 400 worldwide
2004	RICS invite Sir Bryan Carsberg to carry out a review of RICS' regulatory regime with a view to improving and modernising it according to better regulation principles
	RICS President Nick Brooke's Review instigates improvements to RICS' governance, member communications and member structures
2005	RICS membership reaches 120,000
2006	RICS celebrates 125 years of holding a Royal Charter
2007	RICS membership reaches 140,000
	Regulatory reform comes into force which ensures RICS can continue to regulate individual members and member firms regardless of work they undertake

**Figure 5.1**  
**Total Chartered Membership (FRICS and MRICS) by World Region as at June 2014**



#### 5.1.1.2 Growth of RICS

RICS is headquartered in London, with its main support functions in Coventry. There are regional offices in the UK, across mainland Europe, in China, Hong Kong, Singapore, Australia, the Middle East, Sub-Saharan Africa, North America and Brazil.

In 2015, there were RICS-qualified professionals in more than 140 countries. The total number of those accredited worldwide was 120,000 plus student membership of 81,000. While the majority of accredited individuals are still based in the United Kingdom with large numbers also in mainland Europe, Australia and Hong Kong, there is now strong growth globally, and particularly in China, India and the Americas (see Figure 5.1).

RICS has close links with many national surveying institutions and is a founding member association of the International Federation of Surveyors (FIG). Within RICS the primary areas of practice represented at FIG are geometrics (land and hydrographic survey), environment, planning, construction and valuation.

RICS works in close collaboration with other professional bodies, central banks and international organisations such as The United Nations, World Bank and The European Union. In 2013 RICS was a founder member of the coalition to develop International Property Measurement Standards, which launched its first standard – for measuring office space – in November 2014. In 2014 RICS was a founder member of the coalition to develop International Ethical Standards. In each case, coalition member bodies will implement the new standards through training and guidance for professional practitioners.

RICS – University partnerships were launched in 2001 which led to the growth in accredited course. There are more than 400 RICS-accredited university courses run worldwide which indicates the extensive growth and recognition of the RICS as a world professional body.

#### 5.1.1.3 Vision and Goals

The strategic vision of the RICS, set by the Governing Council is:

*“To be recognised in key international markets as the leading body that develops and enforces professional standards, and offers access to the most sought after professional status.”*

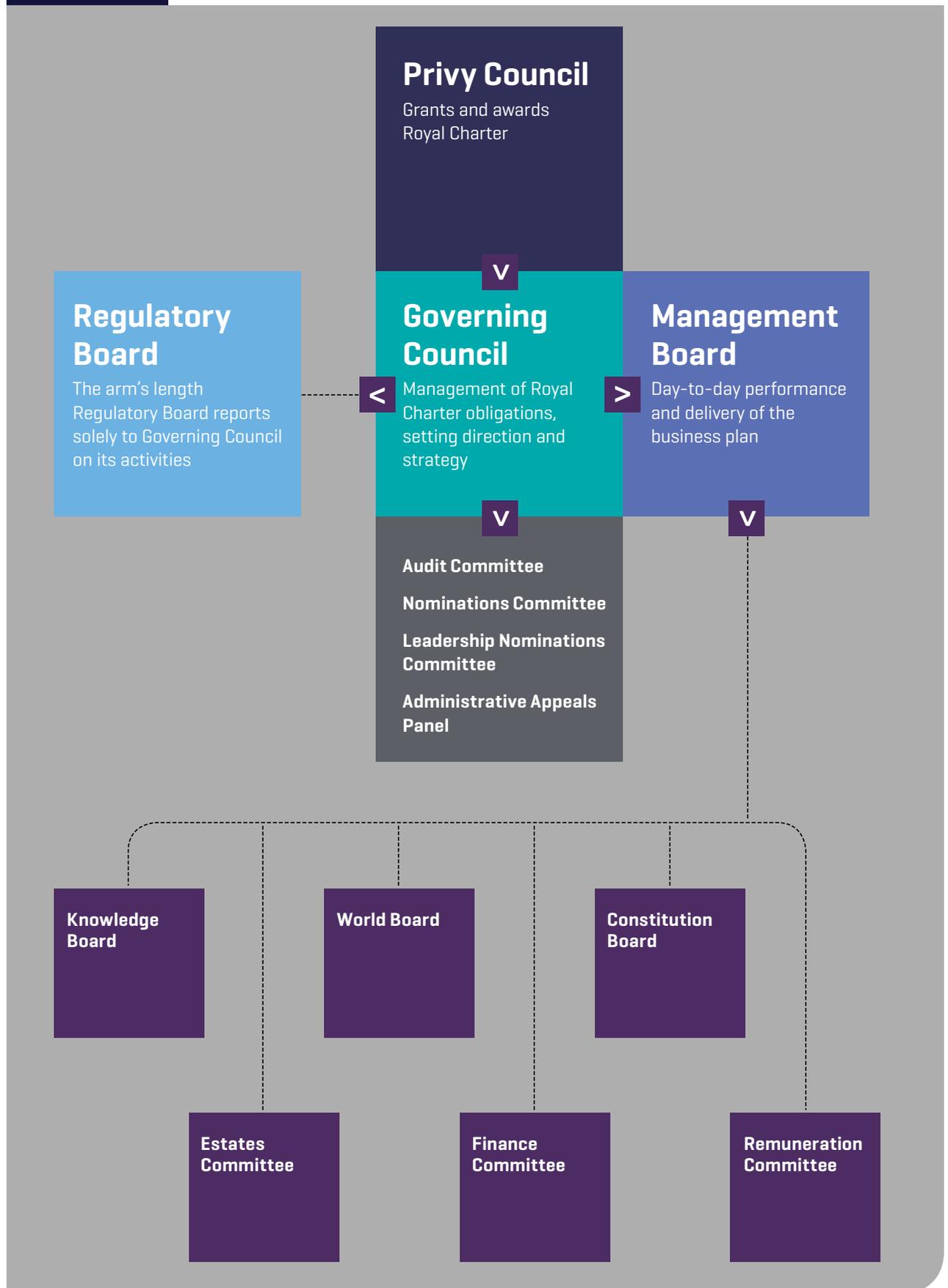
RICS’ corporate goals 2012-2015 are:

1. To improve performance and agility to deliver globally against all business plan objectives;
2. Gain market recognition of RICS standards in the key economic and political centres of the world
3. Take a leadership role in the development, regulation and enforcement of international standards
4. Be a role model as a ‘responsible’ organisation
5. Grow the profession in strategically important markets with an emphasis on the BRICS economies
6. Ensure the profession continues to develop through the provision of leading-edge training, knowledge and information
7. Ensure that members understand the direction of RICS and take pride in their professional status.

#### 5.1.1.4 Structure

Figure 5.2 illustrates the governance structure of RICS

**Figure 5.2** Governance Structure of RICS



### 5.1.2 Quantity Surveying Profession within RICS

Quantity Surveying (QS) is a key profession within the RICS and the profession has grown significantly within the UK in the past few years. In terms of member, the contribution of the QS profession is high; hence, the profession has a strong voice within the RICS. The Figure 5.3 outlines the number of quantity surveyors in relation to total chartered membership.

#### 5.1.2.1 Routes to Membership

RICS has different types of membership including Associate (AssocRICS) MRICS and FRICS. In order to become a member of RICS, candidates have to go through the Assessment of Professional Competence (APC) process (discussed in Section 2.2). RICS has developed various routes to memberships which are discussed below:

- Associate (AssocRICS)**  
 The Associate route is for those with a minimum of four years relevant experience. RICS approved vocational and academic qualifications in relevant subjects can be used towards reducing the experience requirement. Direct entry for this route is available to candidates holding a RICS approved qualification or membership of a recognised professional body. Figure 5.5 shows the path to becoming an Associate member of RICS.
- Chartered (MRICS)**  
 There are several routes to attain chartered membership. These are outlined in Figure 5.4. Each route has specific requirements depending on a candidate's qualifications and experience. More details can be found on the RICS website (RICS, 2015c & 2015d).

Table 5.3

Total Number of Chartered Quantity Surveyors (MRICS and FRICS) in Relation to Total Chartered Membership

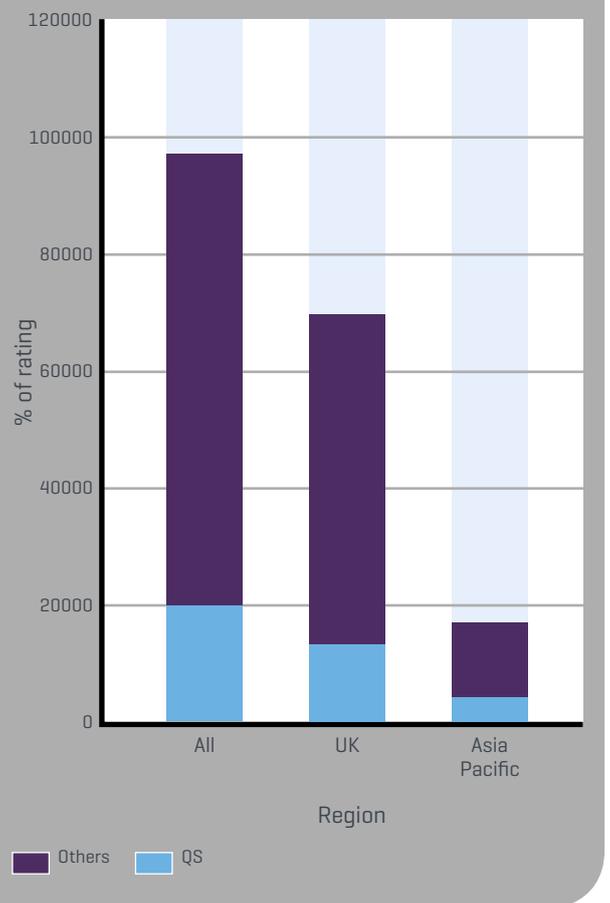
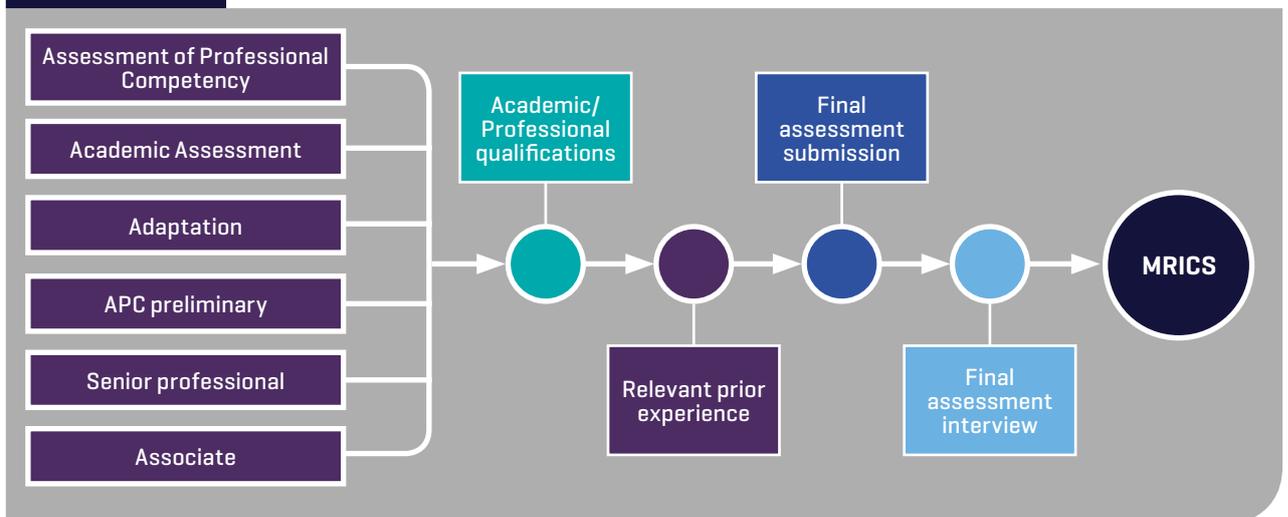


Figure 5.4 Routes to Chartered Membership - MRICS



**Figure 5.5** Route To Membership – AssocRICS



**Figure 5.6** APC Process



• **Fellowship (FRICS)**

Fellowship is a mark of distinction recognised by the members of RICS, professionals and the public as denoting the highest standards of success, achievement and expertise. To achieve Fellowship a candidate must demonstrate how they are exceptional in their professional capacity. Candidates must choose three characteristics from a defined list and provide supporting evidence of how they have achieved the characteristics. On demonstration of excellent professional skills, practices and significant contribution to the profession, the member will be awarded Fellowship).

**5.1.2.2 Assessment of Professional Competence (APC) Process**

The APC aims to assess that a candidate is competent to carry out the work of a qualified chartered surveyor. Figure 5.6 illustrates the APC process in brief. The APC process for graduates with an RICS accredited degree consists of a period of structured training. The length of the structured training is determined by the amount of relevant experience an individual candidate has gained at the point of enrolment on to the APC. At the end of the structured training period candidates must have met the competency requirements for their chosen APC pathway and had this signed off by a chartered member. In addition candidates must prepare submissions to demonstrate the skills and competencies gained during their structured training and sit the competency-based final assessment interview. The process may take longer, depending on a candidate's progress. Other routes (for example APC preliminary) do not require structured training though the submissions

on competencies and final assessment interview must be achieved. Exceptions to this process are Fellowship, Eminent and Honorary membership.

**Competencies**

The competencies are defined at three levels of attainment and each APC pathway has its own specific combination of competencies that a candidate must achieve at the appropriate level.

- **Level 1** – knowledge and understanding
- **Level 2** – application of knowledge and understanding
- **Level 3** – reasoned advice and depth of technical knowledge

There are three types of competencies expected to be demonstrated by the candidate in the APC process. These are as follows:

- **Mandatory competencies:** Personal, interpersonal, professional practice and business competencies – common to all pathways and compulsory for all candidates.
- **Core technical competencies:** Primary competencies of the chosen APC pathway.
- **Optional technical competencies:** a set of competencies selected by the candidate from a list defined for their particular pathway.

Table 5.2 outlines the competencies of the QS and Construction pathway and the levels that candidates must demonstrate.

**Table 5.2** Competencies for Quantity Surveying and Construction Pathway

Mandatory competencies	
Level 1	Accounting principles and procedures, Business planning, Conflict avoidance, management and dispute resolution procedures, Data management, Sustainability, Team working
Level 2	Client care, Communication and negotiation, Health and safety
Level 3	Conduct rules, ethics and professional practice
Core technical competencies	
Level 3	Commercial management of construction or Design economics and cost planning, Contract practice, Construction technology and environmental services, Procurement and tendering, Project financial control and reporting, Quantification and costing of construction works
Optional Technical Competencies [Any two]	
Level 2	Building information modelling (BIM) management, Capital allowances, Commercial management of construction or Design economics and cost planning (whichever is not selected as a core competency), Contract administration, Corporate recovery and insolvency, Due diligence, Insurance, Programming and planning, Project evaluation, Risk management, Conflict avoidance, management and dispute resolution procedures or Sustainability

**5.1.2.3 Education, Training and Guides**

There is a core set of professional guidance developed by RICS available for QSs, called the ‘Black Book suite’. This a series of standards, practice statements and guidance notes provided on various topics and competencies setting standards and helping professionals in practice as well as APC candidates. The suite is expanding and new standards and guidance being added continually. The NRM suite is another important document developed by RICS which supersedes the standard method of measurements (SMM). Several other standard and guidance notes are produced by other professional groups within RICS which have direct relevance to cost management.

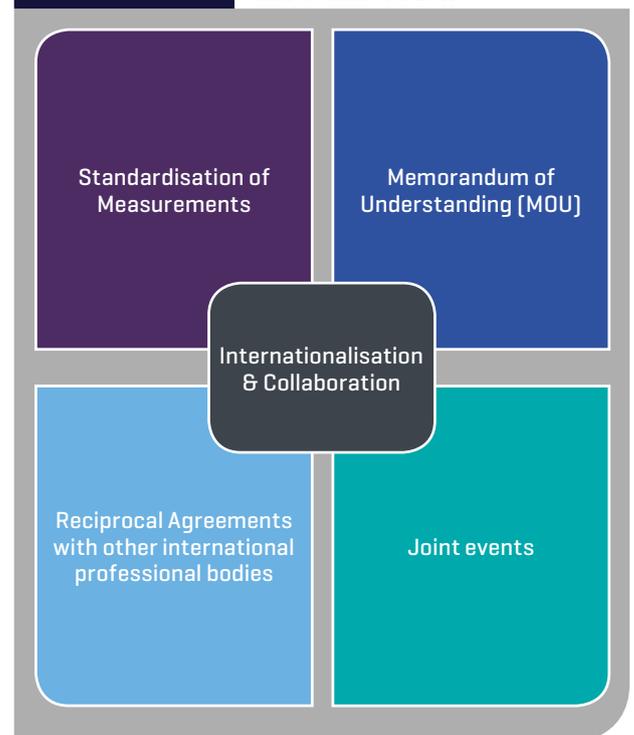
RICS disseminates knowledge through an extensive series of Continuing Professional Development (CPD) programmes. CPD is a mandatory commitment by members to continually update their skills and knowledge in order to remain professionally competent and achieve their true potential. RICS expects all its members to undertake a minimum of 20 hours CPD each calendar year (January to December) out of which at least 10 hours must be formal CPD. More importantly, members should undertake the mandatory CPD on RICS Global Professional and Ethical Standards at least once every three years.

**5.1.2.4 Next Level of Development in QS Profession**

RICS envisage a smarter, leaner and greener construction industry by 2025 in line with construction 2025 strategy of the UK government. Consequently, the QS profession is expected to significantly adopt BIM, sustainability, lean construction, robotics and off-site fabrication. Therefore, RICS is working closely with the UK government to develop the profession in these areas.

However, the next level of development will be significantly affected by global issues. RICS is focused on setting international standards that apply across all world regions providing uniformity and consistency in standards. RICS has been instrumentally in the development and acceptance of International Property Measurement Standards. RICS intend to follow this with construction industry measurement standards.

**Figure 5.7** RICS – Internationalisation and Collaboration



### 5.1.3 Internationalisation and Collaboration

RICS highly value internationalisation and as a result its international membership has grown to exceed 30%. Figure 5.7 illustrates internationalisation and collaboration approaches of RICS.

- **Standardisation of measurements**  
RICS believes that professional standards are essential in the global market and has worked closely with other international standards setting bodies to form a coalition to produce international standards. As a result, RICS have been successful in developing the International Property Measurement Standards (IPMS).
- **Memorandums of Understanding**  
RICS works with a range of professional bodies in the UK and internationally. These agreements set out how RICS can work collaboratively with similar organisations. RICS has recently signed memorandums with the Construction Management Association of Japan and Ghana Institution of Surveyors. RICS has already signed MOUs with the International Cost Engineering Council (ICEC) which represents project and cost management around the world. Furthermore RICS is also developing relationships with other bodies. RICS believes that collaboration is the best way of setting international standards and raising the profile of the profession. In addition to international collaboration RICS also collaborates with UK bodies including RIBA, CIBSE, and ICE.
- **Reciprocal Agreements with other international professional bodies**  
Prior membership of certain professional bodies around the world can provide a route to RICS Associate or Chartered membership. This can either be as a direct entrant or exemption from certain requirements. A list of the current agreements is available on the RICS website.
- **Joint events**  
RICS organises joint events with other professional bodies. A recent example is the Project Leadership Conference held in collaboration with the APM in February 2014.

#### 5.1.3.1 Collaborating with China

It is expected that there is potential for RICS to collaborate with China. There has been previous links with China, but RICS believes that to improve, standardize, and be mindful of practices and procedures within other countries it is very important to collaborate with all potential countries.

RICS China supports a network of over 2,800 individual professionals across the region with an objective to help develop the land, property and construction markets in China, by introducing professional standards, best practice, education and training.

## 5.2 China Engineering Cost Association (CECA)

### 5.2.1 Background

#### 5.2.1.1 Origin and History of the CECA

China Engineering Cost Association (CECA) was established in July 1990. It is an independent organisation, which registered under the Ministry of Affairs in China. CECA is also approved by and have a strong working relationship with Ministry of Housing and Urban-Rural Development (MoHURD). CECA is a professional body, mainly concerning engineering cost consulting services and engineering cost management in various of sectors, such as, building, civil engineering, railway projects and other infrastructure development. It governs Cost Engineers in terms of examination, registration, regulations as well as continuing professional development. The main business scopes are:

1. Formulate and implement the regulations governing the practice of engineering cost consulting units, professional ethics and operation regulations on consulting business
2. Review of qualifications of engineering cost consultants, examination, registration and continuing education for registered cost engineers (CPD)
3. Assist the government departments to regulate the engineering cost consulting market
4. Maintain the legal rights and interests of the members
5. Organise industry training and promote the advanced experience in engineering cost consulting and management
6. Establish contact and communication with international organizations in the world on behalf of cost engineering profession in China
7. Resolve issue and complaint against malpractices in engineering cost consulting industry.

#### 5.2.1.2 Growth of the CECA

The CECA originated from a budget estimating committee of the Department of Standards, under MoHURD. After CECA was established, it has been actively promoting the cost engineer qualification system and cost engineering consulting enterprise licence system. In 1996, China established the sectorial registration of cost engineer qualification. It is a personal qualification system. The qualified cost engineer can be compared to chartered quantity surveyor in the UK, who has the responsibility for the project cost. The Enterprise license system is to regulate the business scope of consulting companies and its service quality which is presented in Table 5.3. There are two categories: Jia Ji (Grade A) and Yi Ji (Grade B). The enterprise license in China is a unique way to regulate the industry. The license is issued by MOHURD and administrated by CECA.

CECA facilitate the development of these two systems and support the development of Chinese construction cost engineering industry. One of key roles of CECA is to help in the transition of the Chinese cost management system from a centrally planned model to a free market model. The General Secretary of the CECA Mr WU Zuoming said: *“A lot of things are moving to market orientation, which is why we reform and develop, to meet the market demands. The old government based project pricing system is part of the legacy of the country’s accounting system. This is the process of moving from the planned economy to a market economy”*.

Since the cost engineer qualification system was set up, the project cost consulting industry has been growing rapidly. According to the 2012 Annual Report of CECA the engineering cost consultation has an annual output value of 77.6 billion RMB, which includes a number of other services, such as tendering, etc. The pure cost engineering and cost management business is valued around 35.2 billion RMB. There are over 143,000 professionally qualified cost engineers while further 126,000 have valid registrations.

Another key role of CECA is to formulate industry standards, for example, terminology standards; the concept of the project cost, the concept of project cost management, project valuation standard, among others. Those standards are quite important to a newly developing industry in order to avoid conflicts and to lay the foundation for stable development.

The third key role of CECA is to look regulate the cost engineer qualification system. They are responsible for the need to prepare the exam, registration, to prepare continues professional development education, removal of disciplinary violations, among others.

**5.2.1.3 Vision and Goals**

The goal of CECA is to be an industry organization of social service functions to provide some services for its members. It aims to promote the development of the entire construction industry, including working with the legislative department, planning, strategy and research and to form national standards and association standards such as the standard for use of Bill of Quantities. Since 2007, CECA have published nine association standards. Later, in order to increase the influence of the association, these standards were gradually set up as national standards.

**Table 5.3 Cost Engineering Consulting Business License Categories**

Categories	Entry Conditions
<b>Jia Ji (Grade A)</b>	1 It has been Grade B business qualification certificate for three years;
	2 Technical Lead Cost Engineer qualification for registration has been made, and has engineering or economic series of senior professional titles, and is engaged in the project cost more than 15 years of professional work;
	3 It engages in full-time professional staff for project cost [referred to full-time professionals] not less than 20 people, including: engineering or engineering economics series intermediate professional titles of the staff at least 16 people, cost engineer to obtain a certificate of registration of persons no less than 10 people, others have engaged in professional work experience project cost;
	4 The registered capital of not less than one million Yuan;
	5 In the last three years of enterprise engineering cost consulting revenues accumulated no less than 5 million Yuan;
	6 Having a fixed office space, office space of not less than 10 square meters per person;
	7 The technical file management system, quality control system and financial management system complete;
	8 The employee’s social pension insurance formalities are complete;
	9 Full-time professionals to comply with the national occupational age dossier relationship recognized by the state agency on behalf of Personnel Management;
	10 The number of people who invested enterprises Cost Engineer not less than 60%, amount of not less than 60% of the registered capital.
<b>Yi Ji (Grade B)</b>	1 Technical Lead Cost Engineer qualification for registration has been made, and has engineering or economic series of senior professional titles, and is engaged in the project cost more than 10 years of professional work;
	2 The cost of full-time professional work in engineering staff [referred to as full-time professionals] not less than 12 people, including: engineering or economic series intermediate professional titles of the staff at least eight people, cost engineer to obtain a certificate of registration of persons not less than six people, others have engaged in professional work experience project cost;
	3 The registered capital of not less than 500,000 yuan;
	4 In the tentative project cost consulting business revenue during the period of not less than a total of 500,000 yuan;
	5 The company has a fixed office space, office space per capita of not less than 10 square meters;
	6 The company has technical file management system, quality control system, a complete financial management system;
	7 The employee’s social pension insurance formalities are complete;

**5.2.1.4 Structure**

Figure 5.8 illustrates the organisation structure of CECA. The Executive Board of CECA has 40 members, is elected by Council members. The Board performs the function of Council according to the Constitution of CECA and is responsible for the Council. The Council of CECA with 167 members, are the committees of the Council that held every four years. Executive Board Director is the legal representative. There are 7 Vice Directors among the leading core. Secretary General is in charge of the routine works for CECA, 3 Deputy Secretary Generals are in charge of various businesses under the supervision of Secretary General. Under the Council of CECA, there are 20 professional committees and work committees and 30 interprovincial engineering cost associations in China.

Table 5.8 illustrates the functions of the five offices operating under the Deputy secretary General.

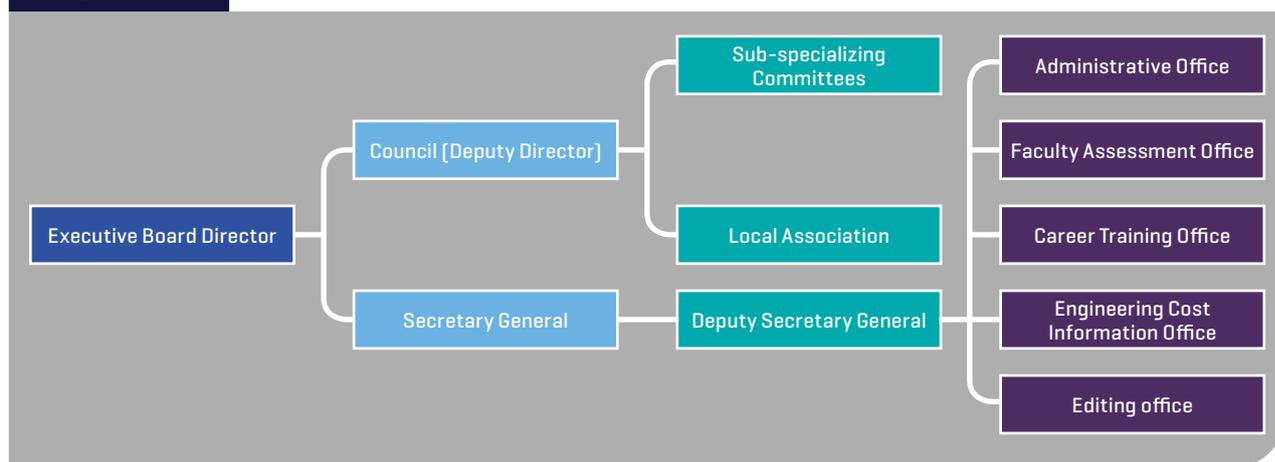
**5.2.1.5 Role in Property and Construction Industry**

The scope of work for Cost Engineers in China differs slightly from Quantity Surveying practice. Cost Engineers in China specialise in various Engineering fields (Civil Engineering, Building, Mechanical or Electrical) and have the knowledge of procurement and cost management. The establishment of engineering cost consulting industry, not only has made important contributions for the construction industry, but also significantly raised awareness. They also have a greater influence through the construction project decision-making stages: project appraisal, value enhancement, contract management, investment determination, cost control and auditing.

**5.2.1.6 Accreditations**

CECA has not accredited any university courses till now in China. However, there are about 40 universities offer Engineering Cost Course, but mainly approved by Ministry of Education.

**Figure 5.8** CECA organisation structure



**Table 5.4** Offices in CECA

Stage	Techniques
Administrative Office	Dealing with daily administrative activity, communicating with domestic and foreign society. Faculty Assessment Office: Assessing the conformity on faculties of consultant agencies and registered professional, conducting the annual audit.
Faculty Assessment Office	Processing the annual audit on the faculties of consult agencies of A Level authorized by Ministry of Construction [MoC].
Researching and Training Office	Organizing specialists and scholars to research on various subjects concerned, promoting information of calculation and management, taking charge of the professional education and training, conducting examination proposition of qualification.
Engineering Cost Information Office	Establishing the MIS of engineering cost, collecting and publishing the price information of construction material and mechanical equipment
Editing Office	Editing and publishing the journal "Management of Engineering Cost" bimonthly

## 5.2.2 Engineering Cost Profession within CECA

There are over 143,000 people possess the professional qualifications, while 126,000 have valid registration.

### 5.2.2.1 Qualification Pathways

Candidates must pass the qualification examination conducted by CECA to become a qualified cost engineer in China. It is conducted once every year. This examination assesses the candidates in four subjects: Project Cost Management; Project Cost Estimating System; Technology & Measurement, which also includes the contents of some of the computer literacy; and Case Study Analysis. Every year approximately 100,000 candidates sit for the examination and the pass rate is generally low. For instance, pass rate in 2012 was about 4%. The candidates should fall into one of the following categories to be eligible to sit for the exam:

- The engineering cost college graduate and work in the engineering cost sector for five years; engineering or engineering economics college graduates with six years working experience
- The cost engineering university graduate and work in an engineering cost company for at least four years; engineering or engineering economics university graduate need at least 5 years working experience.
- Upon eligible for a second bachelor's degree or above graduate or obtain a master's degree, need work in an engineering cost sector for three years
- PhD degree needs at least 2 years' experience
- A senior staff with working experience more than 15 years (if the degree is engineering or engineering economics before 1970, if graduated from a college then need 20 years' experience, if graduate only with a certificate, then need over 25 years' experience), then candidate is exempted from two subjects: 'Cost Management Theory and Regulations' and 'Construction Engineering Technology and Measurement'

### 5.2.2.2 Education, Training and Guides

CECA actively involves in education and research with many universities in China. CECA funds research project and use the research result to design and develop new association strategy and development framework. On other hand, CECA supports cost engineering programme development of universities, and facilitate the programme to be recognised by the Ministry of Education. However, according to the provisions of Qualified Cost Engineer Continuing Education Temporary Guide, registered CECA member should take 30 hours of required courses and 30 hours of elective courses every two years to complete, to organize and participate in the prescribed form of continuing education of qualified cost engineer.

The main forms of learning includes: network continuing education and centralized face-to-face training. CECA advocates continuing education and training of cost engineers to form network based education.

### 5.2.2.3 Next Level of Development in Engineering Cost Profession

The next stage of CECA development has several aspects: the first one is to pay attention on the management of personal qualifications, and personal continuing education, to promote and improve the level of individual abilities. The second is that the integrity of the entire industry, to build a strong foundation for the industry, such as, national guides and legislations, norms, strategies, including talent development strategy, size of the business strategy and international strategy. Further, promotion of enterprise development and informatisation of cost engineering will be paid attention. The central government has set ICT industry as a driver of future economic growth. As a result, promotion of digital services such as BIM, database and software development cross whole industry is considered to be crucial.

On the top of the agenda of engineering cost industry is to change the old quota system to a market led price system. Chinese quota system is adjusted every five year. The quotas are not prescriptive and are only considered as a guide for practice at the moment. It is gradually labelled as a reference system that is optional. The gradual transition is from a central government planning system to a consumption management for government social services. Now the market guide price is the mainstream price information. Cost management agencies around the country, considered a quasi-government, which is equivalent to the government's quota system. The next step should be the market price system, which is published by independent cost information organization. The Government is to provide support and information to help the development of market based mechanism making it as the basis for future engineering cost services.

Another undergoing area is to develop a credit system. The credit is open to public and to be monitored by the public. It will cover all qualified cost engineers. The credit status of the entire industry will be then transparent to the public indicating the quality levels of the industry. Furthermore, history of consulting firms and cost engineers' services will be recorded and tracked. The enterprises will be graded on a hierarchical system, like Standard & Poor rating through a comprehensive evaluation.

### 5.2.3 Internationalisation and Views on Collaboration

Internationalisation is one of CECA's important strategies. In the state level, the government encourages enterprises to expand their business from domestic market to overseas. CECA supports the consulting firms to set up business in other countries. However, China has two problems; one is language barriers; and the other is variations between domestic and international standards. Hence, there are some obvious obstacles in the internationalisation and collaboration. In the near future, once the enterprise qualification system is cancelled, there is opportunity for Chinese Engineering Cost companies and British QS firms to collaborate or set up a joint-venture, therefore, the internationalisation of Chinese company could speed up.

On the other hand, CECA became a full member of the Pacific Association of Quantity Surveyors (PAQS) in 2004 and the International Cost Engineering Council (ICEC) in 2007. In 2005 and 2010, CECA has the Reciprocity Agreement with HKIS (Hong Kong Institute of Surveyors), which allow the quantity surveyors to get the qualification of cost engineer in China. In July, 2013 CECA has signed a MoU (Memorandum of Understanding) with AACE (American Association of Cost Engineers). The agreement facilitates communication and mutual promotion among international cost engineering professionals and encourages CECA professionals to apply for membership and related certifications within AACE International. The two organizations will exchange information on relevant cost engineering issues and recommended practices and encourage participation in conferences and events sponsored by the other entity.



## 6.0 Comparative Analysis of Cost & Commercial Management Practice Surveys



The questionnaire survey in the UK was conducted during June to November 2014. The survey population was QS consultancy companies of which random sampling of 100 companies were selected and survey invitation was sent - one per company. As such the survey was not to gather individual views but to gather practices of companies surveyed. The online survey was supported by the RICS and a total of 25 responses were received. This type of low level of response rate is not unusual for a construction industry survey in the UK; for example, Black et al (2000) received a 26.7% response rate to their survey questionnaire. Another reason for the low response rate could be the survey focus is on cost management practices of organisations rather than views of individuals, thereby, cautiousness of invitees with regards to misrepresentation of the actual state of the organisations' practice. On the other hand, questionnaire survey in China was conducted during July and September 2014. A total of 101 responses were received (out of 250 invitations) from a paper based postal survey supported by the CECA.

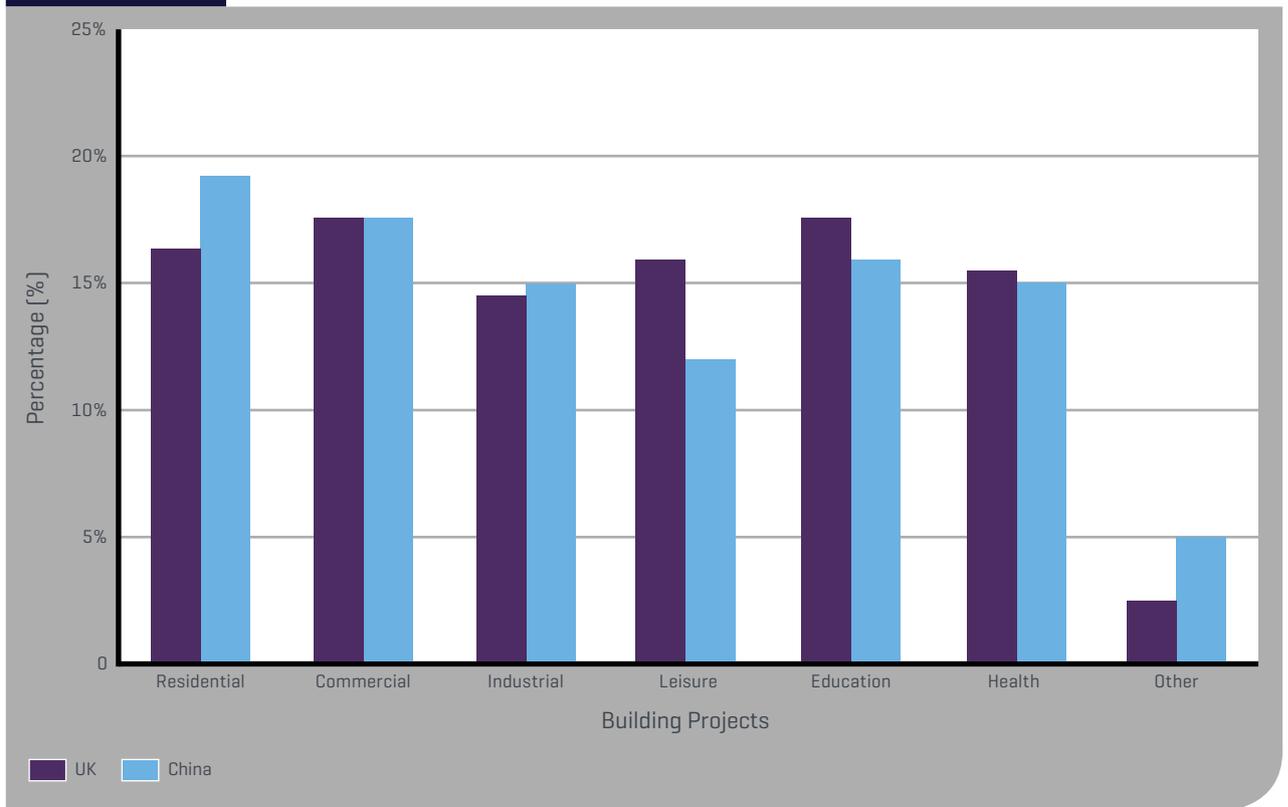
The results of the surveys were analysed using descriptive statistics (percentages, mean, standard deviation etc.) and have been organised in four main sections. The first section analyses the respondent profile (company profile).

The second section analyses data related to the business models adopted by the companies that responded. The third section evaluates the cost management techniques and software used by the responding QS consultancy companies. Section four summarises the future trends of QS profession and takes into consideration the challenges of the 21st century (such as advancements in ICT, BIM, internationalisation, sustainability, and other).

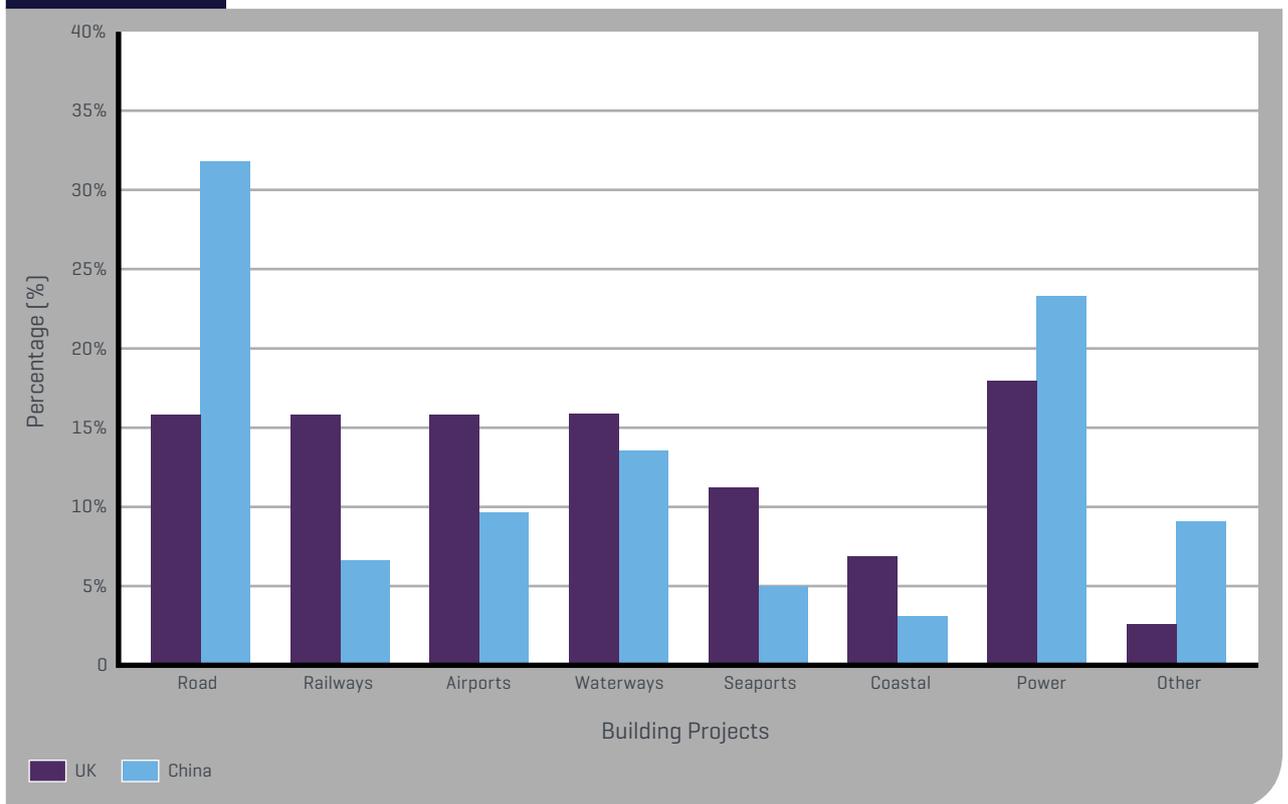
### 6.1 Responding Organisation Profiles

The UK survey has been fairly limited in that the total numbers of responses received were limited to 25. Nevertheless it presents a fair representation of the UK practice of cost and commercial management activities. The survey in China has been highly successful with target number of 100 organisations responding to the survey. In like for like comparison in the UK there were 16% QS only firms responding as opposed to 50% in China for EC consultancy firms. Most of UK responses came from multi-disciplinary practices (80%) compared with 47% in China.

**Figure 6.1** Comparison of Type of Work – Building Projects



**Figure 6.2** Comparison of Type of Work – Civil Projects



### 6.1.1 Type of Work

The comparison of responding organisation profiles for type of work they undertake in terms of Building and Civil Engineering projects are indicated in Figure 6.1 and Figure 6.2 respectively. It indicates that there is greater distribution of work types undertaken by firms in UK and China with respect to the building sector. In terms of Civil Engineering projects the spread in the UK is fairly even except for project related to Sea ports and Coastal defence.

The overwhelming majority is involved in residential and commercial development projects in China. However, there is a fair distribution of other building types as well. In terms of Civil Engineering projects (Figure 6.2) Road projects are considered the most popular with almost all responding companies having involvement followed by Power generation projects. Both building and Civil Engineering projects are highly reflective of the development needs and patterns of China currently in existence.

### 6.1.2 Organisation Size

The comparison of the responding organisations' employee profiles indicate a greater bias for medium to large companies in the UK as opposed to small to medium in China (Figure 6.3).

It is clear that 92% of the organisations have less than 250 employees (as such SME) in China. This is reflective of the profile of the Chinese construction industry where the majority of the construction organisations SMEs. The organisations are grouped under Grade A or Grade B firm, where Grade A requires at least 20 professionals working within the company, Grade B needs at least 12 people. It also indicates that there are very few large consulting companies (over 250 people). In stark comparison to the UK there are very few larger construction companies exceeding 250 employees in China.

### 6.1.3 Organisation Age Profile

The age profiles of the responding companies in the two country surveys are very much reflective of the level of maturing of the cost management professions in the two countries. 55% of UK companies were over 50 years old compared to 90% companies in China were less than 30 years old (Figure 6.4).

Figure 6.3

Comparison of Employee Profiles of Responding Organisations

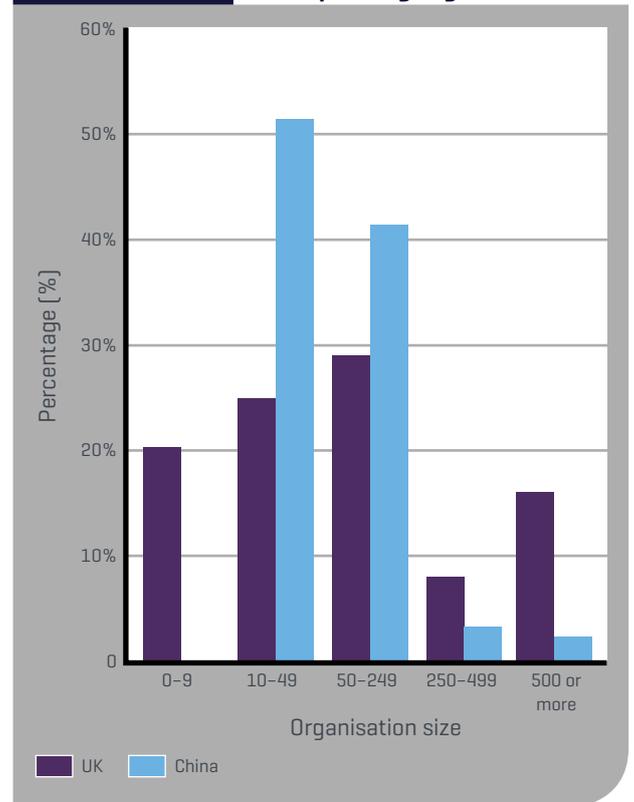
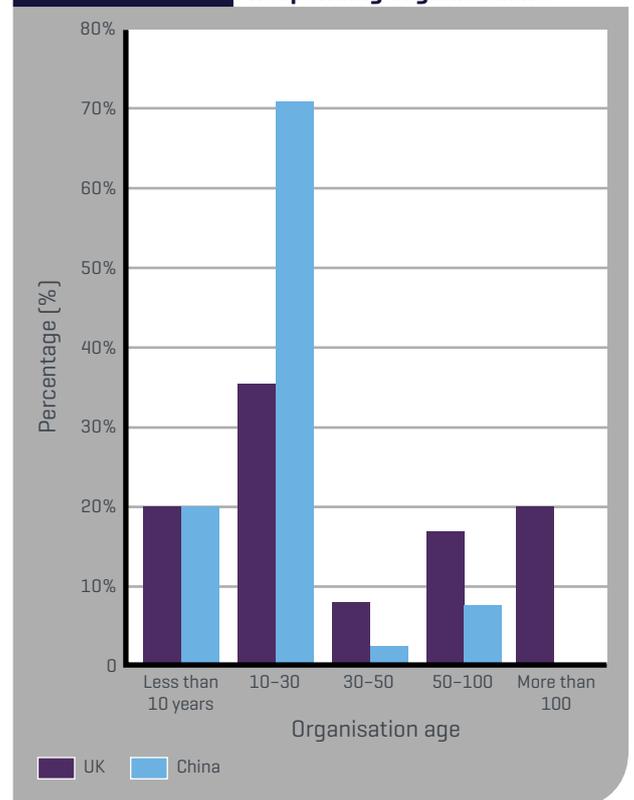


Figure 6.4

Comparison of Age Profiles of Responding Organisations



## 6.2 Aspects Reflecting Business Models in Use

This section analyses the survey responses related to the business models used by cost management firms in the two countries under five main subheadings.

### 6.2.1 Type of Business

The two surveys reveal two different business entity profiles that very much indicate the legacy issues of the two countries (Figure 6.5). UK represents a wide range of firms from sole trader to Limited Liability companies and subsidiaries. In contrast 96% of firms in China are Limited Liability companies (LLC). This reflects the recent origins of firms in China following 21st century business trends. LLC are still the majority in the UK but a considerable number (28%) still remained as a Partnership.

### 6.2.2 Level of Operation

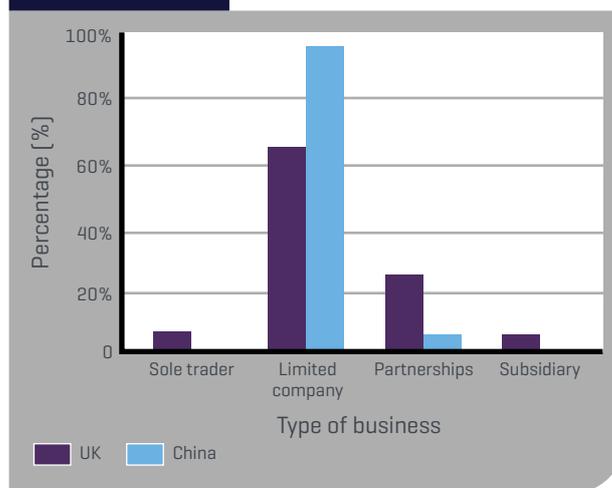
The level of business operations is indicative of the level of maturity of the cost management processes of the two countries. Figure 6.6 and Figure 6.7 below indicate a distinctly different business operation profiles for the two countries. Most cost managements firms in the UK have international operations compared to none in China (based on survey samples). This is reflective of the fact that the UK have more mature cost management processes compared to much younger profile presented in China. The UK national income statistics also confirms the significantly proportionately high levels of international business activities of the cost management consultancies. This is also helped by the fact that English as a business language has greater worldwide spread.

### 6.2.3 Professional Fees

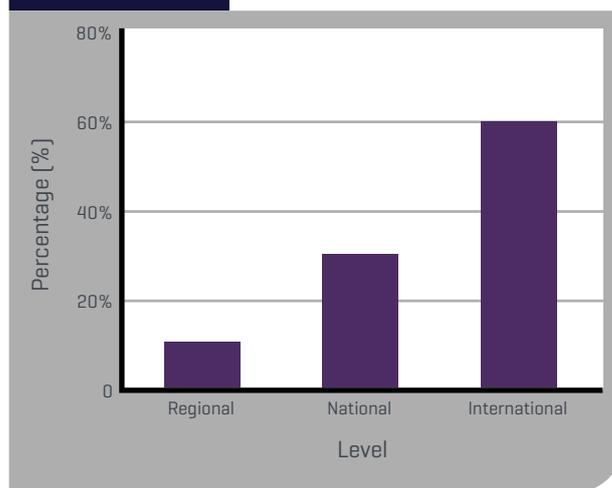
#### 6.2.3.1 Professional Fee Strategy

Three mainstream professional fee strategies were queried on the survey: percentage, fixed rate and on a negotiation basis. Figure 6.8 indicates that all of these strategies are equally popular in the UK. However, in China the Percentage fees and Negotiated fees are significantly more popular than Fixed fees.

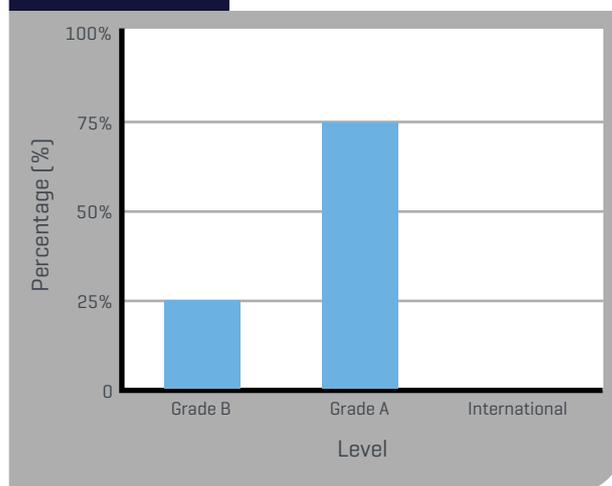
**Figure 6.5** Comparison of Type of Business



**Figure 6.6** Level of Operation – UK



**Figure 6.7** Level of Operation – China



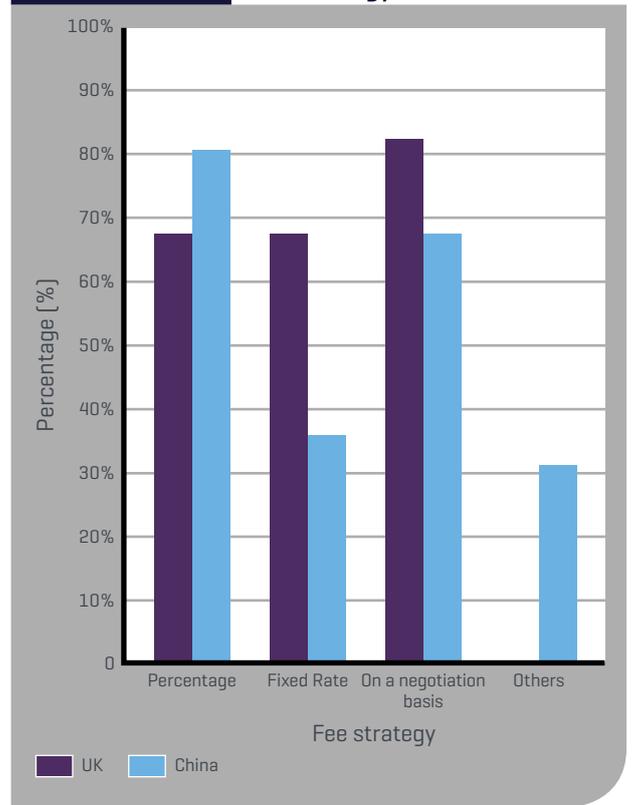
**6.2.3.2 Level of Operation**

In the UK the fees relate to the full service provided by quantity surveyors, both pre- and post-contract stages. This full service will include: preparing full bills of quantities; tender documents; tender reports and contracts; valuation of works in progress; preparing final accounts. Fees exclude expenses and VAT (The Fees Bureau, 2013).

The fees for QS services vary from project to project and whether it is regional, national or international as well. The question on range of fees for QS services were based on the percentage amounts contracts were awarded based on the services provided and these percentages are from 0.1% to above 5.0%. Figure 6.9 indicates that the common percentage amounts are in the region of 0.5% to 2.0%. A very few of the respondents reported percentage amounts of over 5% and this can be put down to a number of reasons, such as the issue of multidisciplinary nature of the organisations or the type and nature of projects, etc. The fee levels for EC services in China are significantly lower than in the UK. Nearly 70% indicated that the fees are less than 1%. However, this is not a like for like comparison as the scope and scale of services provided as QS services in the UK are significantly extensive compared to the profile of work completed under EC services in China.

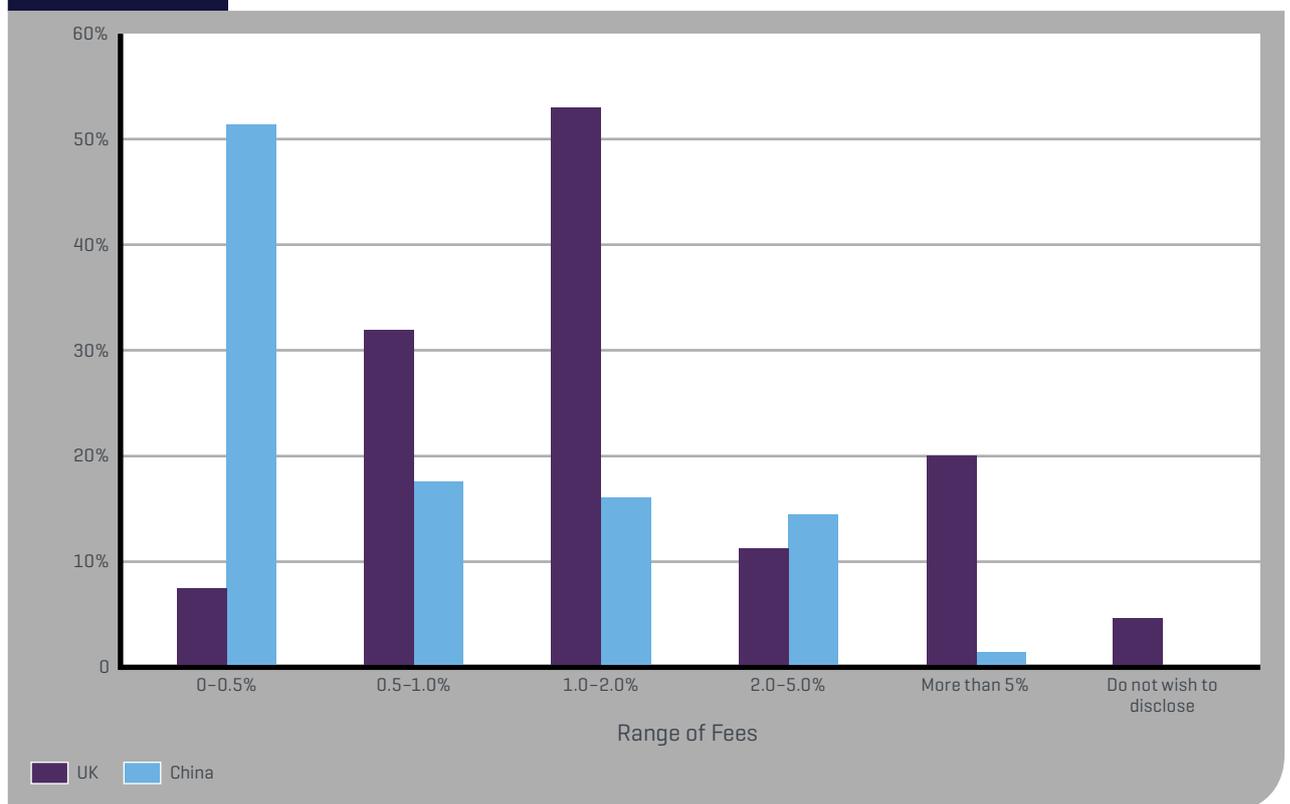
**Figure 6.8**

**Comparison of Professional Fee Strategy**



**Figure 6.9**

**Range of Fees for QS Service (UK) and EC Service in China**



### 6.2.4 Use of ICT

The use of information and communication technology (ICT) was divided into two parts as use of the internet technologies and business communication.

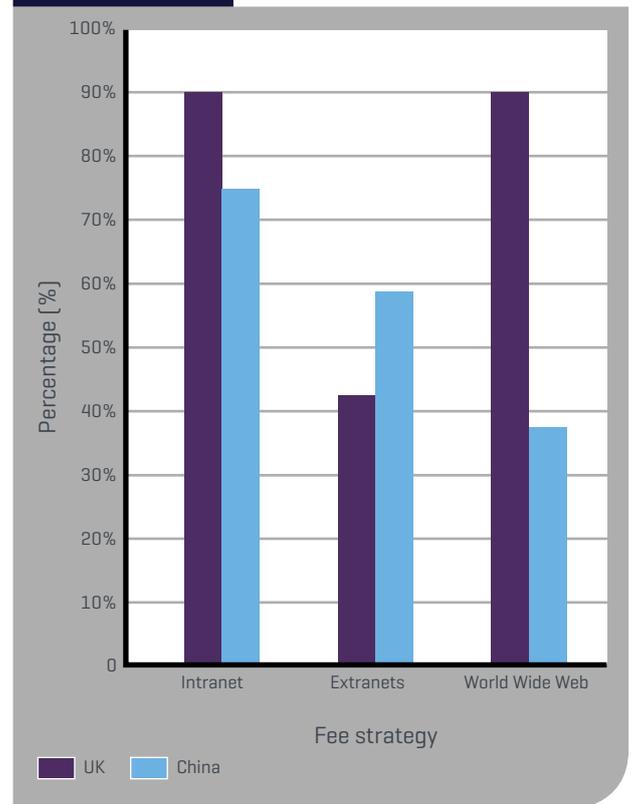
#### 6.2.4.1 Use of Internet Technologies

Figure 6.10 indicates that the Intranet (92%) and WWW (92%) are used heavily in the UK with less than half using Extranets. Firms in China use internet technologies significantly differently with 75% using Intranet and over 50% usage of Extranets. The WWW usage is significantly lower (38%) reflecting the barriers and limitations imposed by the state on the use of the Internet.

Figure 6.11 analyses the use of internet technologies by functional purpose that reflects high usage for day to day business functions but limited usage for marketing and other related purposes.

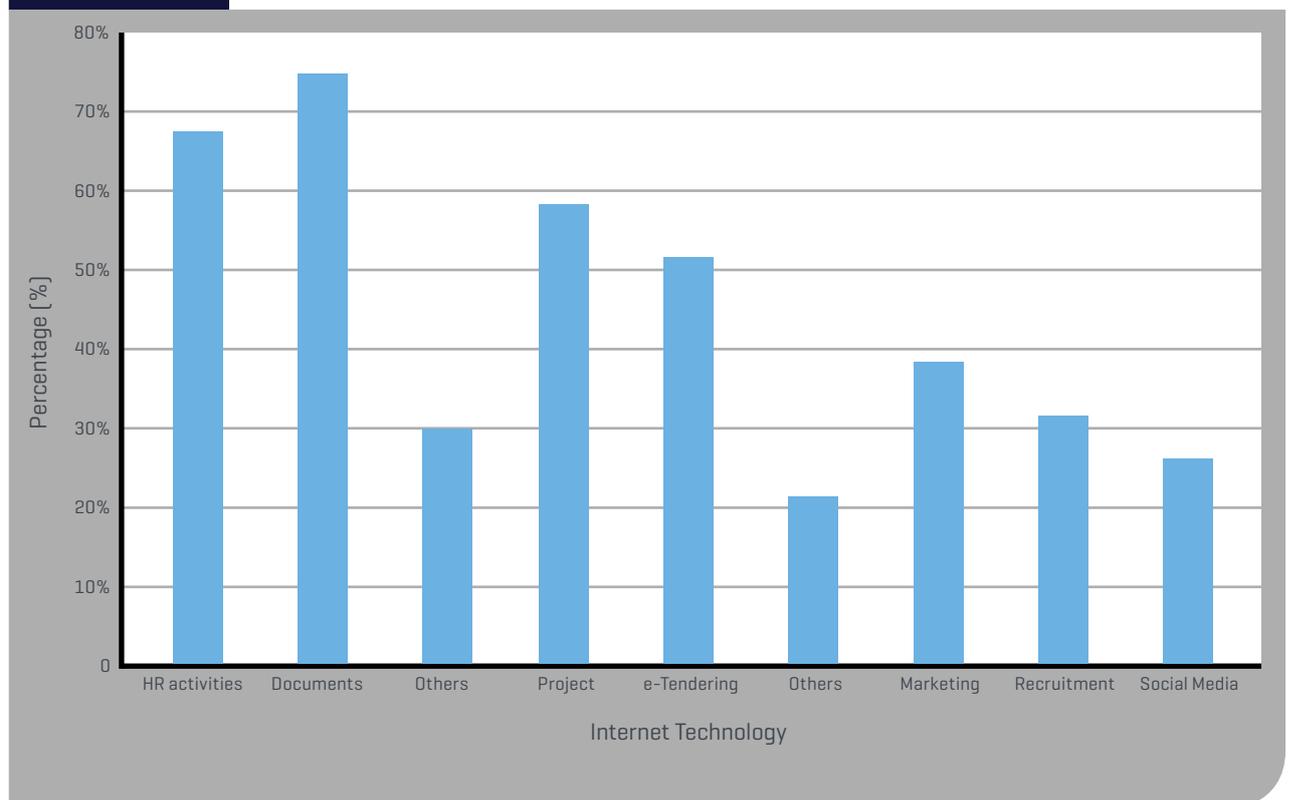
**Figure 6.10**

**Use of Internet Technologies**

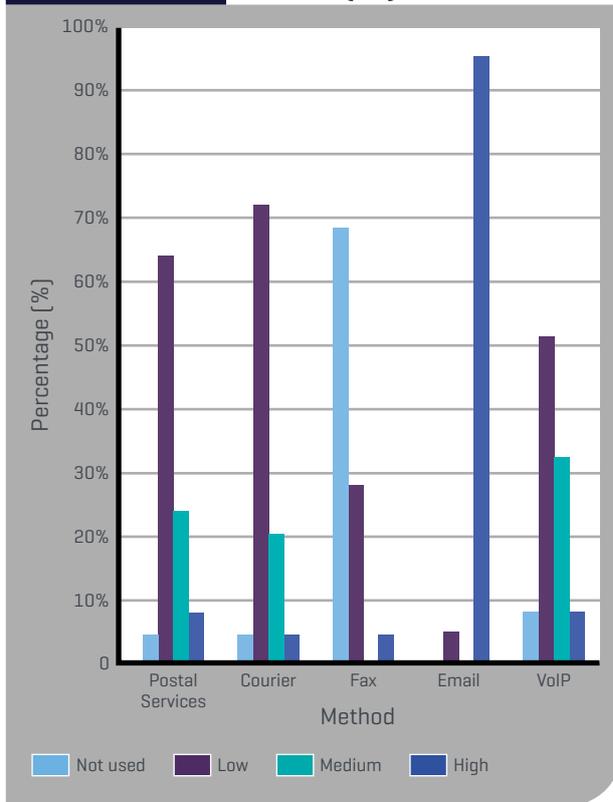


**Figure 6.11**

**Use of Internet Technologies by Functional Purpose (China)**



**Figure 6.12** External Communication Methods (UK)



### 6.2.4.2 Methods of Communication

Methods of business communications and were analysed in (see Figure 6.12 and Figure 6.13). It was clear that email was the most commonly used external communication method (96% – UK and 84% – China both at High level). This is reflective of its cost effectiveness, high usage by other organisations, faster and instantaneous nature of communication. The second most used method in China was the Voice over Internet Protocol (VoIP) followed by Fax. Again, this can be put down to cost and how quickly communications can be transmitted or delivered.

### 6.2.5 Type of professional services delivered

#### 6.2.5.1 Core Cost Management Services

QS firms in the UK deliver various types of professional services. These are categorised in to twelve services as shown in Figure 6.14. The result indicates that all 12 services are always or frequently used by 40% UK practices. This does not come as a surprise because these services are the core cost management services that these QS organisations provide but re-affirm prominence of these.

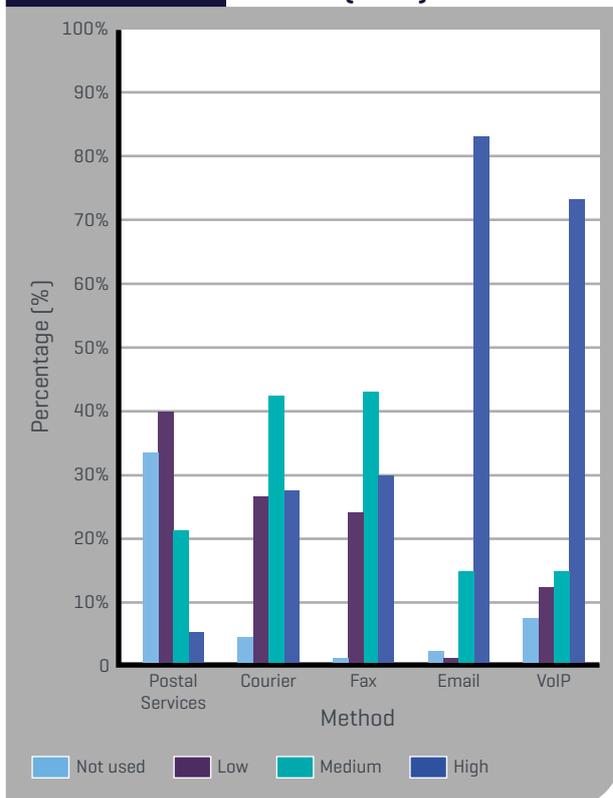
In China, the EC service profile seems significantly different (Figure 6.15). The prominent use is indicated in Measurement & Valuation, BoQs, Tendering and Final accounts. These services are then followed by Interim Valuations, Valuing Variations and Claims. The significant minimal provision is primarily in early stage estimating, feasibility studies and cost planning. These are reflective of typical EC service profile focusing from mostly on detailed design to post contract phase related cost management activities. It is also reflected by the fact that a licence system that operate in China limiting and specialising of services provided (see section 8.2).

The difference in service profile somewhat explains the lower fee scales prominent in China (see Figure 6.15).

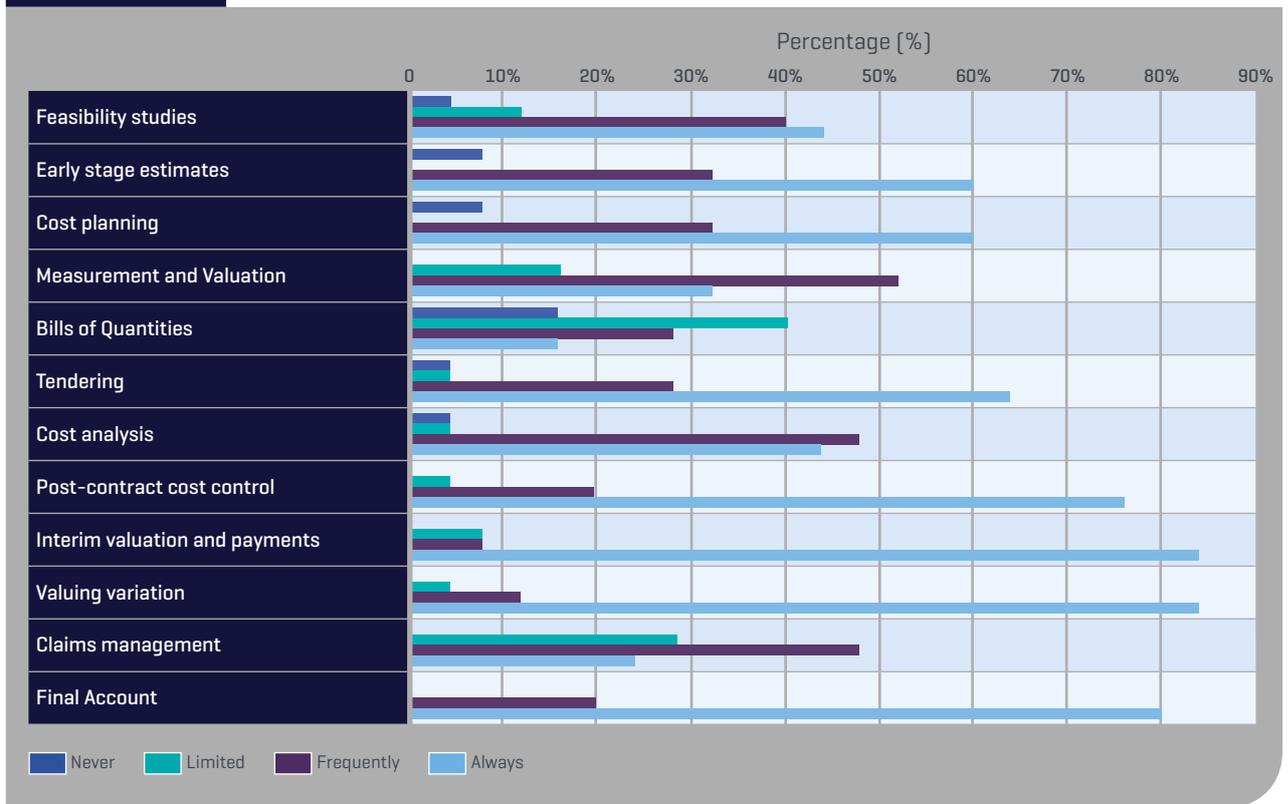
#### 6.2.5.2 Supplementary Services

The supplementary services are those services that are associated with UK QS services but are not seen as the core services of the QS practices. Sixteen of such services as shown in Figure 6.16 were identified. The result of the survey identified contract administration as the most commonly used service and while insurance claim advice as the least used service. Overall, Figure 6.16 depicts an evenly matched variation of usage of these services. Most of services classed as supplementary services in the UK QS service profile are not included in the China EC service profile. However, services related to Contract Administration, Dispute Resolution, and Cost Auditing are somewhat prevalent with some firms in China (see Figure 6.17).

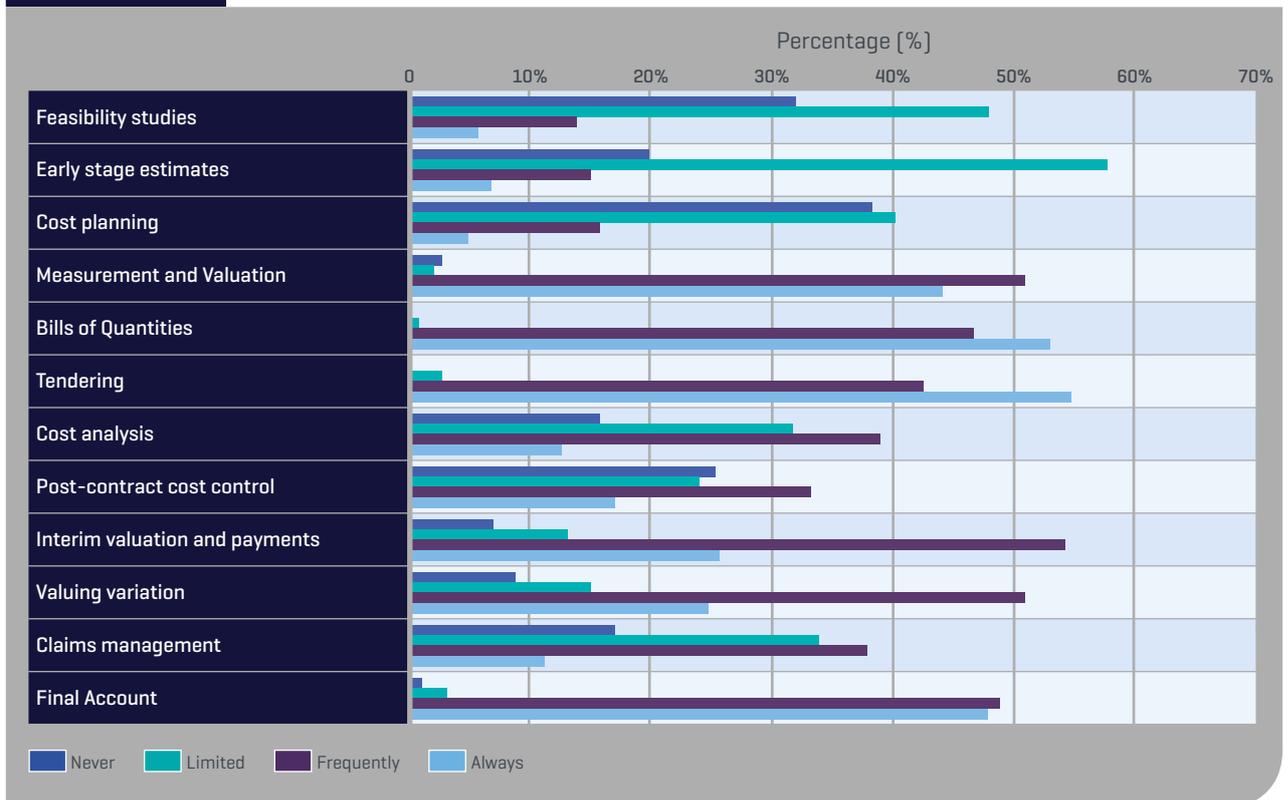
**Figure 6.13** External Communication Methods (China)



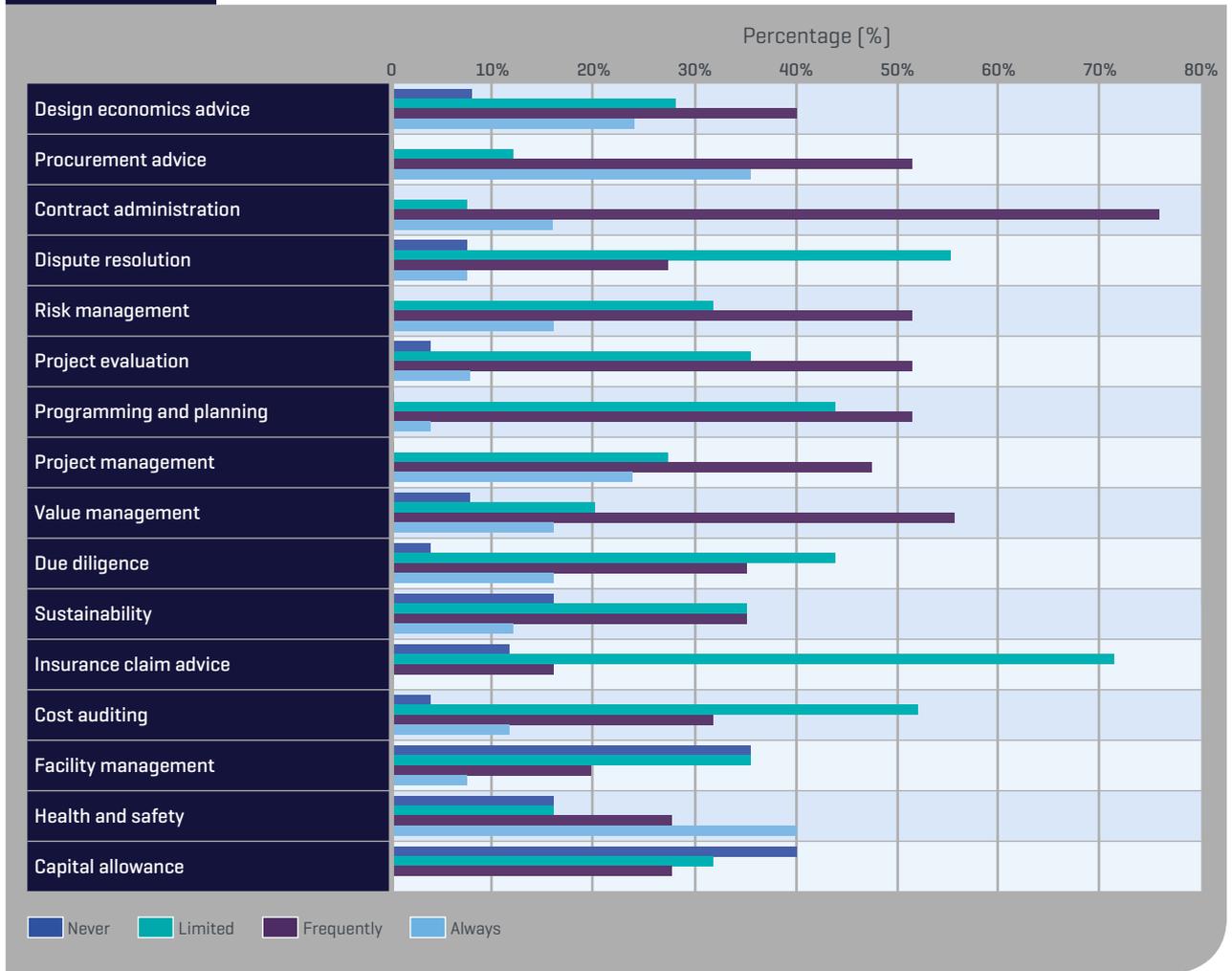
**Figure 6.14** Core Cost Management Services (UK)



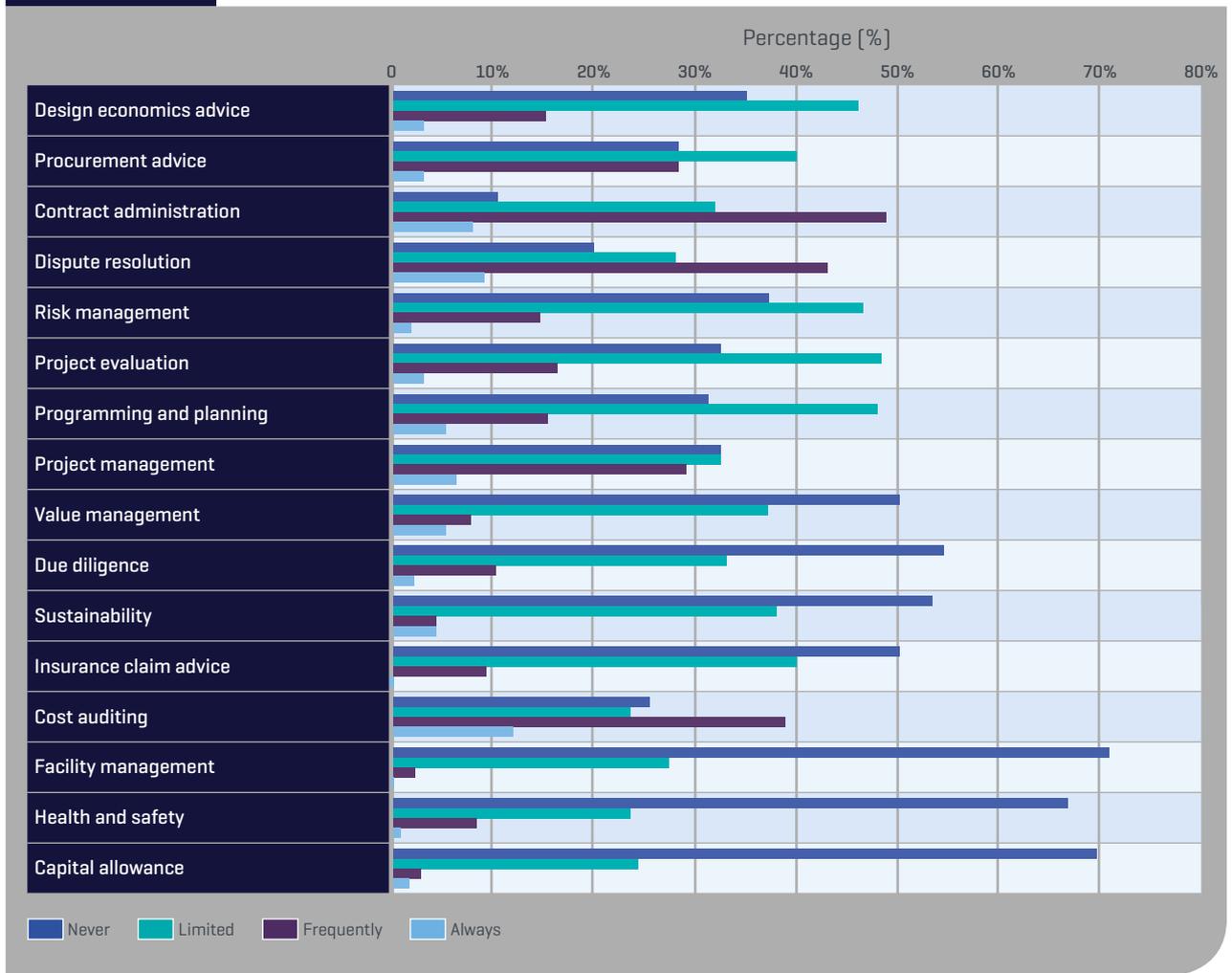
**Figure 6.15** Core Cost Management Services (China)



**Figure 6.16** Supplementary Services (UK)



**Figure 6.17** Supplementary Services (China)



## 6.3 In Depth Review of Cost Management Services

This section reviews cost management practices in the UK and China in four stages: early stage, design development, detailed design and post contract stages. This is then followed up by an analysis of Documents, Tools and Software used for cost management services. Each stage was further divided in to various cost management techniques used and analysed in detail.

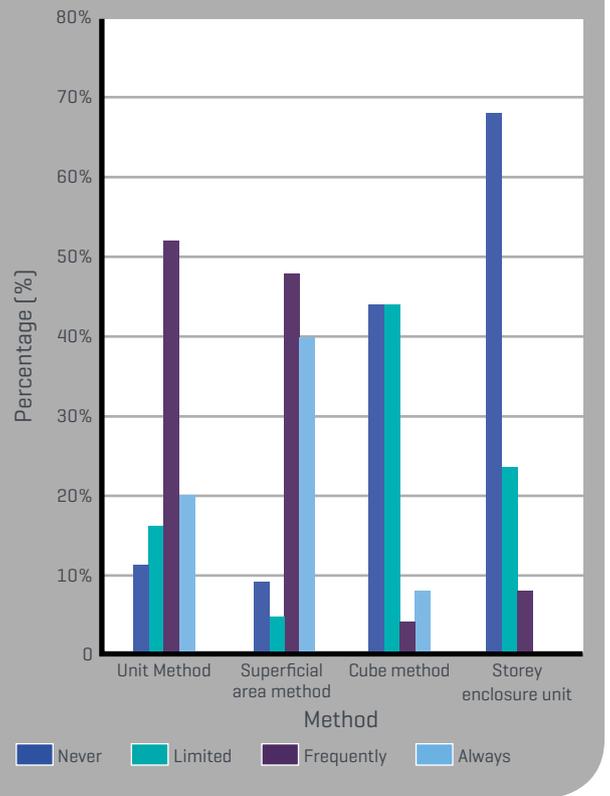
### 6.3.1 Early stage cost management

At the early stages preliminary estimating techniques such as unit method, superficial area method, cube method and storey enclosure unit are used to establish the Order of Cost Estimate (the ballpark estimate). Figure 6.18 depicts the level of usage of these techniques within the UK organisations. The figure shows that the superficial area method is most used technique followed by Unit method. On the other hand, most of the respondents indicated that they have never used or have limited use of the Storey Enclosure Unit method and the Cube method.

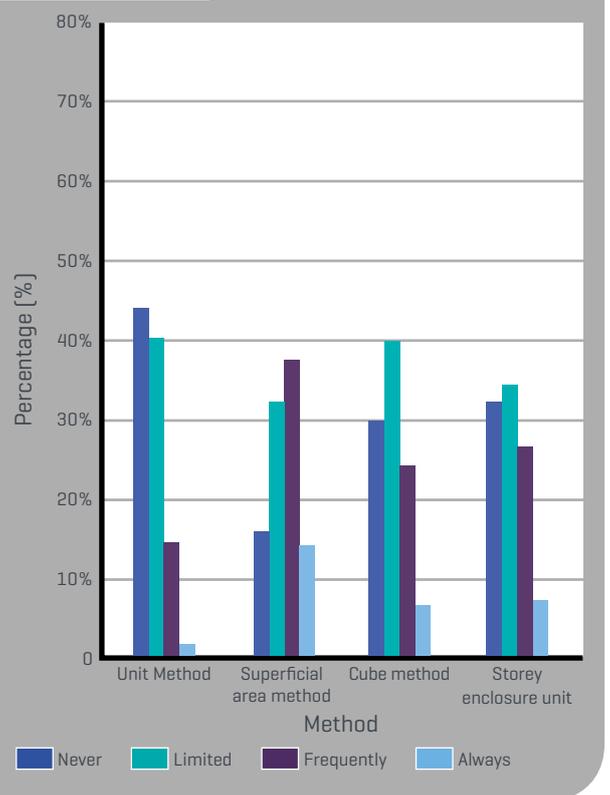
It is interesting to note that many firms in China do not use most of the methods indicated here. This reflects the fact that most EC consultancies are not involved in cost management activities at early stages. It is also explained by the fact that budgetary allocation methods use mostly resource based approaches in China (Figure 6.19).



**Figure 6.18** Preliminary Estimating Techniques (UK)



**Figure 6.19** Preliminary Estimating Techniques (China)



### 6.3.2 Design Development Stage Cost Management

#### 6.3.2.1 Cost Estimating

During Design Development stage detailed cost estimating techniques such as Approximate Quantities and Elemental Estimating techniques are commonly used. These were well confirmed by the survey and interestingly no other technique emerged dominant in the UK (Figure 6.20).

These techniques apply less in China as most of estimating activities still rely on the legacy of the Quota System and based on resource based estimating techniques. There is no dominant approach emerging in China as well (Figure 6.21).

#### 6.3.2.2 Cost Planning

Figure 6.22 depicts the responses related to cost planning activities where the use of NRM 1, BCIS and In-house formats for cost planning were reviewed. It is interesting to note that NRM 1 usage has been significant although it was recently introduced. Furthermore the latest NRM 1 revision now has a commonly agreed format with BCIS and hence are clearly becoming the industry standard both in theory and practice. Notable contingent still use in-house formats for cost planning.

There is no cost planning activity in China. At this stage estimates are based on in-house formats as indicated in Figure 6.21.

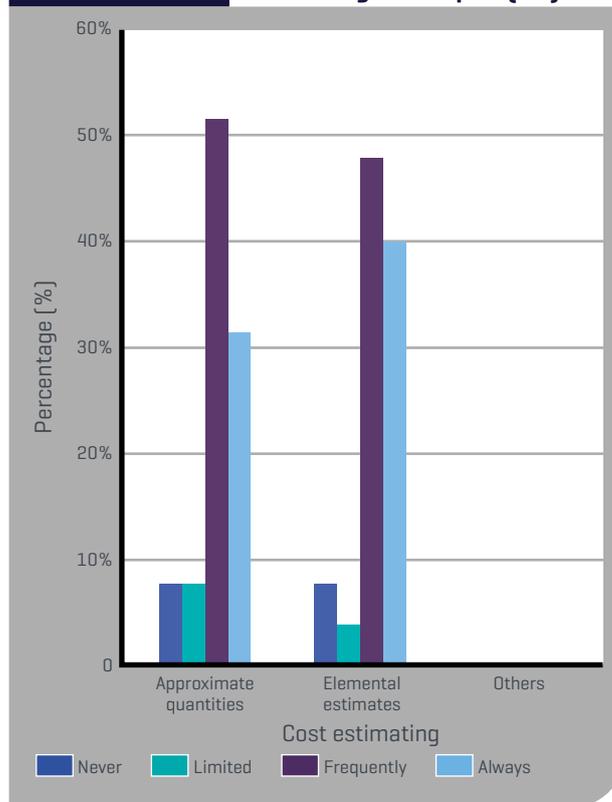
#### 6.3.2.3 Whole Life Costing

It is also interesting to note the rising use of Whole Life Costing and Life Cycle Costing in practice. Figure 6.23 indicates that 92% of responding organisations have either frequent or limited use of the technique in the UK. However, WLC/LCC is not much used in the China and it is at early stages of penetration in to the EC service profile.

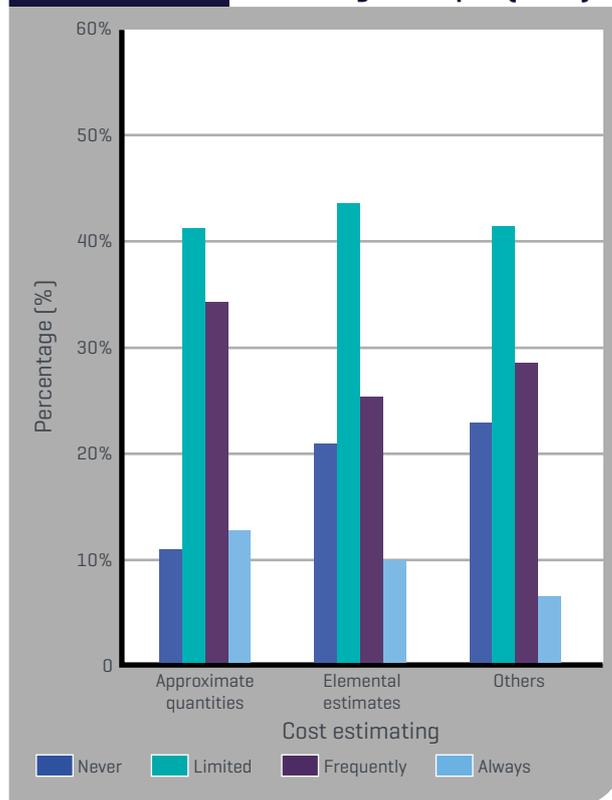
#### 6.3.2.4 Risk Management

The use of Risk Management techniques were reviewed and presented in Figure 6.24 and Figure 6.25. It indicates that Risk Registers (32% - always) as the predominant technique use to manage risk with considerable usage of Brainstorming (52% - frequently) as well. Risk management is also in its early stages of introduction to the construction industry in China. 95% organisations do not provide Risk Management services.

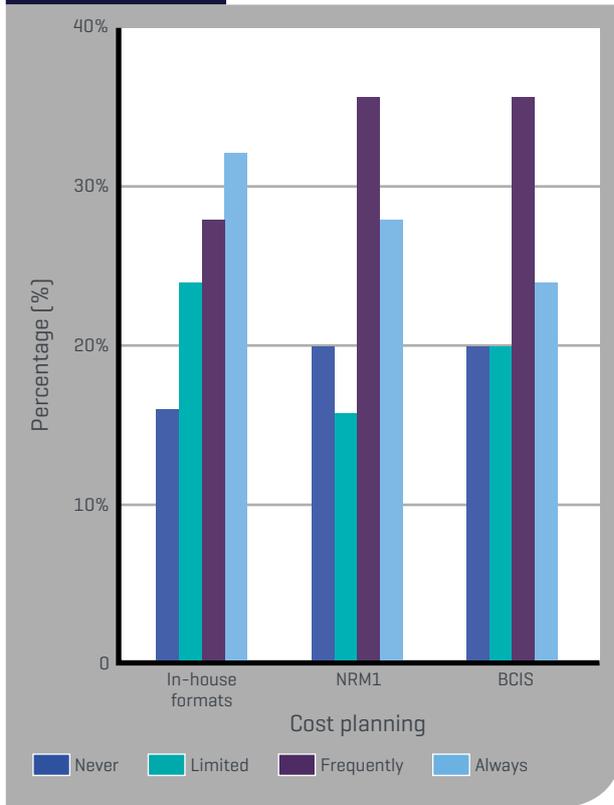
**Figure 6.20** Design Development Stage Cost Estimating Techniques (UK)



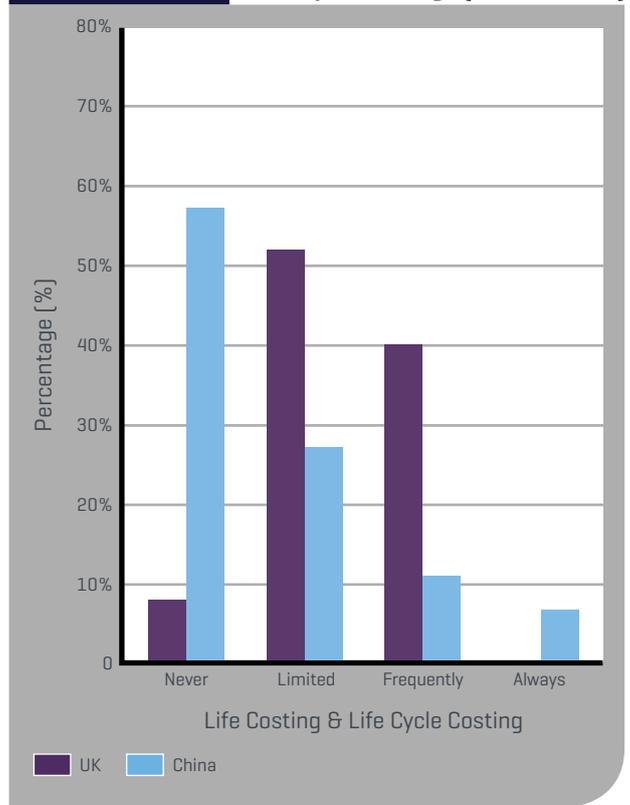
**Figure 6.21** Design Development Stage Cost Estimating Techniques (China)



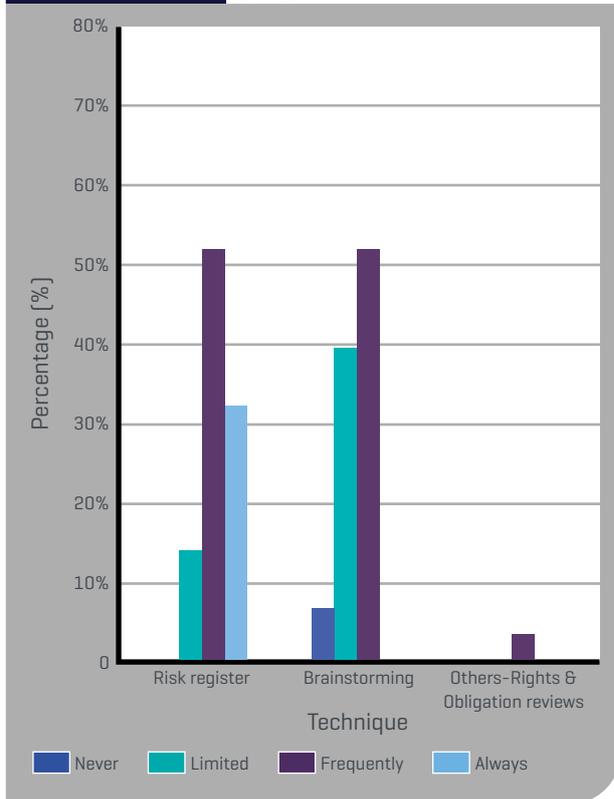
**Figure 6.22 Cost Planning Techniques (UK)**



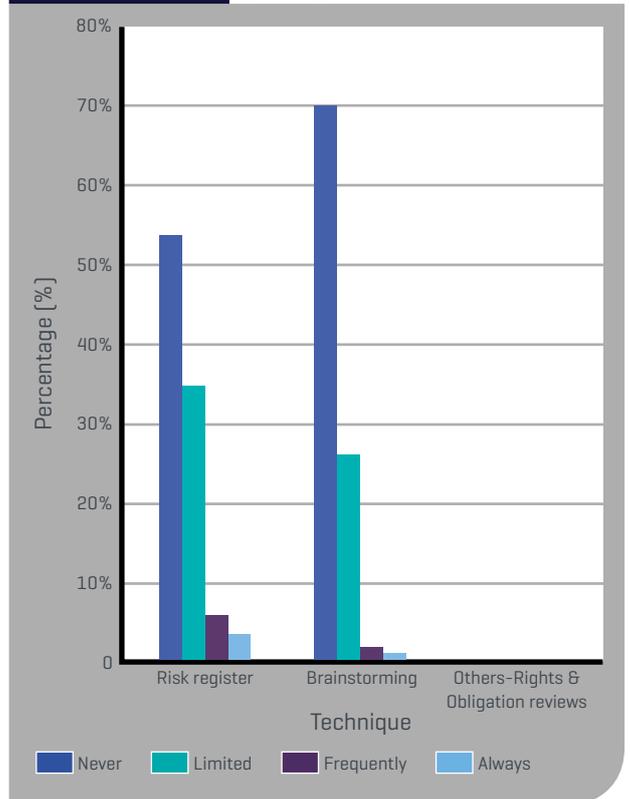
**Figure 6.23 Use of WLC/LCC at Design Development Stage (UK and China)**



**Figure 6.24 Risk Management Techniques (UK)**



**Figure 6.25 Risk Management Techniques (China)**



### 6.3.3 Detail Design Stage Cost Management

The detail design stage for cost management was reviewed under four key categories: cost estimating, cost planning, cost analysis and WLC/LCC. The results of the survey analysis for these four key activities are reported in the following sub-sections.

#### 6.3.3.1 Cost Estimating

The main techniques used for detailed estimating were reviewed in Figure 6.26 and Figure 6.27. It indicates that BoQ as the main method of detailed estimating. Over 50% indicated that they do not use BoQs or use limitedly. This is reflective of the fact that BoQs are increasingly being replaced with detailed Cost Plans (see next section). It is also noted that nearly 50% organisations use resource based estimating techniques as well.

The supervise element was to note that 5 organisations indicating that they use Quota Systems at detailed stage. However, it is not clear whether these respondents indicated this thinking of their organisations practice in China.

It is clear that BoQs are gaining increased popularity in China with over 90% indicating their heavy usage. However, other resource based methods and Quota System is still equally popular in China. This indicates that China is in a stage of transition from the legacy of centrally planned Quota Systems to a market oriented BoQ based estimating system.

#### 6.3.3.2 Cost Planning

This section reviews the use of Cost Planning techniques at the detailed stage of design (Figure 6.28 and Figure 6.29). The results found are very similar to the Design Development stage where NRM1 and BCIS dominating but closely followed by In-house systems. NRM1 has filled a gap in the UK cost management systems by providing a standard for the industry. It is clear that it has been well received by the industry.

Cost planning is not practiced in China in the way it is practiced in the UK. This is evident from Figure 6.28 above with overwhelming majority stating they never use or limited use. However, the practice is changing with British influence and cross fertilisation of techniques from foreign trained or experienced EC consultants returning to China.

#### 6.3.3.3 Cost Analysis

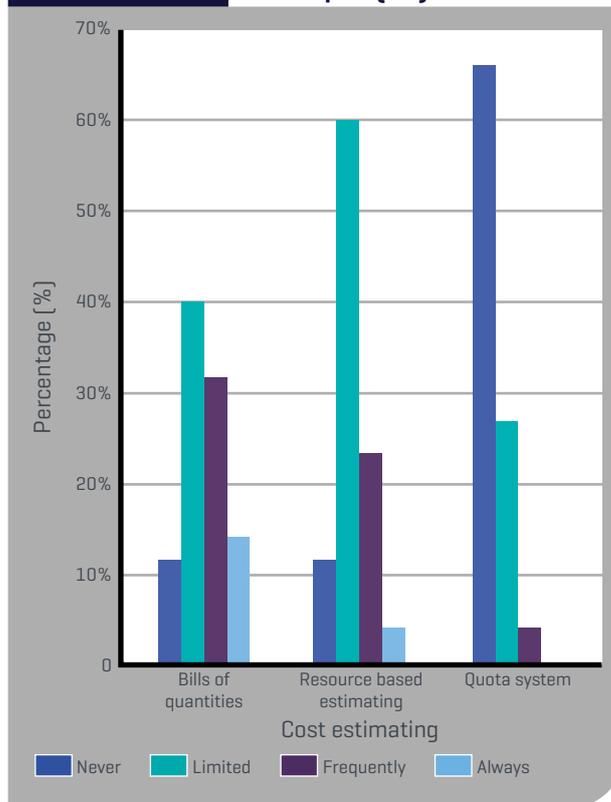
In terms of usage of cost analysis formats the results were unsurprisingly similar to the use of cost planning techniques. The latest NRM1 have harmonised the elemental layouts with BCIS and hence there will be greater uniformity expected in the UK industry than portrayed here (Figure 6.30).

In the absence of a clear elemental format in China the use of cost analysis in the format used in the UK is not present in China.

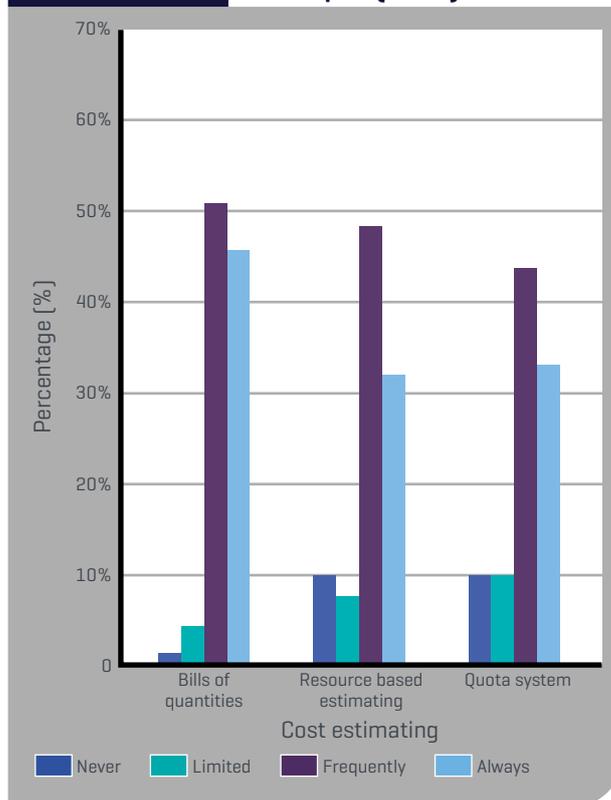
#### 6.3.3.4 Whole Life Costing

Whole life costing and Life Cycle Costing are not heavily used in the UK industry and recently being introduced to China. Only less than 35% indicated that it is always or frequently used for projects in the UK. The figure drops down to 15% for China (Figure 6.31).

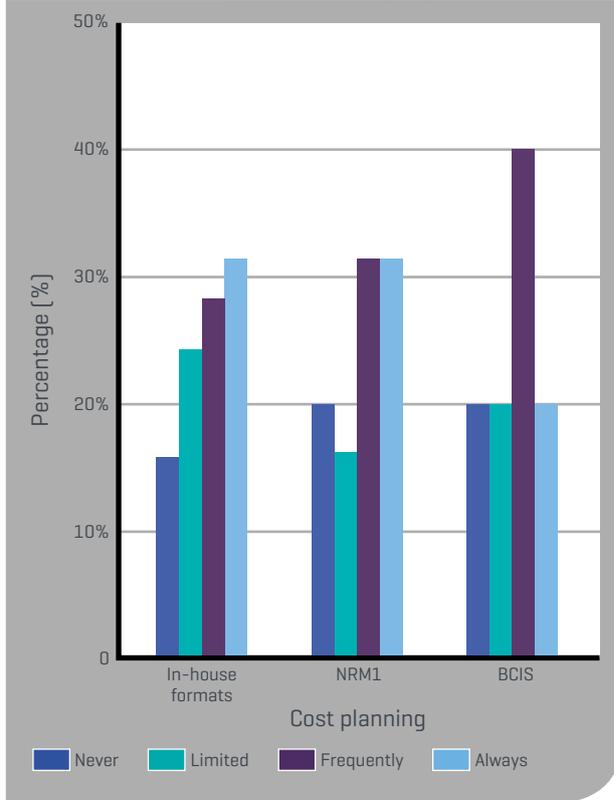
**Figure 6.26** Detailed Stage Cost Estimating Techniques (UK)



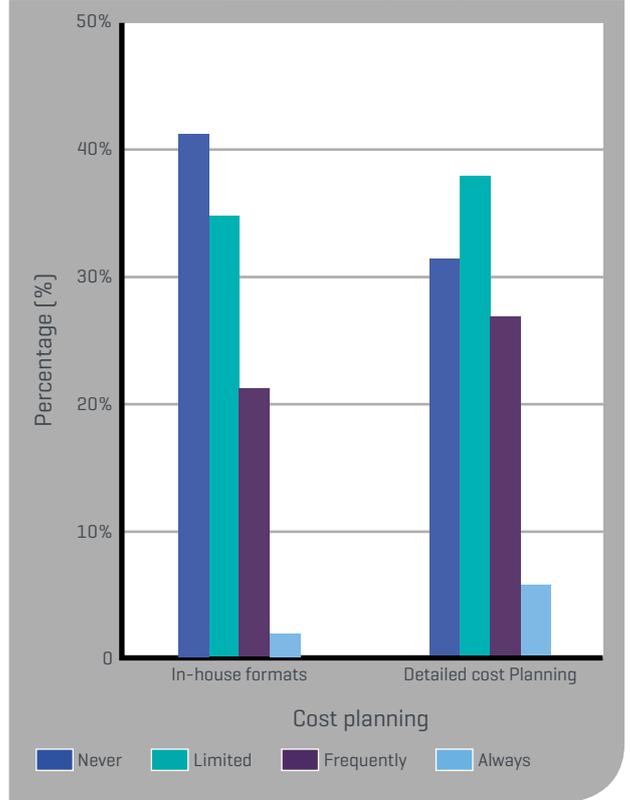
**Figure 6.27** Detailed Stage Cost Estimating Techniques (China)



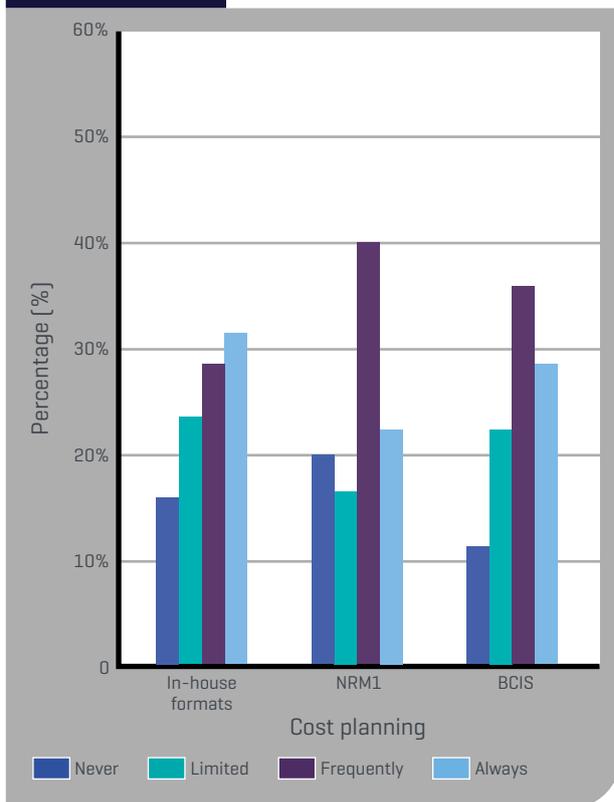
**Figure 6.28 Detailed Cost Planning Approaches (UK)**



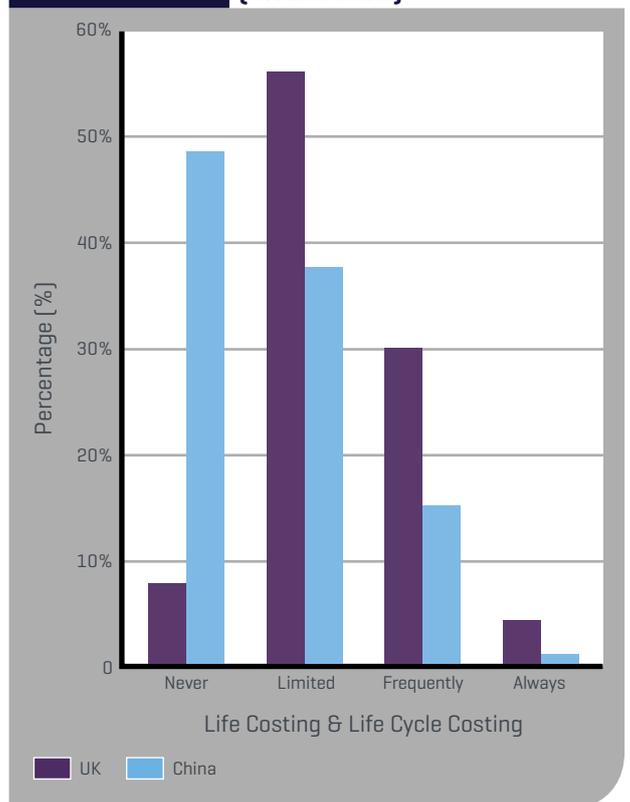
**Figure 6.29 Detailed Cost Planning Approaches (China)**



**Figure 6.30 Use of Cost Analysis (UK)**



**Figure 6.31 Use of WLC/LCC at detailed stages (UK and China)**



### 6.3.4 Post-Contract Stage Cost Management

The post-contract stage for cost management cover three key activities: interim valuations cost controlling, and variations (change management). The results of the survey analysis for these three key activities are reported in following sub-sections.

#### 6.3.4.1 Interim Valuations

This section reviews the use of different techniques for interim valuations in construction projects. Figure 6.33 indicates that 80% (always & frequent) use actual measurements for valuations while 64% (always & frequent) use BoQs. It is also noted that there is still considerable usage of percentage based valuations (54% always & frequent) in the industry.

Usage pattern of Interim Valuation techniques in China are very similar to UK with BoQ and Actual measurements dominating with small amount of percentage based valuations (Figure 6.32).

#### 6.3.4.2 Cost Controlling

This section evaluates the use of cost controlling techniques during the post contract stage. Figure 6.34 indicates the prominent use of cash flow forecasting (84% at always and frequent) and value of work done evaluations (88% at always and frequent) closely followed by Project Programme Tracking (68% at always and frequent) in the UK.

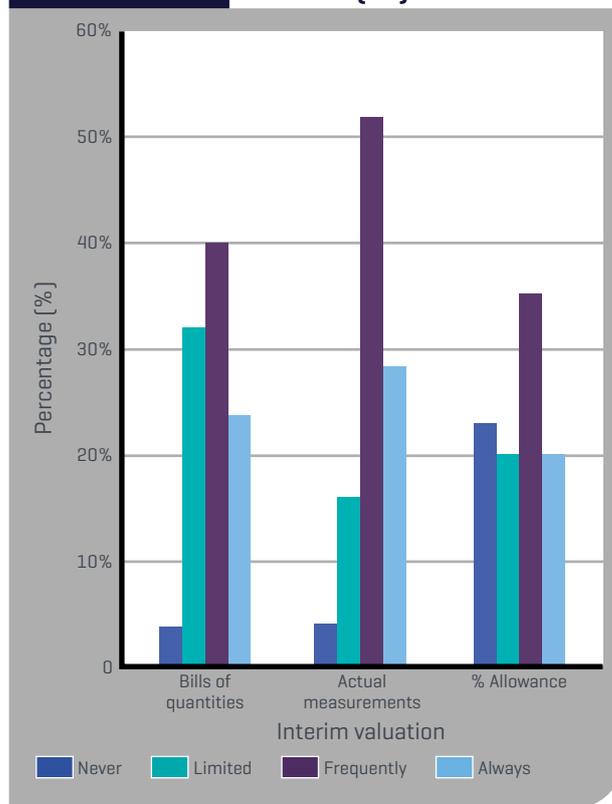
Post contract cost control in China is predominantly uses Value of work completed as the basis of cost control with limited use of Cash Flow Forecasting in comparison to the UK practice. However, there is an even spread of use of the other two techniques indicated (Figure 6.35).

#### 6.3.4.3 Valuing Variations

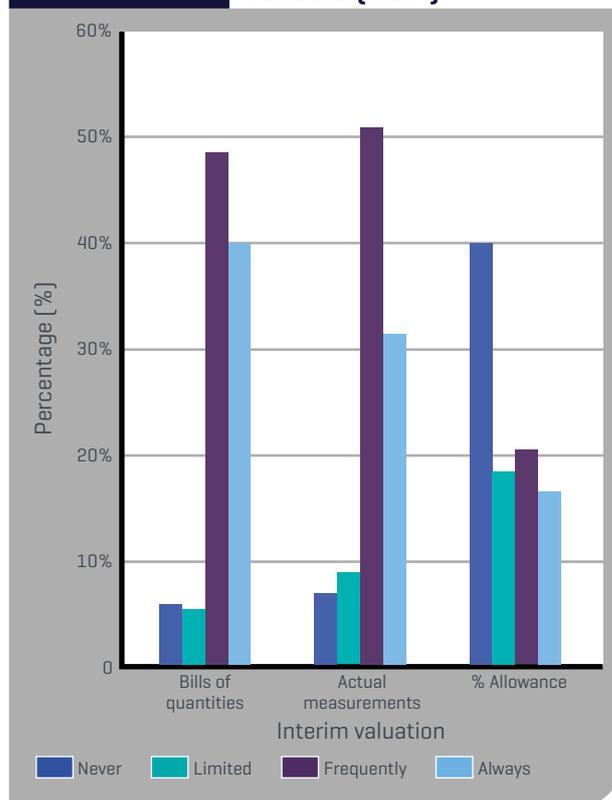
This section reviews techniques used for valuing variations in contracts. It indicates (Figure 6.36) that BoQ rates and Pro rata rates as the main methods (80% Always and Frequently for both) followed by New rates (76% Always and Frequently) in the UK.

Use of BoQ rates and New rates have been indicated as equally important in valuing variations in China (Figure 6.37).

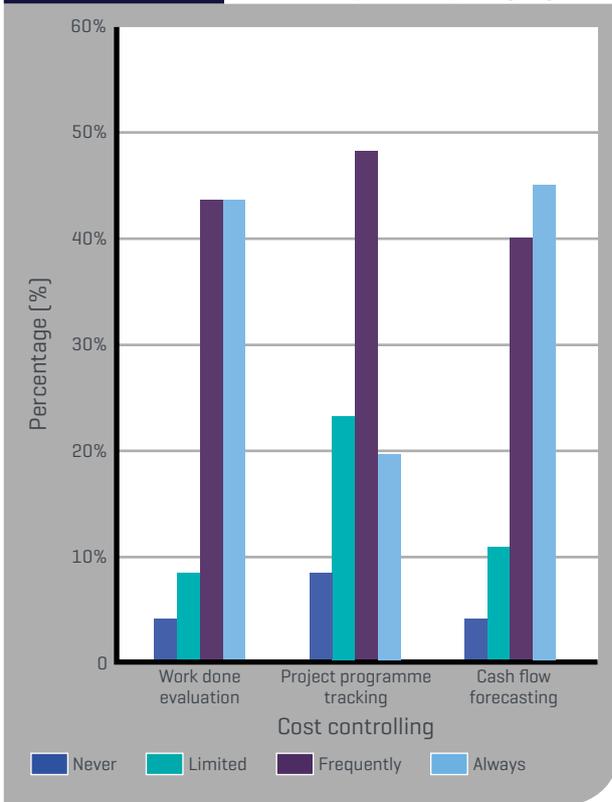
**Figure 6.32** Methods used for Interim Valuation (UK)



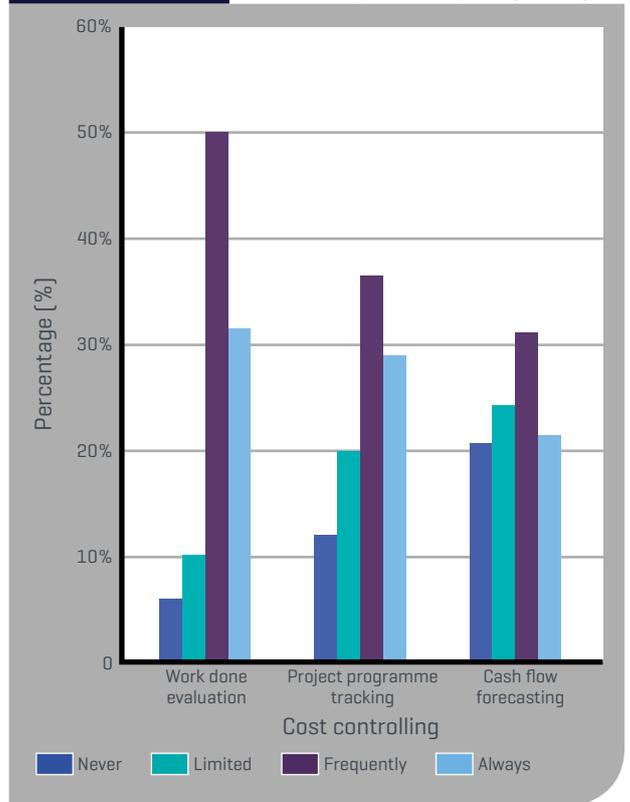
**Figure 6.33** Methods Used For Interim Valuation (China)



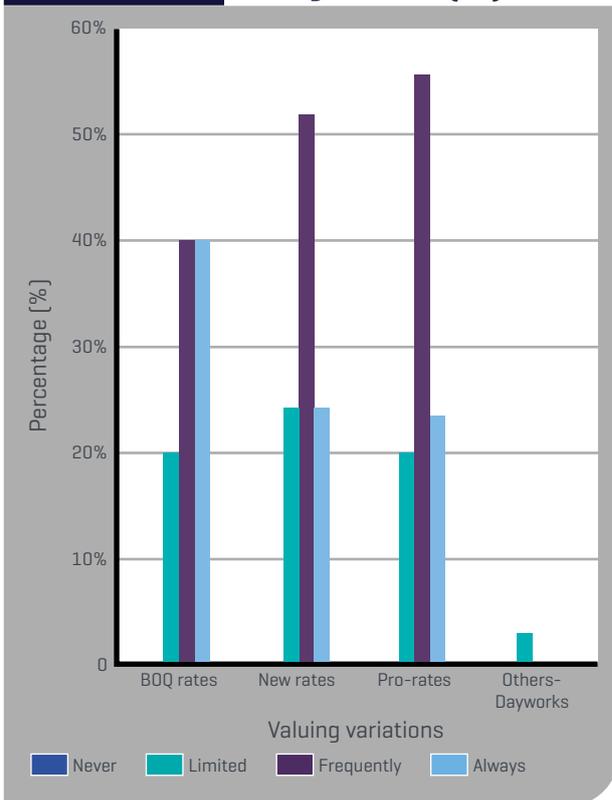
**Figure 6.34 Detailed Design Stage Cost Controlling Techniques (UK)**



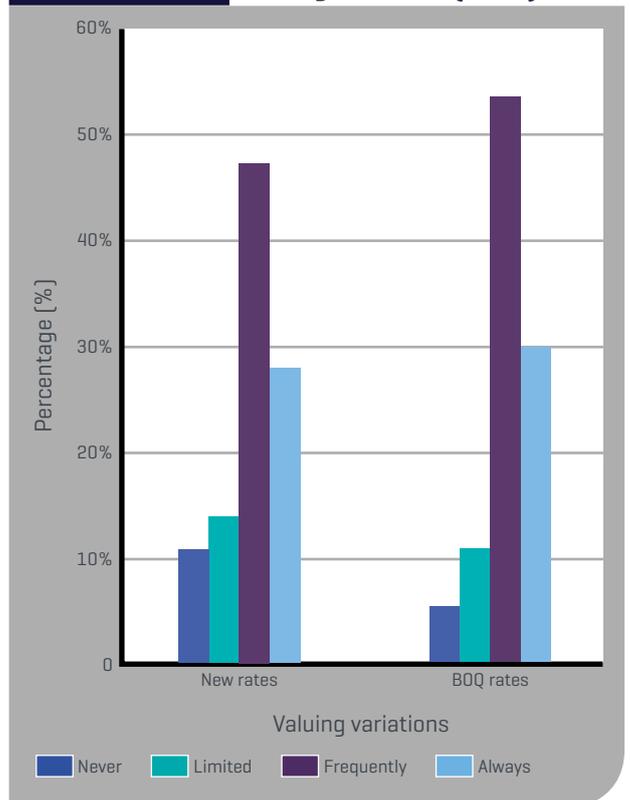
**Figure 6.35 Detailed Design Stage Cost Controlling Techniques (China)**



**Figure 6.36 Techniques Used For Valuing Variations (UK)**



**Figure 6.37 Techniques Used For Valuing Variations (China)**



### 6.3.5 Documents and Tools Used in Exercising Cost Management Services

There are various documents and tools used in providing cost management services. Figure 6.38 indicates the review of sixteen different documents and tools used in UK cost management practices.

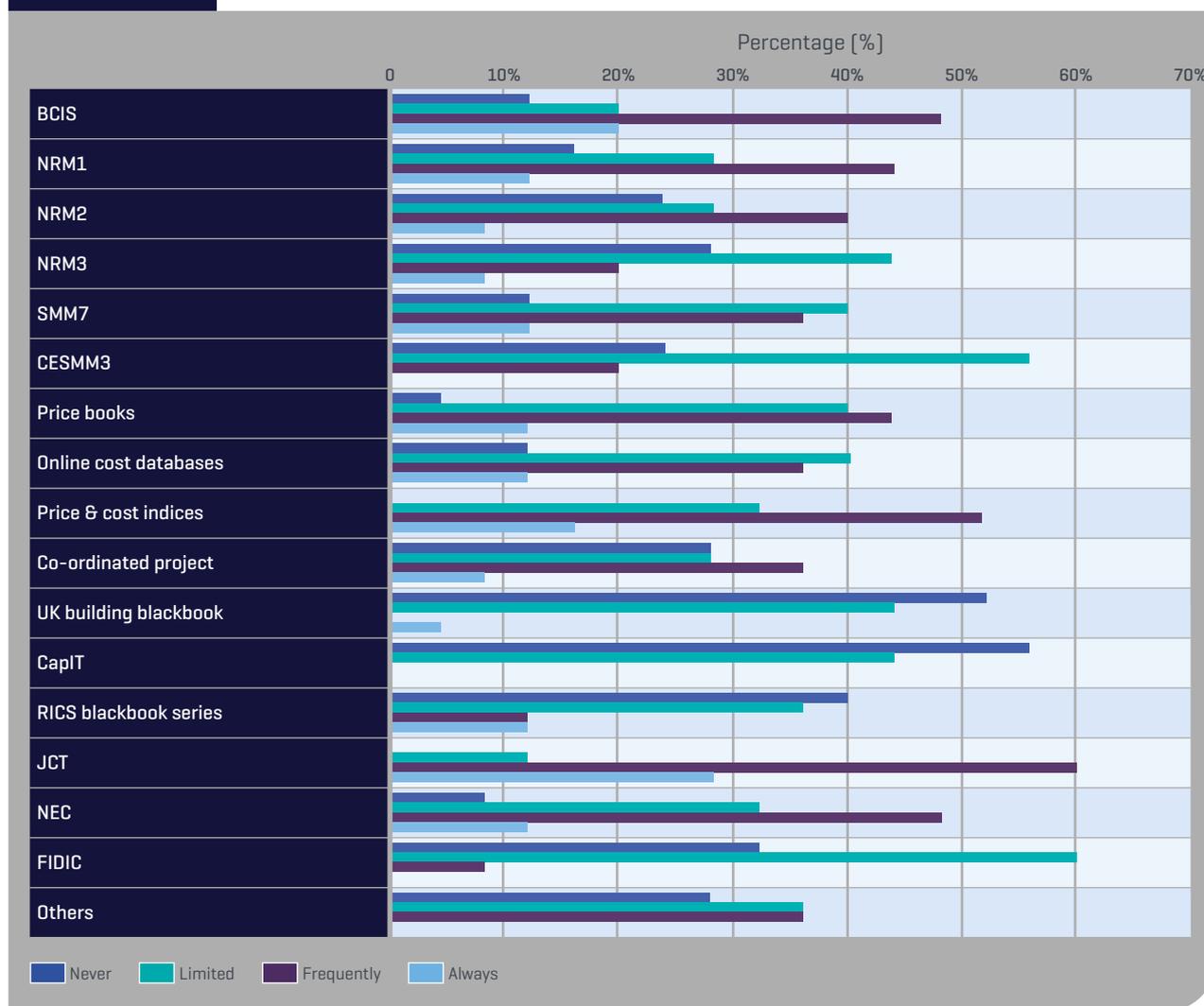
Traditional tools such as BCIS and Price Books, as expected are clearly of high usage. It is interesting to note the increasing levels of popularity of the NRM suite of documents though recently introduced. NRM1 indicates 56% and NRM2 48% (Always and Frequent) usage.

The Black Book series published by the RICS have yet to penetrate the practice adequately. This might be due to lack of awareness. It is also noted that Embodied Carbon estimating data book CapIT has limited usage among

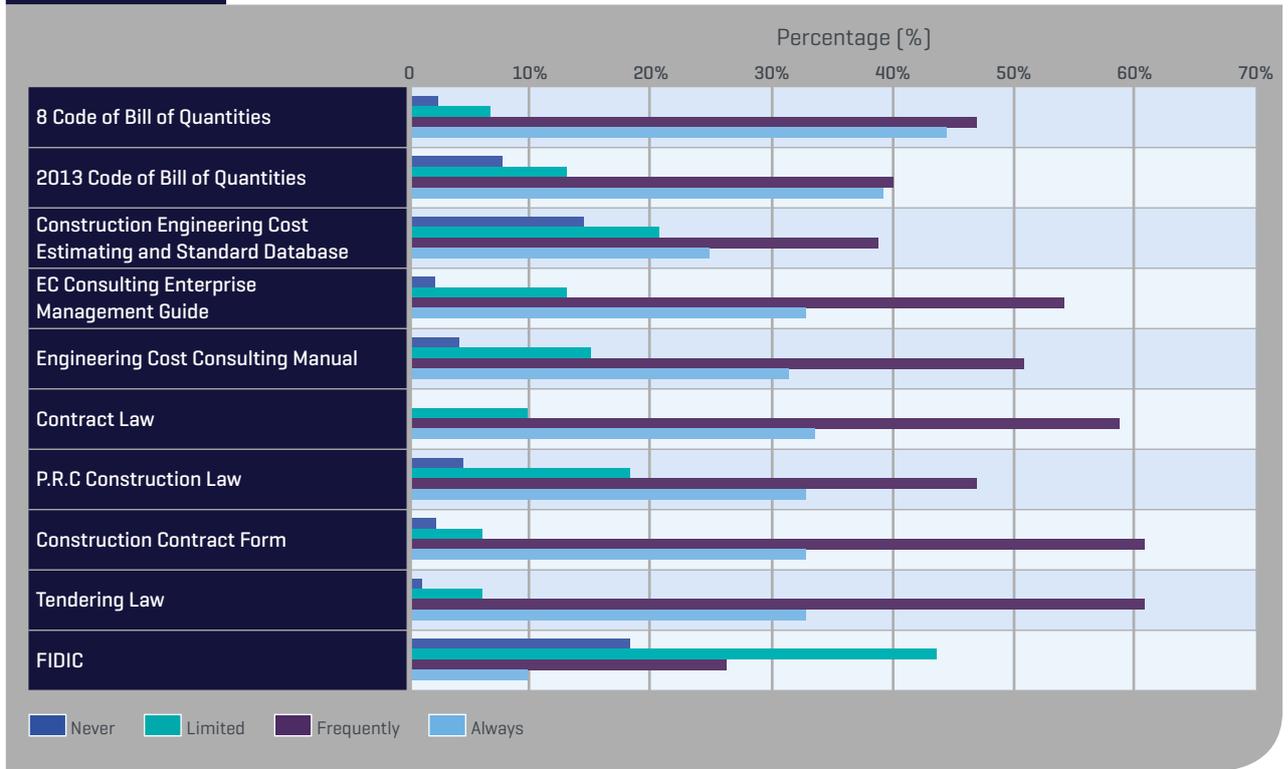
respondents. This could be due to limited practice of carbon estimating itself. The standard forms stack up in order of JCT, NEC and FIDIC in terms of popularity in practice.

Ten different tools and documents used for cost management practices were surveyed in China (Figure 6.39). The analysis indicates a prolific use of almost all surveyed except FIDIC conditions of contract. This could echo upon the limited interest in internationalisation from the EC firms in China (as demonstrated in the Case Studies, section 7.2).

**Figure 6.38 Documents & Tools Used For Cost Management Services (UK)**



**Figure 6.39** Documents & Tools Used For Cost Management Services (China)



### 6.3.6 Software Usage for Cost Management Services

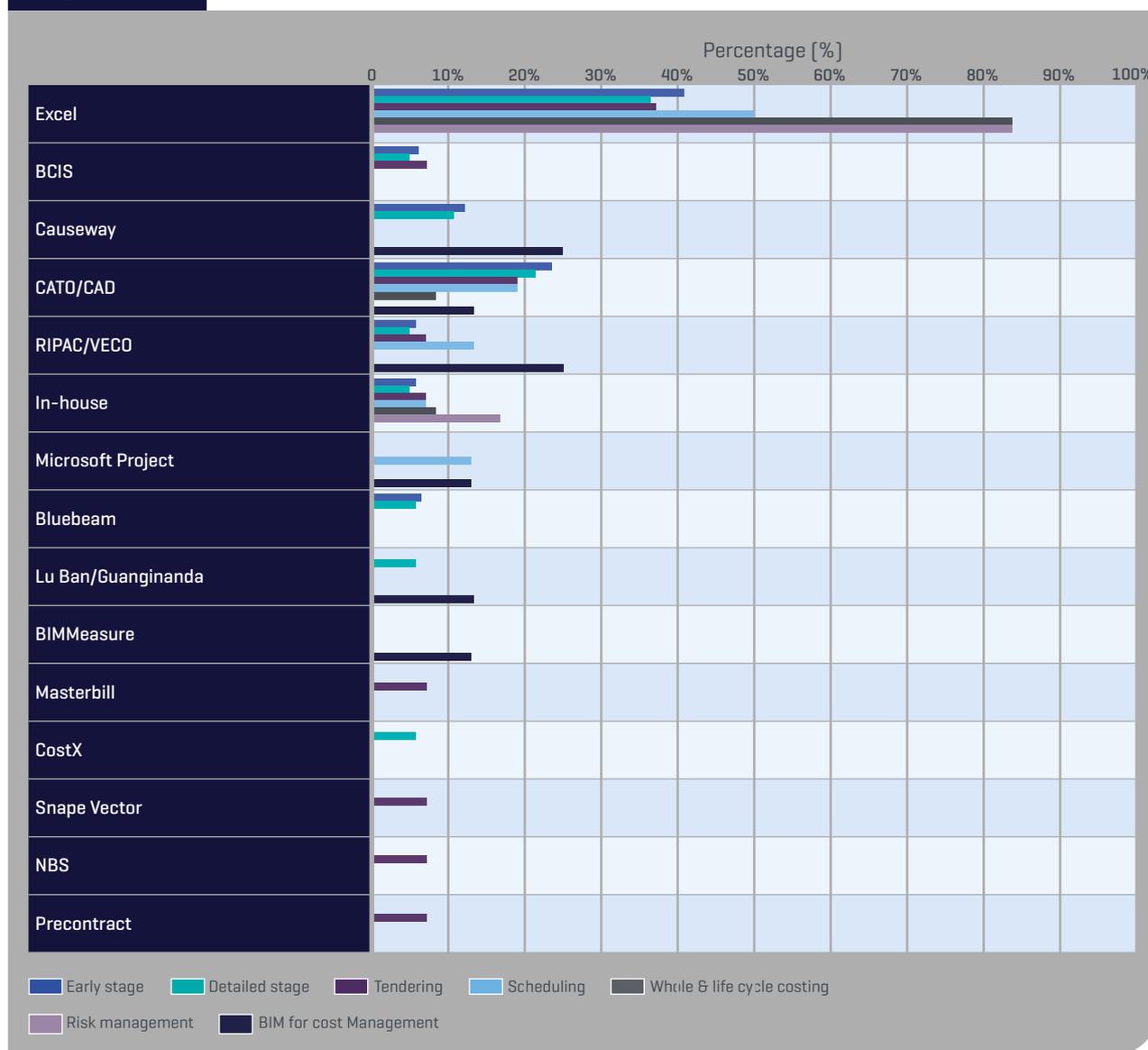
This section analyses software usage for various cost management service activities at different stages as an overview. Figure 6.40 indicates that there is clearly significant level of software usage in the practice of cost management right across all activities and especially at the pre-contract stages. There are noticeably lower levels of software usage for Life Costing and Risk Management. 40% of the organisations indicated that they do not use BIM with further 12% indicating limited usage despite severe push from the government and the professional bodies.

There is demonstrable strong usage of software for cost management activities in China (Figure 6.42). However, in a similar way to the UK practice there is limited usage of software for Scheduling, WLC/LCC and Risk Management

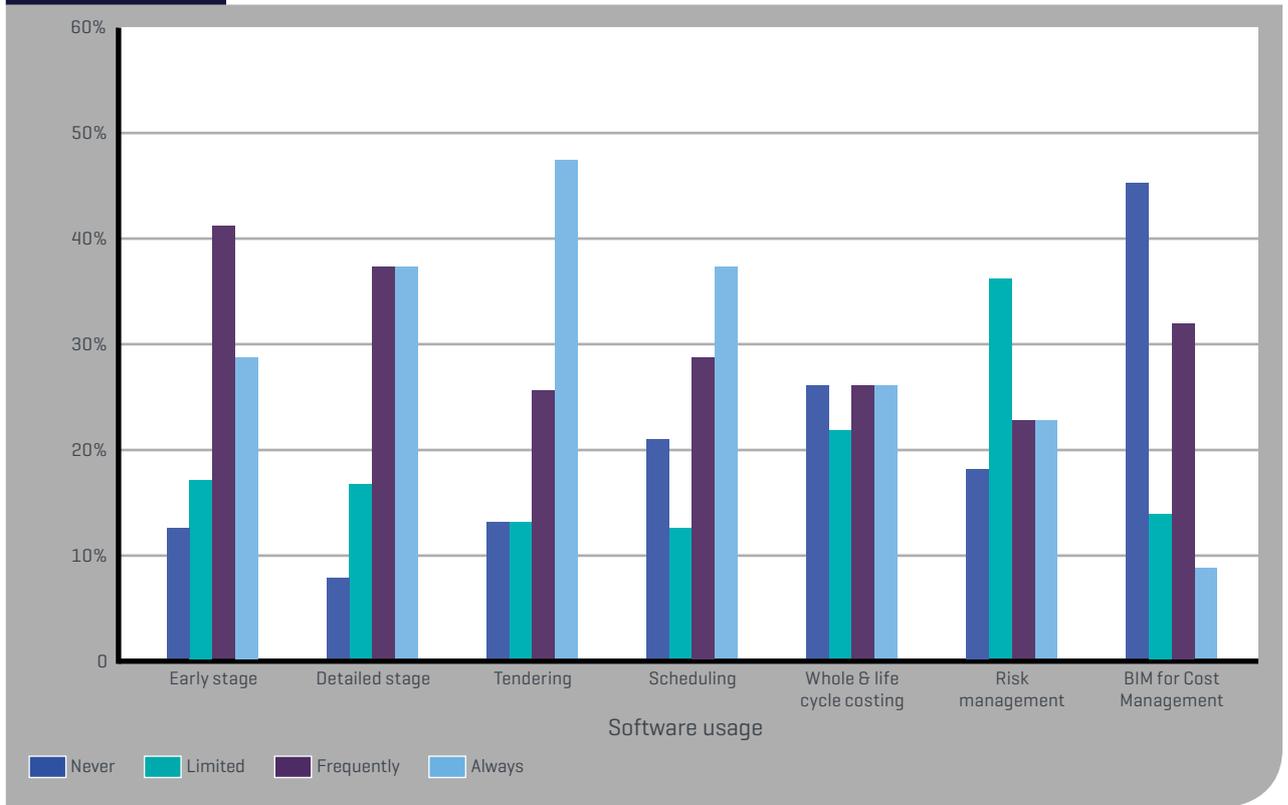
activities in China. This could also reflect on the earlier finding the WLC/LCC and Risk Management is not much used in the industry at present while in case of scheduling it may fall within the practice of other disciplines. Another noted low usage is in BIM where over 50% indicated that they have never used while further 35% indicated Limited usage. Only 10% have considerable usage of BIM where his figure stacks at 40% for the UK.

The survey also reviewed the use of specific software for various tasks as indicated in Figure 6.41. It indicates that Excel is the most popular software for most QS functions in the UK. It also indicates that Excel is the predominant software for WLC/LCC and Risk Management. However, some of the contemporary tools such as BIMMeasure, CostX are hardly used by the responding organisations. This is reflective of the current situation in the industry with BIM still not adequately penetrating QS practice.

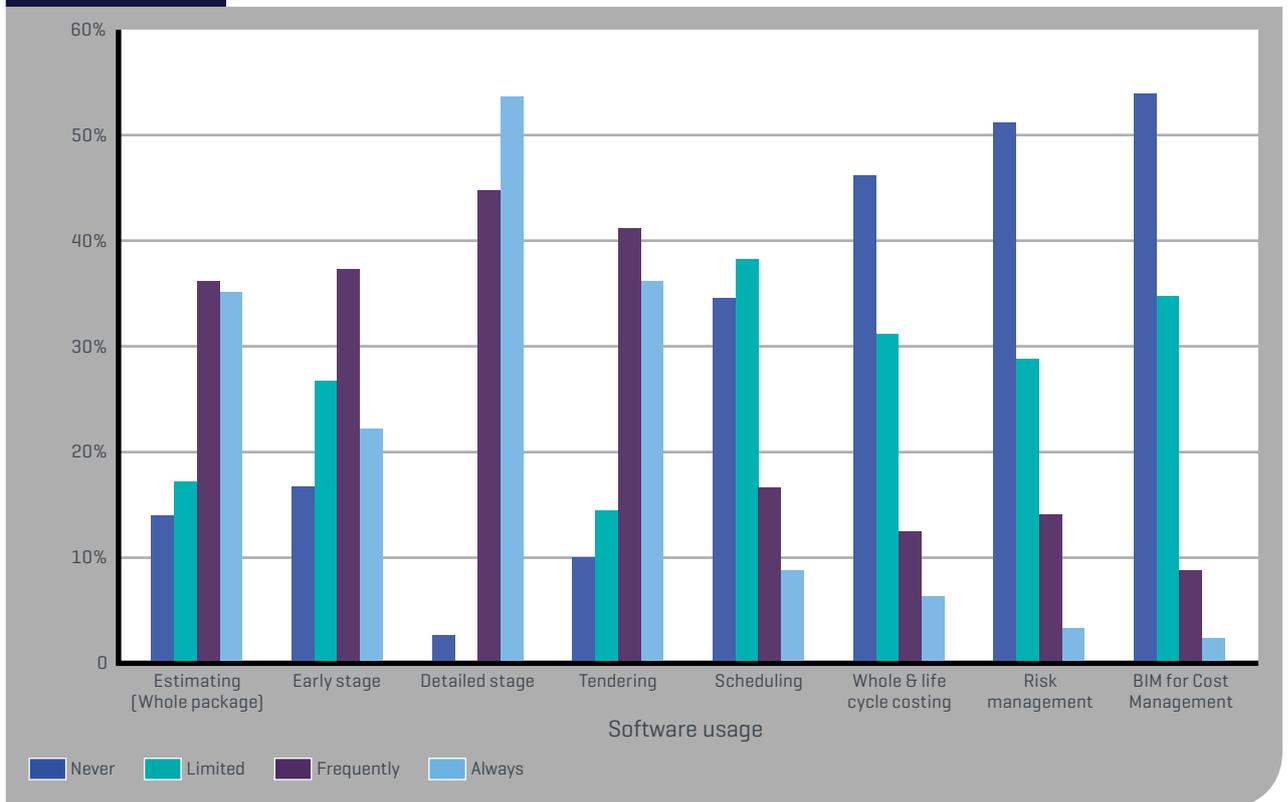
**Figure 6.40** Popular Software and Their Usage by Stage [UK]



**Figure 6.41** Software Usage for Different Types of Cost Management Service (UK)



**Figure 6.42** Software Usage for Different Types of Cost Management Service (China)



## 6.4 Future Trends

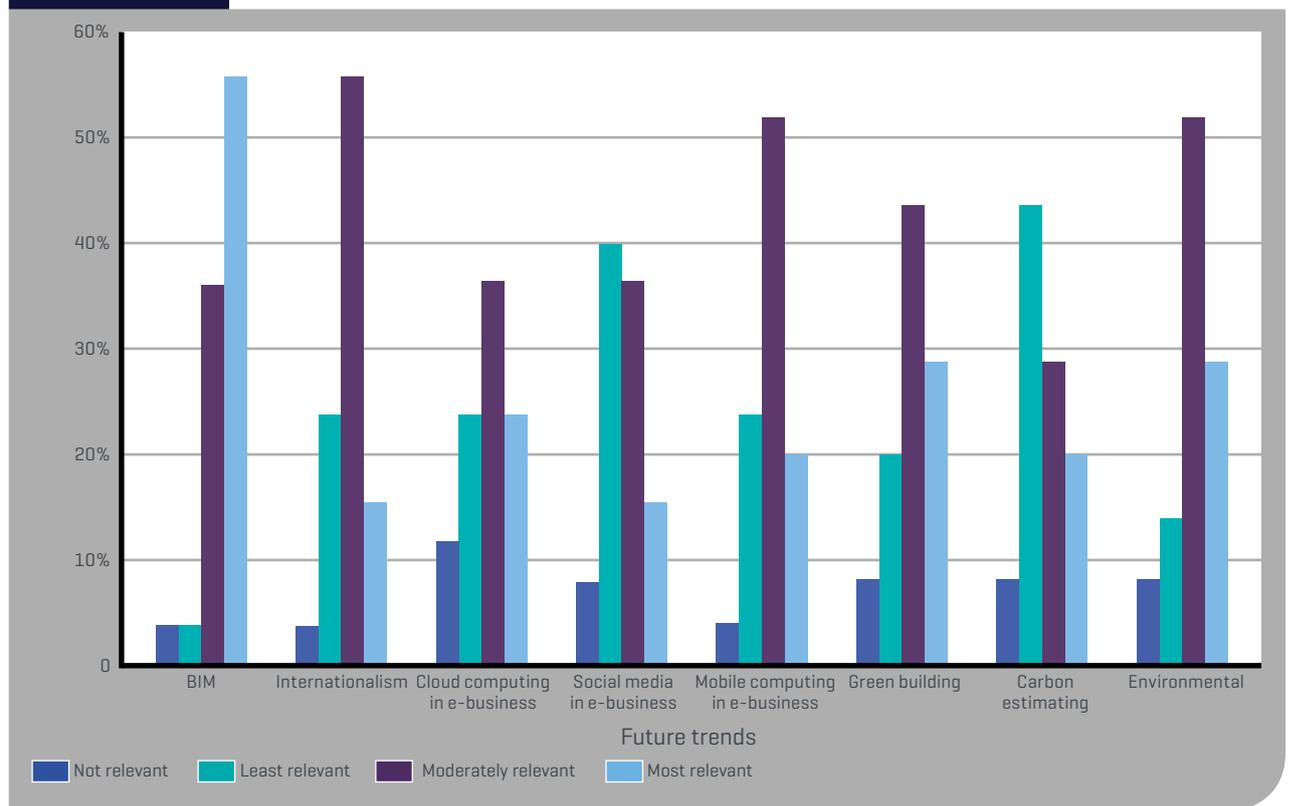
### 6.3.1 Professional Trends

The questions on future trends were generated based on the current issues driving the industry. Eight such issues were identified ranging from BIM, e-business to carbon estimating as shown in Figure 6.43. Although six or more respondents rated all the issues above moderately relevant to most relevant, BIM was identified to be the single most relevant future trend. This might be reflective of the current trend in the industry where BIM adoption is heavily publicised and promoted by the government and professional bodies across the industry. Issues related to sustainability such as Green Buildings, Carbon Estimating and Environmental Assessment were also identified as important for the QS profession in the future.

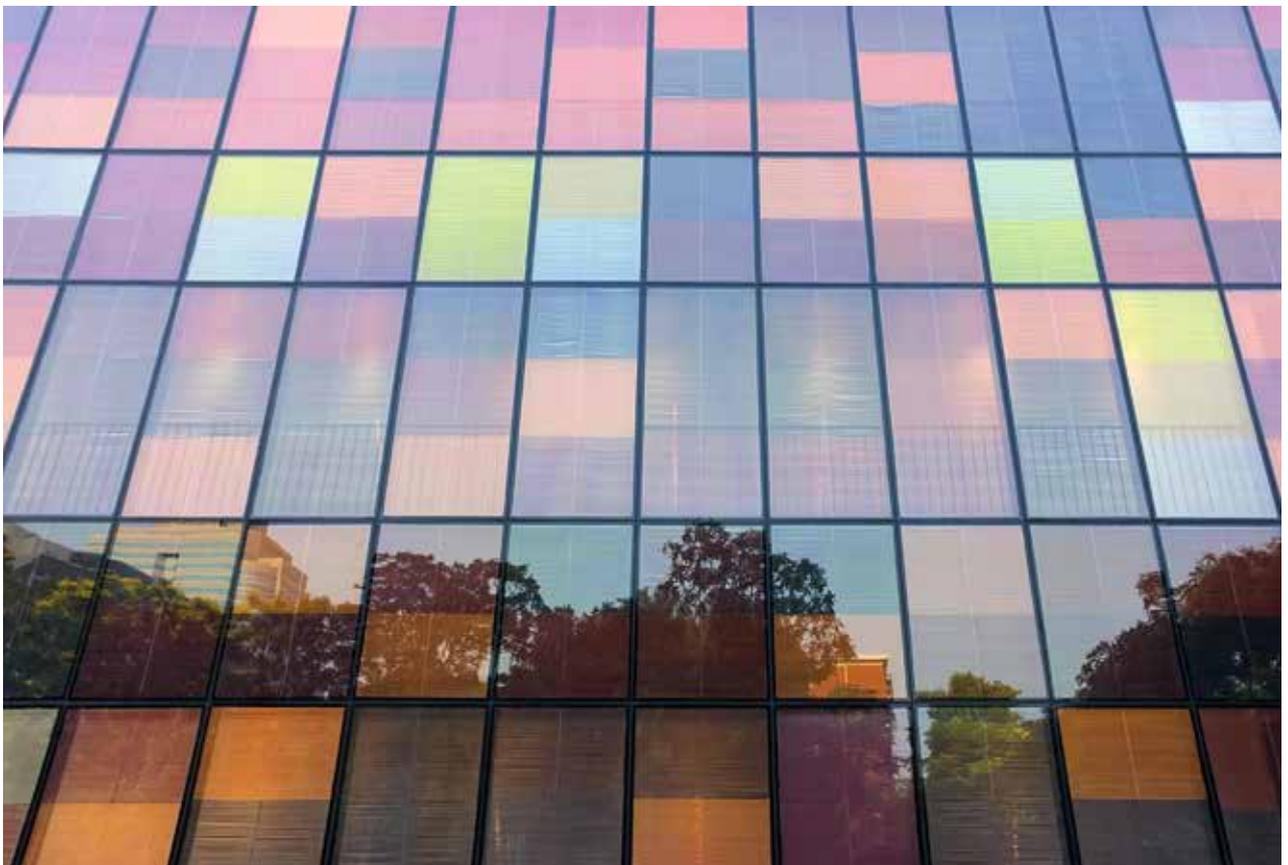
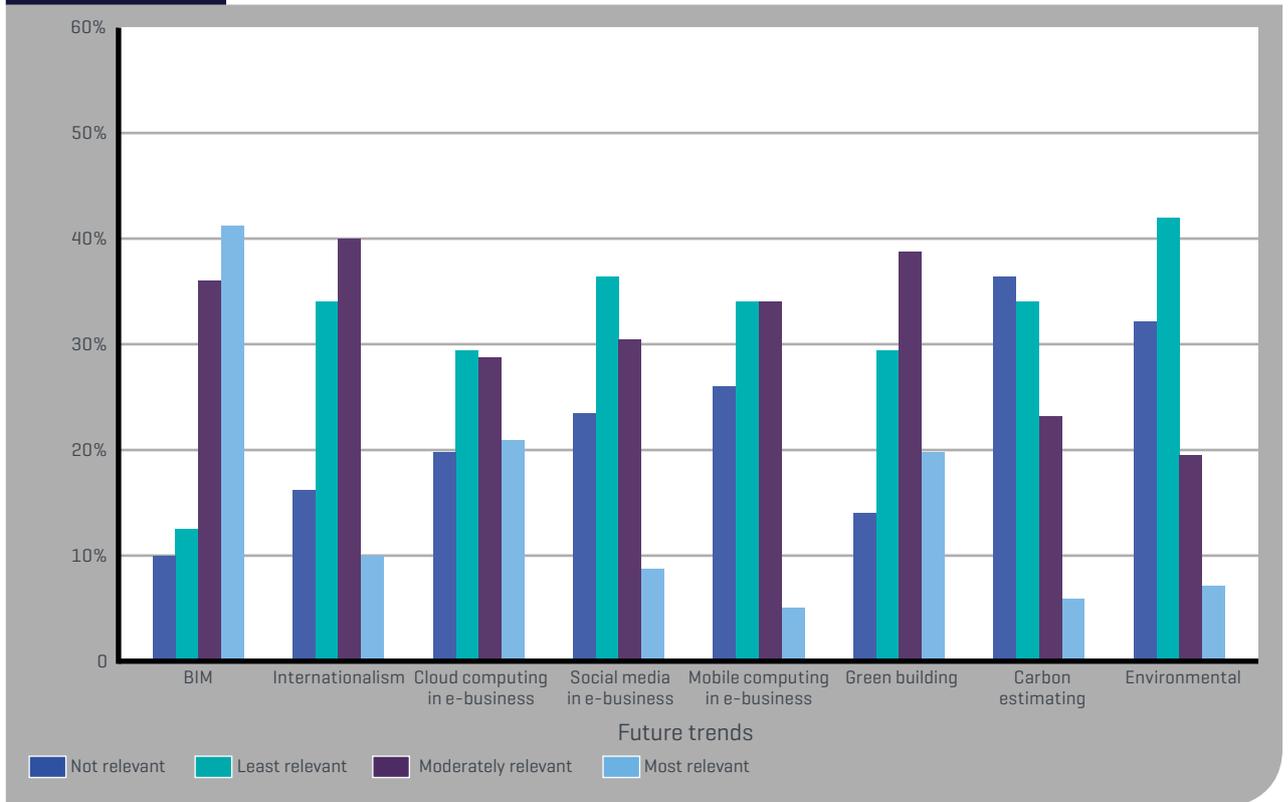
A similar trend is predicted for the EC profession in China where BIM is identified as the single most key trend that would be important for the profession. This is followed up by Internationalisation and technological developments such as Cloud Computing, Social Media and Mobile Computing.

Sustainability aspects were given lesser prominence with the exception of Green Buildings. However, this could be due to lack of awareness in terminology such as Carbon Estimating (Figure 6.44).

**Figure 6.43** Future trends important for the QS profession [UK]



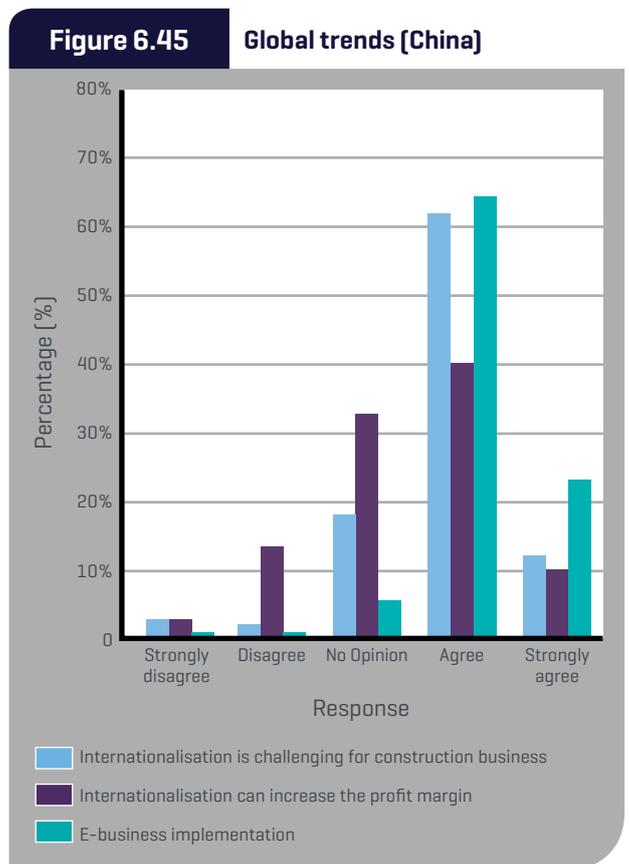
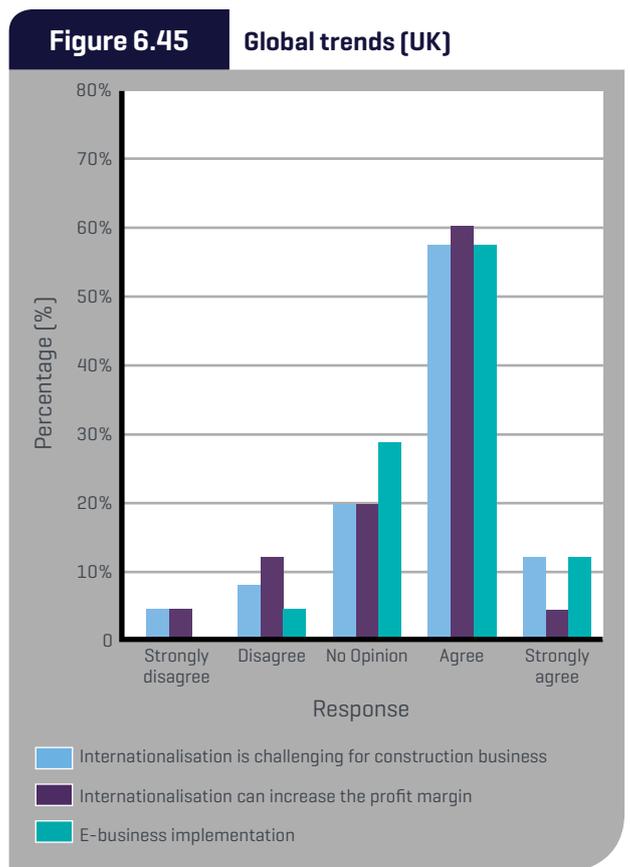
**Figure 6.44** Future trends important for the QS profession (China)



### 6.4.2 Globalisation and e-Business

The issues related to globalisation, internationalisation and e-business were reviewed. Three issues were identified that explored internationalisation as challenging for construction business; internationalisation can increase profit margin and e-business implementation. Figure 6.45 indicates that most of the respondents agreed on all the three issues and they see these issues as a competitive strategy that will give them a greater market share in the industry. The survey in China also indicated very similar views to the UK in identifying global trends (Figure 6.46).

The next section of the report further explores the issues and practices identified in the UK and China surveys through a series of detailed exploratory case studies.





## 7.0 Cost and Commercial Management Practice Case Studies

This section presents six case studies of industry practices of cost and commercial management services in UK and China. There are three case studies from each country which represents a large, medium and a small company. The case studies analyses five main area:

1. General company profile
2. Business Model and Structure (the company background, organization structure and management systems used and business models and strategies are explored in this category)
3. Core services (explores the services provided by the company including cost and commercial management services)
4. Business Innovation and Challenges
5. Internationalisation and Collaboration.

## 7.1 Practice Case Studies from the UK

### 7.1.1 Case Study A: EC Harris

#### 7.1.1.1 Company Profile

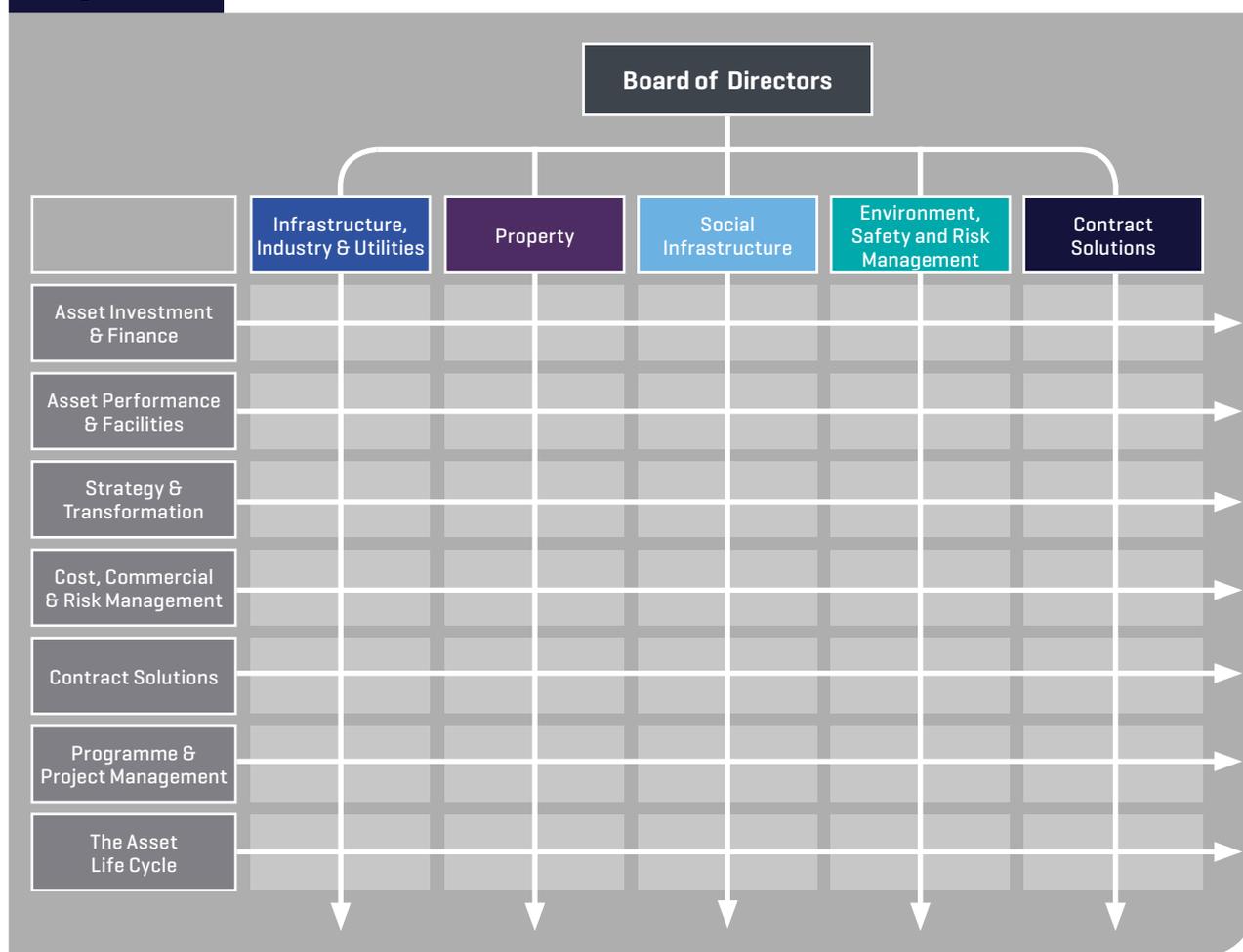
Company name	EC Harris
Website	www.echarris.com
Year of establishment	1912
Parent/holding company	ARCADIS
Annual Turnover	EUR 2.5 Billion
Total employee	22,000
National	19 regional branches in the UK
International	America, Asia Pacific, Europe, Middle East

#### 7.1.1.2 Business Model and Structure

- Company background**

EC Harris was established in 1912 as a QS practice. During 1950s and 1960s it diversified from property industry to developing capability in building, civil engineering and infrastructure. It further expanded to international markets in 1980. In 1986, it pioneered facilities management services in the UK. By 1996 the company developed the capability of delivering whole life costs for projects from planning and funding, through to design and construction and into operation. The traditional consulting model in delivery of services was changed by the integration of whole life costing in to the core services which has been the key to success over the last 20 years for the company. Consequently, this change laid the foundation for EC Harris to become a leading built asset consulting company.

**Figure 7.1** Organisation Structure – EC Harris



EC Harris became a limited liability partnership in 2003 which created a wide opening for the partnership and brought benefits in terms of the way in which the business was exposed to risks. It also enabled to expand the partnership significantly to about 160 partners at present. In 2008 EC Harris introduced a pre ambition period, which had 2 objectives: one to become a global built asset consultancy and to become a billion dollar consultancy. This was achieved through the merger with ARCADIS (a leading global natural and built asset design and consultancy) in 2011 which enabled the company to achieve its objectives in an international context. At present, EC Harris is one among the top 10 global consultancies.

• **Organization structure and management system**

Even though EC Harris operates within ARCADIS and work very closely, it has its own systems in place. There is also a certain degree of cross-fertilization of management between the parent company ARCADIS and EC Harris with considerable number of managing partners represented within the ARCADIS management structure. The EC Harris management structure is a matrix (Figure 7.1) with key sectors including Property (residential properties, corporate occupiers and commercial office developers), Social Infrastructure (social housing, government expenditure on health, education and the like), Industry Infrastructure and Utilities Sector (transport investment, rail road etc.), environment safety and risk management and contract solutions against key areas of services delivered. Within this structure Client Account Leader (who will look after the client needs) for each sector and Service Heads who leads each service will work together to deliver a client centred services.

• **Business model and strategy**

Business strategy of EC Harris is 'client centric capabilities'. It is about getting the right set of skills and right set of specialist together. Further, EC Harris also takes special care on employees' skills development, so that the best people can be secured and rewarded which is a critical part of the strategy. Another important strategy is that, a shift from traditional business to meet the need of present world.

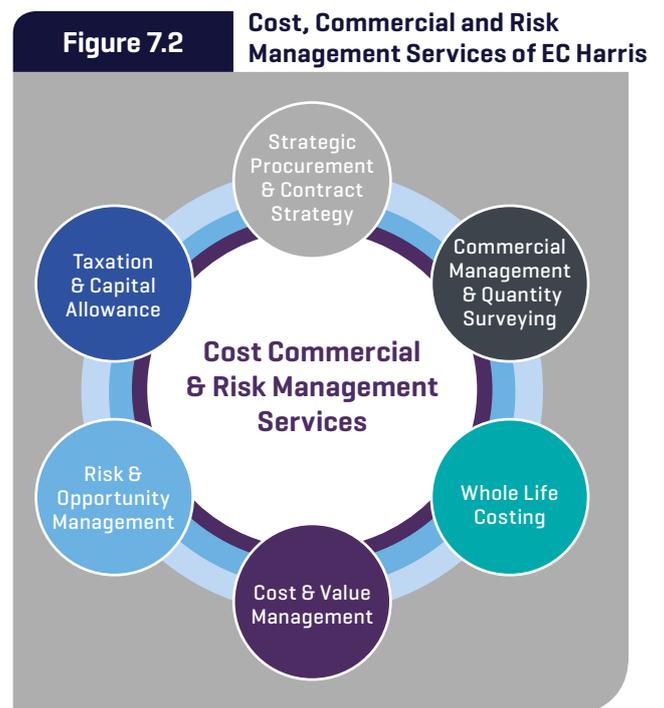
EC Harris has an extensive client record ranging from private one-off clients to public clients, including banks, retailers, network rail, national grid, utilities companies, UK fire networks, corporate occupiers, commercial office developers, universities and the like which demonstrates the diversity of the organization.

7.1.1.3 Core Services

EC Harris follows a four stage asset view in delivering services as follows:

- **Planning** – programming & planning, work place strategy, organizational & eco development capability work, business cases development, due diligence, asset acquisition assistance
- **Creating** – cost management services, whole life costing, value management, earn value management, project programming, taxation and dispute resolution, health & safety, grant design management (whether got the right design for the project)
- **Operating** – facilities management, asset management, built management, building surveying, energy demand management, workplace planning
- **Reinventing** – mitigation of issues around environment and sustainability, repositioning of asset resale and redevelopment of the site

EC Harris has a separate division for Cost, Commercial and Risk Management. The branches of Cost, Commercial and Risk Management services are illustrated in Figure 7.2.



## 7.1.1.4 Business Innovation and Challenges

### • **Innovation**

Company has a sound knowledge management practice in place which is supported by a range of knowledge platforms. EC Harris has a combination of informal knowledge sharing and formal strategic knowledge capture through information platforms. This information promotes innovation in procurement through devising the right engagement strategy between the client and the supply chain (e.g. framework agreements, alliancing). Implementation of BIM and investment in other information platforms such as the one for programme management are examples of other innovations. Another important innovation is the strategic mergers which integrates specialist capabilities and expand the business. A recent merger of EC Harris with an organization known as Corporate Real Estate Partners in the UK, who are specialists in work place planning enabled broadening of the scope of services delivered by the company.

### • **Successes and challenges**

Implementation of the built asset consulting strategy in 2008 was a major success for the company which provided multiple routes of entry for clients.

The mergers often bring greater challenges in terms of bringing the right skills, communicating with the employees and preparing them for the organizational change.

### • **E-business**

EC Harris is one of the leading implementers of ICT and an early adaptor of project intranets. ICT policy of EC Harris is run globally by ARCADIS. The company has a standalone capability called Technology Solutions where IT specialists are engaged to deliver effective information solutions to clients using the best device. Further, EC Harris is actively working towards integrating cost and project management services with BIM. The software used includes BIM machine tool, take off applications, primavera (P6) among others.

## 7.1.1.5 Internationalisation and Collaboration

Internationalisation is critical for EC Harris because of having a client focused strategy to work with large global clients. As a result, EC Harris is well established in Europe, Asia, Middle-East and America. The remaining part of the world, Africa, is of greater concern for the company at the moment. EC Harris work very closely with Chinese investors in property and utilities sectors in the UK. Therefore, the company recognizes Chinese clients as a key element of their business. Although, there is no significant collaboration at present future significant developments are envisaged.

### • **Learning from other countries**

EC Harris feels that it is important to understand how very large projects are delivered in China in order to expand its business and collaborations in China. Learning from other countries is considered to be important to understand how projects are effectively delivered in different countries and their working practices and procedures.



## 7.1.2 Case Study B: Summers-Inman

### 7.1.2.1 Company Profile

Company name	Summers-Inman
Website	www.summers-inman.co.uk
Year of establishment	2002
Annual Turnover	£6.8 Million (2012 to 2013)
Total employee	120
National	Newcastle, Edinburgh, Leeds, Leicester, London, Luton and Stafford
International	Doha - Qatar

### 7.1.2.2 Business Model and Structure

#### • Company background

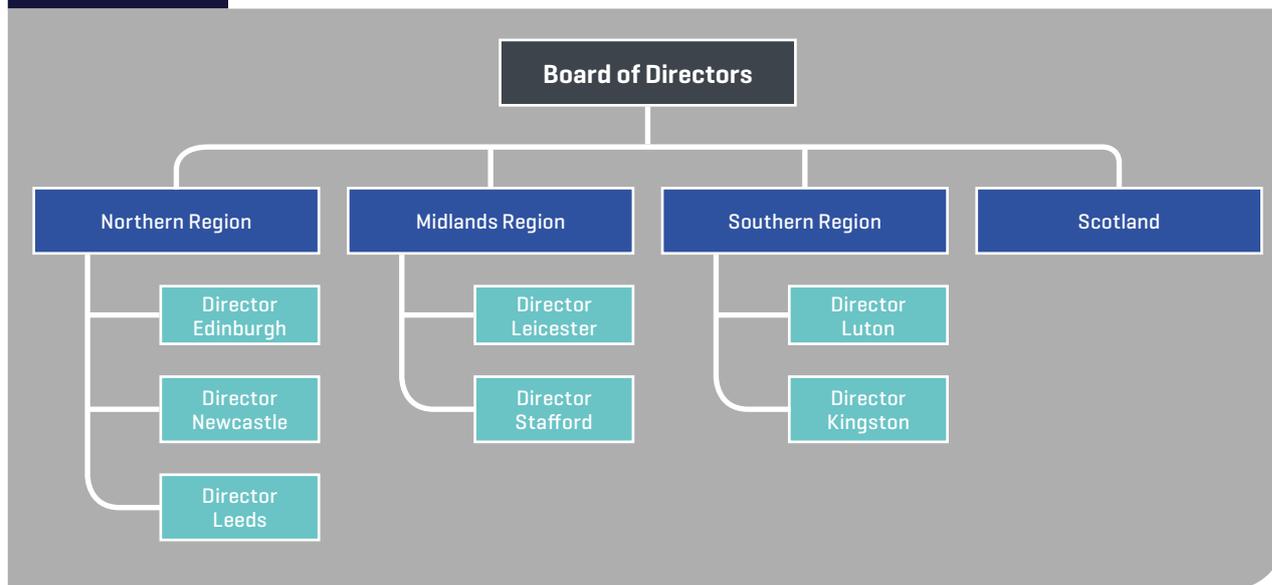
Summers & Partners was established in 1920 in Newcastle upon Tyne and expanded into Edinburgh and Leicester in the 1970's. By acquisition the business expanded into Leeds in the late 1990's. Inman & Partners was founded in London in 1926. During 2002 Summers & Partners and Inman & Partners merged to create Summers-Inman, a practice with national cover that has brought new and exciting opportunities for our clients and staff.

Traditional role of Summers-Inman has expanded and developed over the years into a broad range of complimentary services commensurate with the needs of modern-day construction and development. Company's core services of quantity surveying, project management and building surveying are supported by specialist units that deliver development monitoring, the roles of independent certifier, independent tester and employer's agent, and specialist IT and communications services to enable entire portfolio of services to be supported by the latest in technology and communications.

Summers-Inman responded to the advent of the CDM regulations in 1994 and the subsequent amendments in 2007 with the setting up of a specialist CDMC team with high calibre recruitments brought in from the industry. Summers-Inman is also now being regarded as the leading consultants in the region with health and safety work in all sectors and throughout the UK.

Over the last ten years attention has focused on the whole-life sustainability of projects, including business cases, long-term option appraisals, life cycle cost plans, environmental assessments and cost benefit analyses. This has led the Practice to become one of the leading construction and property consultants in the UK with a strong background in the education and health sectors in the fields of PFI, Procure 21 and NHS LIFT where whole life rather than simple initial capital costs are considered.

**Figure 7.3** Organisational Structure – Summers-Inman



• **Organization structure and management system**

Figure 7.3 illustrates the organizational structure of Summers-Inman.

Offices are classified on a geographical basis, where local directors administer the office. Each office has to stand on its own in terms of financial, security and fee generation though the accounts are generated for the whole Summers-Inman in collaboration. Further, directors are in the capacity of observing how other directors in the rest of the offices operate financially.

• **Business strategy**

The strategy of Summers-Inman is to take care of the existing clients to ensure smooth running of the business and look for emerging markets to expand the business into different sectors. Although Summers-Inman is specialized in Health sector it has now expanded in to various other sectors such as Commercial, Education, Food and Drink, Historic, Industrial, Leisure, Public, Residential, Retail and Utilities & Infrastructure. The types of clients Summers-Inman worked with includes: banks, charities, developers, universities and colleges, local authorities, retailers, transport and offices.

The core services offered by Summers-Inman are illustrated in Figure 7.4 where cost and commercial management services come under the Quantity Surveying branch.

**Figure 7.4** Core services of Summers-Inman



#### 7.1.2.4 Business Innovation and Challenges

- **Innovation**

The main form of innovation arises from adoption of BIM. As a result, BOQ preparation is integrated with design allowing rapid quantification while design develops. It has resulted in shorter time spans for BOQ preparation. Summers-Inman uses Revit™ for designing and Vico™ for bill preparation.

- **Successes and challenges**

BIM implementation in the business was a huge success despite the challenge of extremely high capital cost. However, the change in the operation required staff to be re-trained on the new system. The payback period is little longer as process efficiency takes time with greater embedding of BIM technology within the entire practice. They have also acquired and successfully integrated a digital scanner within the building surveying service.

- **E-business**

Summers-Inman initially had an in-house IT department. Currently, IT services are outsourced to improve efficiency. The IT service providers now manage all aspects of ICT services for the company including managing company run servers and cloud storage using resident staff within offices and their resources. The most commonly used software to perform business functions is the Microsoft office suite. Both Revit™ and Vico™ software are used for cost management functions. In addition to the core services, Summers-Inman uses Commission Manager™ for financial management of the business.

#### 7.1.2.5 Internationalisation and Collaboration

Although, Summers-Inman has a presence in Doha, Qatar for a specific research project, there are no international construction projects in their portfolio at present. Summers-Inman feels that internationalization is not a mandatory criterion for the business to be successful which they have shown with their expanding business profile.

Nevertheless, Summers-Inman foresee a great deal of potential for collaboration between the UK and Chinese construction industries while making a point that reaching an agreement of standards and procedures to be adopted in projects is going to be crucial.

- **Learning from other countries**

Globally, different countries deliver cost and commercial management services in different ways. Some processes are similar to the UK while others are distinctly different. In some countries Architect or Engineer perform the role of the QS. Therefore, it will be interesting to know how different countries deliver cost management services and it might help to capture the best practice. Similarly, other countries could learn from the mature and long established cost and commercial management system of the UK.



### 7.1.3 Case Study C: Adair Associates

#### 7.1.3.1 General Company Profile

Company name	Adair Associates
Website	www.adair.co.uk
Year of establishment	1994
Annual Turnover	1.5 Million
Total employee	20
National	London
International	Dubai and Gibraltar

#### 7.1.3.2 Business Model and Structure

- Company background**

Adair Associates was founded in 1994 by Justin Sullivan as a practice offering quantity surveying services to subcontractors and main contractors. The services offered at that time included bill preparation, estimating and valuations for subcontractors and main contractors. In 2006/2007 Adair Associates was recommended to undertake a high end residential project which elevated the profile of the company. Afterwards, the company delivered many high-end residential projects and became a notable company in the industry. Adair Associates is a traditional QS company which follows the conventional cost management practices. The company has grown up by training school leavers and allowing them to study part time course in the universities once a week who have eventually qualified as chartered surveyors. Due to high industry reputation and expanding clientele Adair associates have established an office in Dubai fledging in to the international market.

- Organization structure and management system**

Adair Associates has a simple organizational structure as shown in Figure 7.5.

- Business strategy**

The strategy is all about excellent client service. Adair Associates is very keen on delivering best service to their clients as they believe the client relationship is the key to successful business. Hence, Adair Associates follows a customer focused strategy. Adair Associates has a good track record in residential and commercial property market and worked with clients ranging from private individuals, banks, private equity funds and solicitors to family offices, developers, contractors and trusts.

#### 7.1.3.3 Core Services

Figure 7.6 illustrates the core services delivered by the company and the cost and commercial management services come under the 'Quantity Surveying Services'.

#### 7.1.3.4 Business Innovation and Challenges

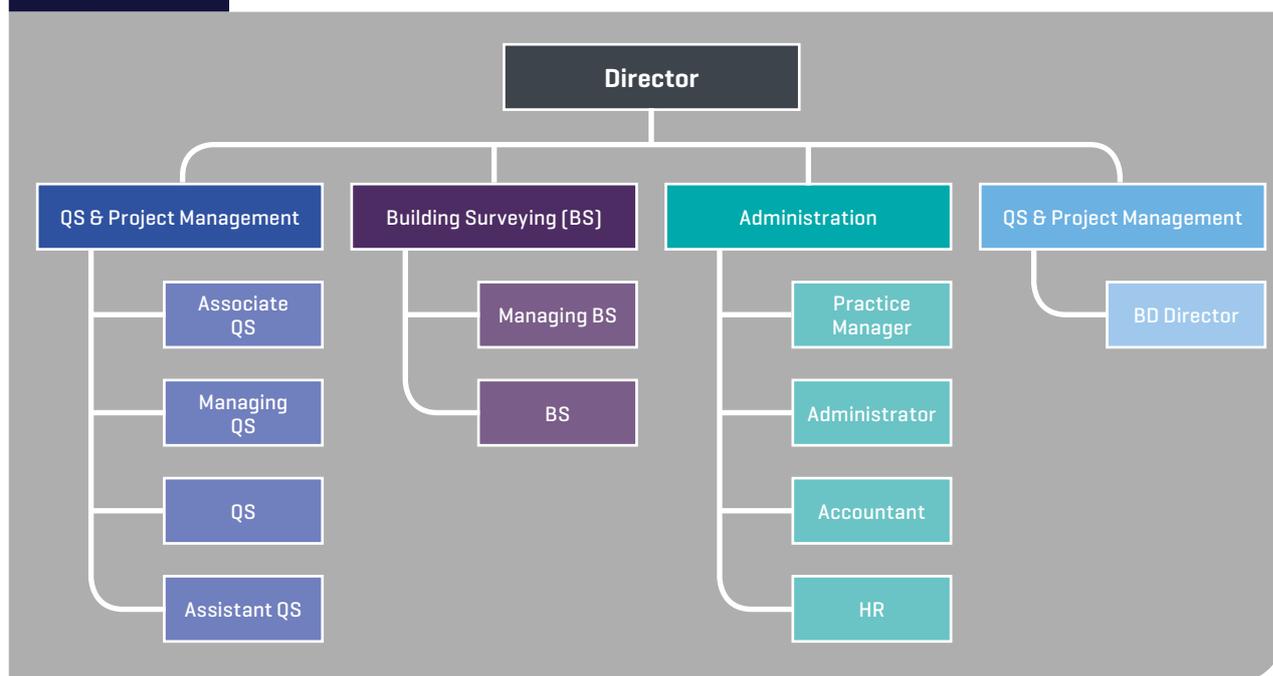
- Innovation**

Adair Associates follows the conventional QS practices is very traditional in its approach.

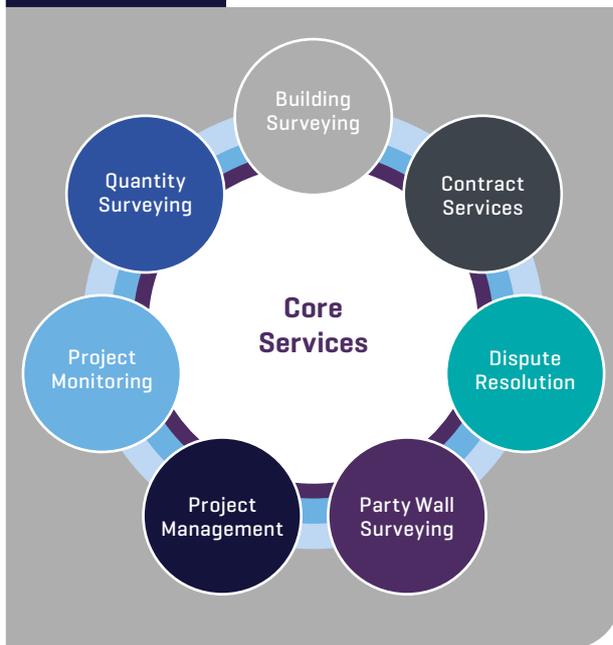
- Successes and challenges**

The most successful experience is maintaining a large amount of repeat business in high end residential property and working with world renowned award winning interior designers and architects. The biggest challenge faced by the company is acquiring right people to work for Adair Associates and retaining them. It is being difficult to attract highly skilled people to be a part of Adair Associates due to the size of the company.

**Figure 7.6** Organization Structure – Adair Associates



**Figure 7.7** Core Services of Adair Associates



- **E-business**

Adair Associates uses measurement software to facilitate bill preparation and not intended to move to BIM environment right now. However, Adair Associates will be working in a BIM project in Dubai which may change their approach. Qs's seem to be concerned whether BIM will override the role of QS, though Adair Associates believes that QS is required to check the output of BIM.

#### 7.1.3.5 Internationalisation and Collaboration

Adair Associates considers internationalization is an important part of their business. It allows transfer of knowledge and skills and establishes the presence of the company. Further, there seems to be a good potential for collaboration between the UK and China though language might be a barrier.

- **Learning from other countries**

Learning from other countries is good though some practices are not suitable for the UK context. For instance, in Hong Kong, rather than managing risks, the contractors are allowed to factor risk in to the prices resulting in higher price levels whereas in the UK risk should be confronted. Therefore, it is important to understand the socio-economic and cultural context when capturing knowledge from other countries.



## 7.2 Practice Case Studies from China

### 7.2.1 Case Study D: Wanlong Construction Engineering

#### 7.2.1.1 Company Profile

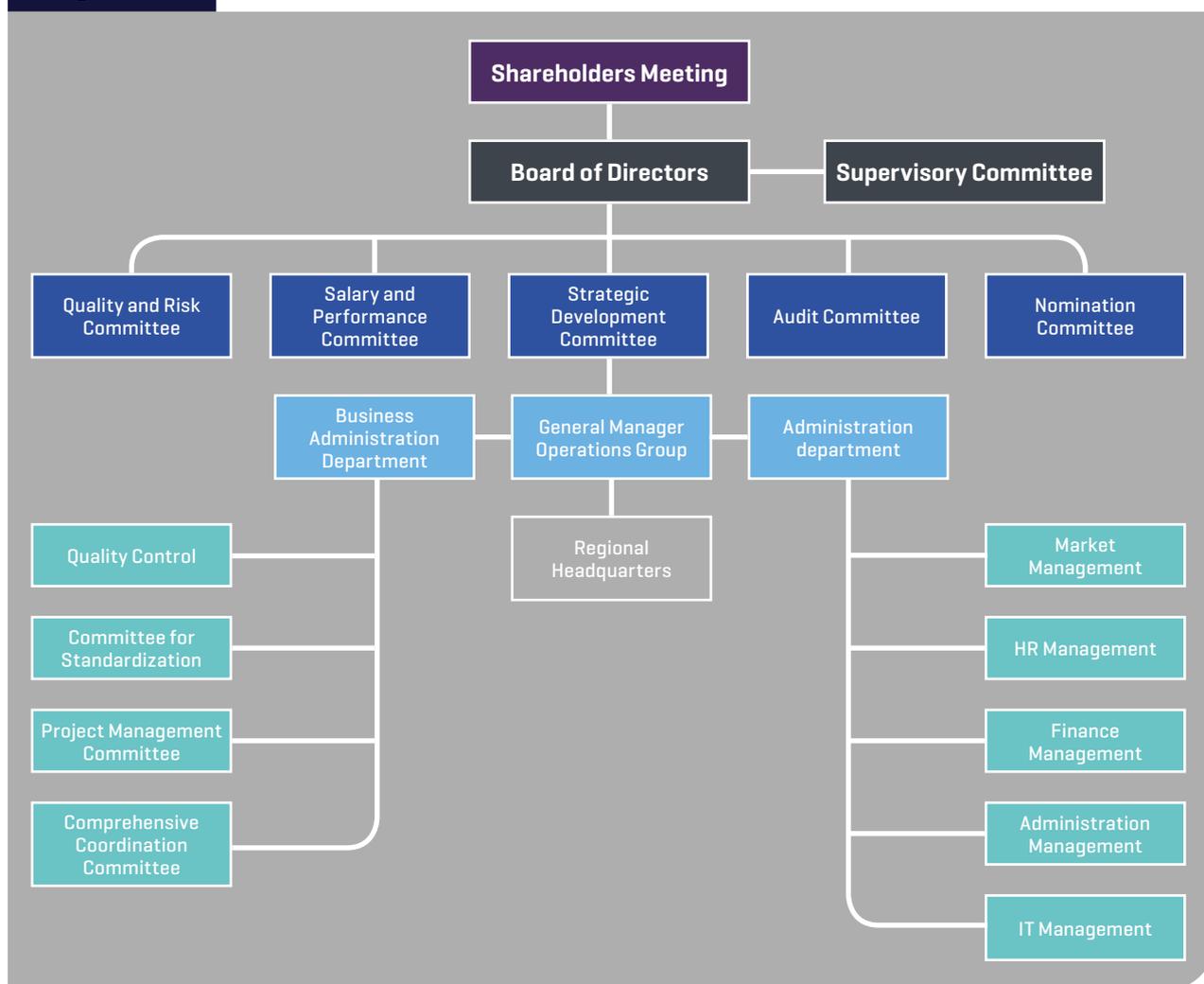
Company name	Wanlong Construction Engineering
Website	http://www.wanlongqs.com.cn/
Year of establishment	2007
Parent/holding company	Wanlong International Consulting Group
Annual Turnover	RMB 110-120 Million
Total employee	250
Total offices (National)	14

#### 7.2.1.2 Business Model and Structure

- Company background**

Wanlong Construction Engineering was originally part of the Shanghai Wanlong accounting company, belonging to Shanghai Municipal Audit Bureau. Wanlong Construction Engineering Consulting Co, Ltd., was founded in 1992. In 2007, The Company changed the name as Wanlong Construction Engineering Consulting Group Co., Ltd. Wanlong has an investment of 50million RMB along with holding 100% shares in two subsidiaries. Up to 2014, it had 14 subsidiaries with 17% voting rights and decision rights. Besides, the Company covers most of Chinese provinces, cities, and municipalities. Wanlong is the first to have the Grade A license for engineering cost consulting along with tender agency from the Ministry of Construction. It also has the government procurement qualification issued by the Ministry of Finance. The Group's headquarters are located in Shanghai.

**Figure 7.7** Organisational Structure – Wanlong



The Group brings together many outstanding professionals, including 243 registered cost engineers, 20 registered supervision engineers, a registered bidding Engineer, 12 Chartered Quantity Surveyors (members of RICS), three Chartered Builders (members of CIOB), a registered architect, 23 registered consulting engineers and certified real estate appraisers. They work in engineering investment projects of different types and cost consulting (cost management, accounting, management consulting, tax agents, and legal counsel). The general manager of the company said “we are ranked in 4th and 6th position, mostly within top 10, in the top100 list produced by CECA”. The mission of the company is to create a domestic first class construction engineering consulting company.

• **Organization structure and management system**

The group has developed a unified quality management system and a practice manual to ensure the satisfactory standard of services delivered to clients with the core principles of ‘control and management, saving and value-addition’. The general manager of the company is responsible for the operation and day to day management of the group activities.

- **Quality Control Committee:** responsible for the implementation of specifications, regulations, standards and other relevant quality control and supervisory aspects of the company;
- **Committee for standardization:** responsible for the development of company’s professional and technical specifications, regulations and standards. They also are responsible for explanation and update of new national/industrial guides, relevant laws and regulations as well as practice standards.
- **Project management committee:** is in charge of allocating personnel for all projects undertaken by the company, coordination of functions of various sections, project completion and follow up services.
- **Comprehensive Coordination Committee:** responsible for marketing, customer liaison, maintain business (project) management and risk control in the customer undertakings.

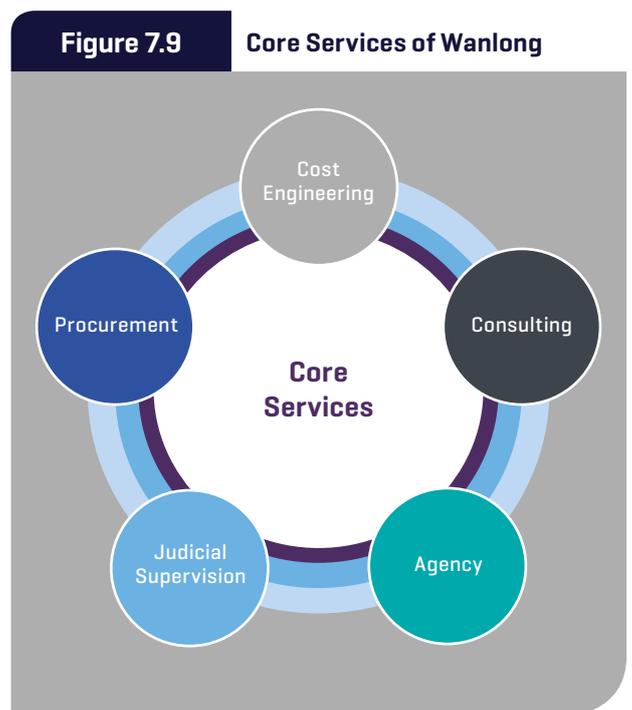
The administration department consists of different departments for Marketing, Human Resources and Finance, Administration Management and IT management.

• **Business strategy**

Wanlong is a ‘management led’ EC company. The company provides traditional EC services and other consulting services, such as legal and property valuation. However, the main focus of the company is to expand its business from regional (Shanghai base) to national scale. Wanlong has established regional offices in Shanghai, Beijing, Shanxi, Liaoning, Xinjiang, Jiangxi, Henan, Shenzhen, Chongqing, Sichuan, Anhui, Shanxi, Gansu Heilongjiang, Hunan, Hainan, Suzhou, Dalian, Guangzhou and other 22 provinces and cities through its network of subsidiaries and member companies. Increasingly, Wanlong is gradually becoming a nationwide consulting network. Development of the brand and internal management are core areas of concern for Wanlong.

7.2.1.3 Core Services

Core services provided by Wanlong are illustrated in Figure 7.8. Now the business is divided into several major parts. Certainly the biggest sector is the cost consulting sector.



Core areas of cost and commercial management activities of Wanlong includes project pre-feasibility studies, project estimates, tendering, BOQ preparation, preparation of base price estimates, the whole process of cost control and project management, completion of the audit of the accounts for settlement, as well as acting as the government procurement agency. Other services include feasibility study reports writing, project proposals, energy assessment, fire tests and analysis. These services fall under the commission of National Development and Reform Commission (NDRC). Other businesses include tendering services for works worth over RMB 3million per year coupled with an additional RMB 3million for dispute resolution services.

### 7.2.1.4 Business Innovation and Challenges

#### • Innovation

Wanlong's main innovation is in expansion and growth through a strategy of acquisitions. Most of the core cost engineering companies are relatively smaller in size and localized. However, Wanlong Group has managed to expand through innovatively co-linking with many other smaller companies in different provinces and cities to create a large corporate group. Its operational systems still have the hallmarks of its origins from a largely accountancy based practice. Wanlong's network of subsidiaries and cooperation companies can retain their own name, character and practice. These subsidiaries and branch offices cover most of Chinese provinces, cities, and municipalities. It facilitates these subsidiaries to maintain the local characteristics and comply with numerous regional variations of policies and procedures.

#### • Successes and challenges

The operational costs of the subsidiary companies are very high. Wanlong stated that to maintain a company particularly in North West China, at least 16 qualified cost engineers are required. The company's operational problem is relate to operational expenses and the maintenance of standards which are required to retain license to practice. The regulations governing licenses therefore somewhat limit rapid growth of the company. However, within these constraints it aims at building a national brand for cost engineering consultancy practice where they have succeeded considerably.

#### • E-business

Wanlong is not leading in e-business and ICT adoption at present. But the company has already adopted the use of estimating software, internal office automation systems, use of Microsoft office suite of software and the like.

### 7.2.1.5 Internationalisation and Collaboration

Wanlong's main focus is on the domestic market. Internationalization is not of any interest for the company at present due to considerable success gained at the national level.



## 7.2.2 Case Study E: Beijing Jinmawei Consultation of Engineering Company

### 7.2.2.1 General Company Profile

Company name	Beijing Jinmawei Consultation of Engineering Co., Ltd.
Website	www.bjjmw.com
Year of establishment	2001
Parent/Holding Company	Limited Company
Annual Turnover	RMB 60 Million
Total employees	150
Total offices (National)	6

### 7.2.2.2 Business Model and Structure

#### • Company background

Beijing Jinmawei Consultation of Engineering Co., Ltd was established in 2001 by Zhou Hesheng and provides project cost consultancy services, project management, following-up audit and management audit with its Grade A qualification of Project Cost Consultation in China.

The company has acquired ISO 9001:2000 International Quality Management System Certificate and has been successively rated as an exemplary unit and one of the top 100 enterprises by the China Engineering Cost Association (CECA). Mr. Zhou Hesheng, the founder and president of the company, actively involves in committees that develop national standards which gives a high recognition for the company.

#### • Organization structure and management system

Organization structure follows a typical private consulting company structure in China. It mainly controlled by the president (the owner) of the company. General Manager is mainly in charge of the daily operations of the whole company. It has an expert panel that includes academics and subject specialists from China who provide strategic direction to the company's national and international activities. Jinmawei also has 6 branches in different provinces/cities, and are managed by regional managers.

#### • Business strategy

Jinmawei is a knowledge-led organization that aims to transfer the new knowledge in developing new product and services. It is the operation principle of transforming knowledge and technique into value, beneficial to customers and even the society that the company adheres to. The company has three main businesses around cost engineering: consultancies, software development and training, which are knowledge-intensive products and services. Drawing on the advanced experience of project cost consultation, the company audaciously conducts a series of reforms and innovation in the mode, approaches, standards as well as evaluation system of current project consultation according to the actual condition of modern construction management in China. Jinmawei provides cost advice on optimising overall architecture, structure and energy

conservation of buildings through the use of value engineering principles so that the value-added service can be provided for its customers.

### 7.2.2.3 Core Services

Jinmawei delivers the whole construction process cost control from early stage cost estimate to the final account cost checks and auditing and is one of the leaders in Whole Process Cost Engineering Auditing. It has a wide range of clients working in many types of building and civil projects. However, the main focus is in two sectors: education and health.

#### • Cost and commercial management service

Audit of Investment Estimation: Estimate construction project investment and its capital requirements

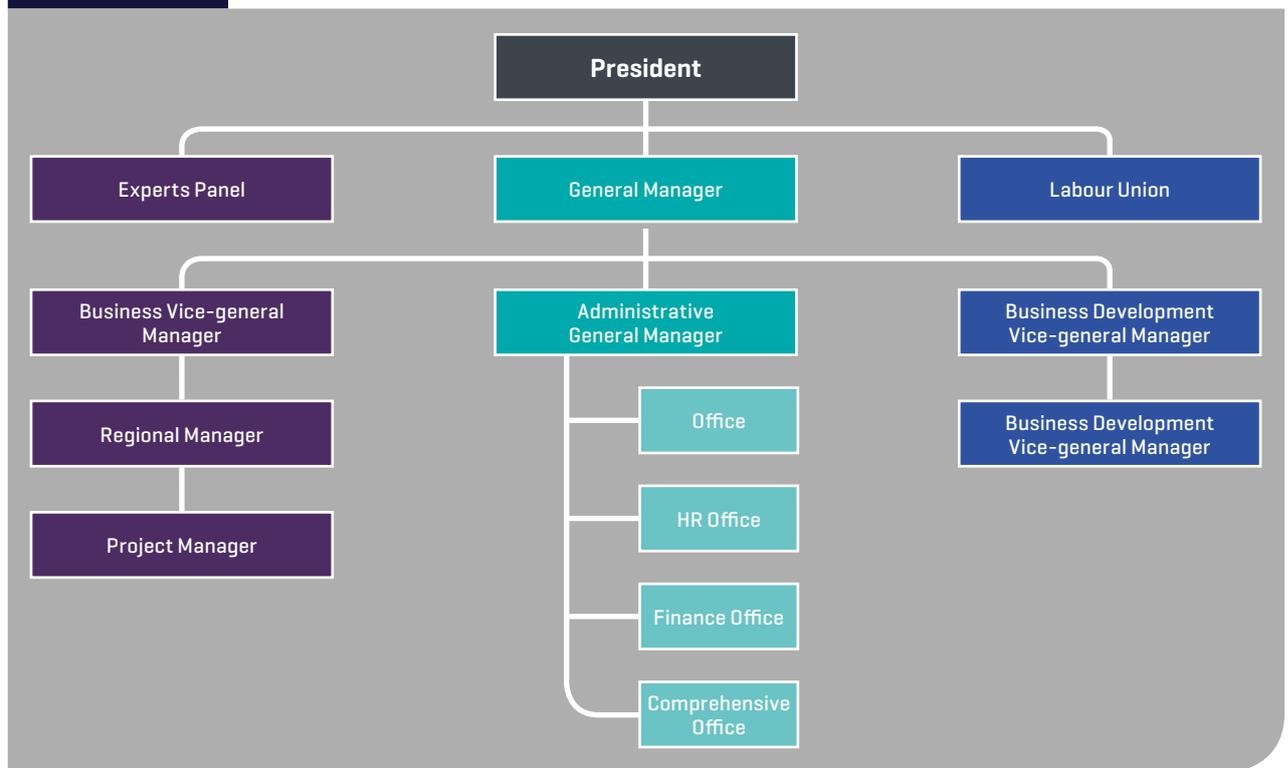
- Project Economic Evaluation: Make profitability analysis, repayment ability analysis and uncertain analysis according to regulations of Economic Evaluation Methodology and Parameter of Construction Project from National Development and Reform Commission and Ministry of Construction
- Establishment & auditing of approximate estimate, construction drawing budget and approximate estimate adjustment
- Provide reasonable suggestion and information about quota design
- Draft bidding documents and agreements
- Establishment & auditing of BOQ, regulated bidding price, tender offer and construction contract
- Cost plan and cost analysis (not elemental format but based on quota system)
- Quantities calculation and issue payment
- Negotiation and investigation of variations
- Investigation of quantity deviation and omission, price difference and temporary estimation adjustment, written Confirmation of Site Instructions and engineering claims
- Investigation and auditing of final accounts for completed projects, developing final accounts
- Establishment and auditing of final building cost

The whole process investment management and auditing for construction projects used by Jinmawei mainly contain three components:

- Investment operation system engages in specific cost estimating work for cost engineers;
- Investment management system mainly works on collecting, transferring, summarizing, monitoring and managing cost estimating;
- Cost information system help cost manager or auditor to inquire about cost estimating information, regulations and experience data.

The three systems supplement each other in achieving comprehensive management of engineering costs.

**Figure 7.10** Organization Structure – Jinmawei



#### 7.2.2.4 Business Innovation and Challenges

The main innovation of Jinmawei is the development of a whole process project management and auditing software. In 2006, a subsidiary company: Jinmawei software company was established in order to upgrade its cost management service, and to promote ICT adoption in development of project management and auditing. This Jinmawei subsidiary specializes in software development for project management and auditing and has obtained almost 20 copyrights for its own software. The software system for the whole process investment management and auditing for construction projects was first released to the public on June, 2012. The system has gained good level of recognition from the industry and professional bodies such as CECA and China Institute of Internal Audit (CIIA).

- **Success and challenges**

Development of whole process project management and auditing software is a huge success for the company. Further, in 2013, the desktop client system and a mobile client system were launched by the company so as to further boost its product and service profile. At present, this software system is extensively used in government departments, colleges, building and auditing consultancy practices in China.

- **e-business**

The venturing of the business in to cost engineering software indicates Jinmawei's appetite towards construction e-business related activities. It is expected that its desktop and mobile client software will bring

about greater usage and functionality to the whole process investment management software developed by the company.

#### 7.2.2.5 Internationalisation and Collaboration

In contrast to most cost consultancies Jinmawei is keen towards internationalization. They have partnered with CECA and has actively involved in many international events and conferences such as those organised by the PAQS and RICS during the past few years. The president of the company is also a member of AACE (American Association of Cost Engineering). Jinmawei, worked together with Northumbria University to organize two *International Construction Engineering Management, Auditing and Informationization conferences*. Jinmawei also have aspirations to open branches in the UK and the US.

Like most other cost management companies in China, Jinmawei currently has experience in working within China using Chinese systems and standards which limits its ability to engage in overseas business. Jinmawei is keen to learn international practices of cost management from other countries, but perceived high cost in such operations limits the process. The company also has the view that foreign projects are less profitable due to high costs. Further, issues of finding and dealing with international clientele inhibit its ability to internationalise. In order to operate in international market it is important to understand the cost management processes used and how services are delivered in other countries.

## 7.2.3 Case Study F: Shanghai Shenyuan Property Consultants

### 7.2.3.1 General Company Profile

Company name	Shanghai Shenyuan Property Consultants
Website	http://www.shenyuan95.com/
Year of establishment	1995
Parent/Holding Company	Shanghai Xiandai Architectural Design Co., Ltd
Annual Turnover	RMB 80 Million
Total employees	100
Total offices (National)	4 [Shanghai, Chendu, Xi'an and Wuhan]

### 7.2.3.2 Business Model and Structure

#### • Company background

Shanghai Shenyuan Property Consultants Co., Ltd (Shenyuan) is a leading company of cost consultancy and project management in China. The company has four Grade A licenses for Engineering Cost, Tender Agency, Public Procurement and Engineering Consultancy. It has ISO 9001:2000 certification. Shenyuan originated from the 'Construction Economy Department' of Shanghai Institute of Architectural Design and Research (SIADR) and East China Architectural Design Institute (ECADI). The parent company has a history of over 60 years; it has been involved in more than 5000 projects with an annual turnover of more than 80million RMB.

Shenyuan has over 100 staff of which more than 30 are experienced senior engineers, 3 are Chartered quantity surveyors and 21 are associate members of the RICS. There are 40 qualified cost engineers. More than half of staff has been sent out to international companies such as RLB, Davis Langdon & Seah in Hong Kong for training and/or temporary work. The spirit of the company follows the Chinese culture: be naturally courteous, be dedicated to work, and be sincere to people. The core objective of the company is to optimize the project's benefits. Shenyuan offers professionals services to meet client's demands and ensure that the project to be of good value for money.

#### • Organization structure and management system

The company is still a state owned company, which is a subsidiary of one of largest design firms in China: the Shanghai Xian Dai Architectural Design (Group) Co. Ltd (SMAD). The organisation structure is typical for a standard shareholding company in China. It is managed by the board of directors (responsible for shareholders), and executed by General Manager (as company's managing director), and deputy manager, who is mainly responsible for day to day business activities, including cost engineering services, project management, feasibility study, and other departments (marketing, HR, financial department, and others). The headquarters of the company is in Shanghai, and it has subsidiaries at Wuhan, Changdu and Xi'an cities.

#### • Business model and strategy

Shenyuan is a 'Technology Led' CE consultancy, which has one of the most advanced technology and service infrastructure in China. It is one of the first companies to promote whole process engineering cost services in China and has already applied the method successfully in practice. They have already implemented BIM into their new service delivery. The business strategy of company is to delivery high-end services to blue chip clients in China, mainly government invested super complex project, such as skyscrapers, which need advanced technology, but will generate an excellent profit in return.

### 7.2.3.3 Core Services

The core services delivered by Shenyuan illustrated in Figure 7.11.

Shenyuan mainly delivers whole process project (cost) management from the conceptual stage to the final account, to mainly help the clients manage the budget. In addition to that, they co-ordinate and support negotiation with local authorities for project approvals, prepare the detailed design briefs, manage the design process, procure consultants, contractors and equipment suppliers, quality control, monitor project programme, manage contracts, issue interim certificates, coordinate with other consultants, contractors and suppliers and organizing operational tests, final acceptance and hand-over.

### 7.2.3.4 Business Innovation and Challenges

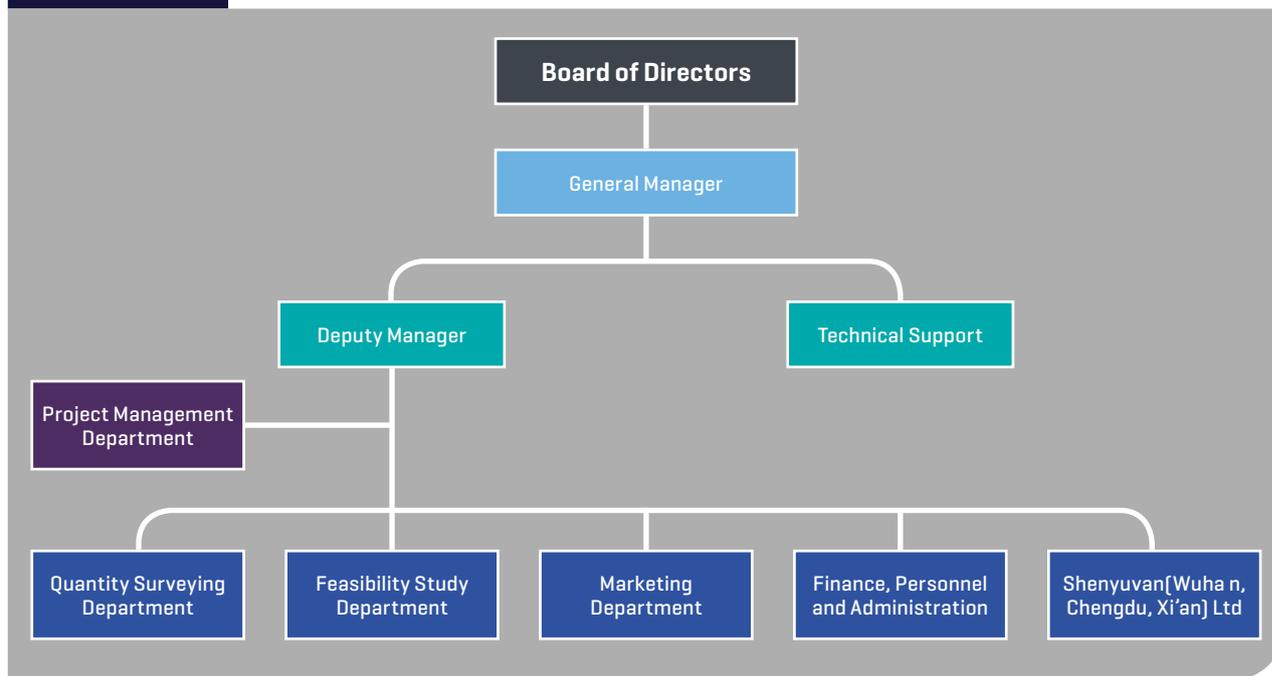
#### • Innovation

There are two main innovations championed by Shenyuan. One is the whole process project (cost) management. The second is use of BIM in cost management services. Shenyuan is the first cost engineering company in China to integrate BIM to its cost management services. It aims to regularize the use of BIM in cost engineering and promote it to the whole industry.

#### • Successes and challenges

The main success is the pioneering and development and successful implementation of the concept of whole process cost management. Shenyuan changed the traditional service throughout the whole process of cost management and made the whole process cost consultation model more recognized and accepted by the whole industry. Further, Shenyuan enhanced the level of business performance through the exploration of theory and practice to create new routes for their development. Its pioneering use of BIM for cost management is an example of such activities. The challenge faced by Shenyuan is from the client side. As the clients get smarter and more experienced clients demand best quality services to be delivered by the company. It is important and challenging for the company to use advanced ICT technology to improve productivity, and core competitiveness.

**Figure 7.11** Organization structure – Shenyuan



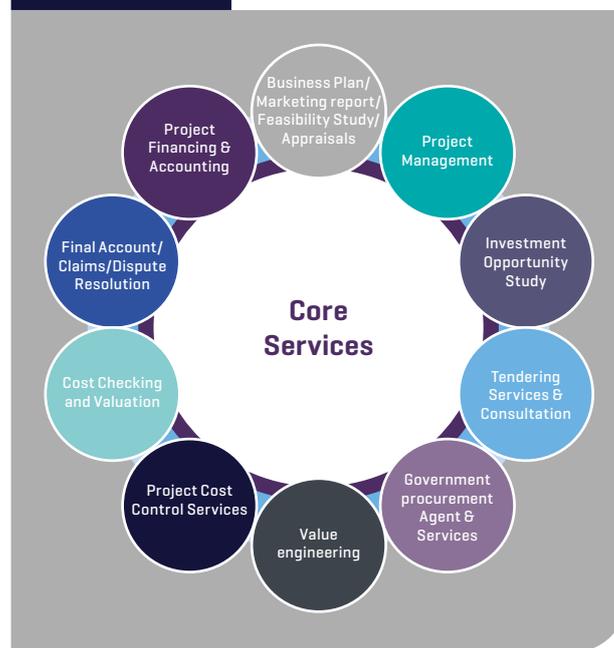
• **E-business**

Shenyuan is working to develop a new e-business platform, which is integrated with BIM. The aim of the approach is to connect manufacturers and building users to provide more in depth cost and commercial data from both supply and demand ends of the economy. This entails further work together with two of the leading estimating software companies in China (Glodon and Sware software ltd).

**7.2.3.5 Internationalisation and Collaboration**

International outreach has always been a part of Shenyuan’s strategy. It has three steps: the first step is from Shanghai to the country; the second step is working with national and international investment companies; and the third step is to expand operations overseas. However, at present, Shenyuan faces difficulty in venturing in to the international market due to language barriers, lack of suitably qualified staff with international experience and, lack of knowledge on international practice and procedures. There is also lack of client side demand for such enterprise. The traditional approach has been to partner with the large international clients and investors operating in the international market. Its future strategy lies in partnering with cost consultancies already operating locally in respective countries it wish to internationalise operations.

**Figure 7.12** Core services of Shenyuan



## 8.0 The UK-China Comparative Cost and Commercial Management Framework

This research analysed in detail the cost and commercial management practices of the UK and China through a literature review, set of industry surveys and case studies. Using the information gathered a conceptual cost and commercial management systems models for both UK and China were developed. It was then subjected to a detailed iterative development process using an Expert Forum appointed for each country (see section 4.2 – research method) and adopting Delphi methodology. The resultant models developed for each country is discussed in detail in this section.

The UK cost management process and China engineering cost process are modelled in to a series of process models presented as a process overview and followed by detailed process model for each stage of the procurement. In order to achieve comparability across both countries RIBA Plan of Work (2013) has been used as the underlying procurement process model for the UK and procurement processes are modelled in a similar way for China.

The detailed process models demonstrate the cost and commercial management processes of the two countries respectively in a typical construction project executed according to the traditional procurement route and for a single stage tendering process to minimise complexity. Further, RICS member online survey 2012 (RICS, 2012) also suggests that 86% respondents frequently use traditional procurement route to procure construction projects. Hence, this would be an ideal starting point.

The models depict fundamental cost and commercial management services delivered at each stage of a typical construction project and how each service is linked to one another. The main focus of the model is the role of the Quantity Surveyor (QS) in the UK and the role of the Engineering Cost (EC) consultant in China. However, the model also depicts how the roles of other team members to facilitate cost and commercial management services to be delivered by the quantity surveyor. Further, the roles of client and project manager are clubbed together as often the project manager acts as the client's representative.

### 8.1 Cost and Commercial Management Process for UK

The UK industry cost and commercial management processes are captured in to a detailed model that consists of a process overview and followed by set of detailed models for each stage of the procurement process. The following sub-sections present the overview process model followed by detailed process models for each stage.

#### 8.1.1 Process Overview

The process overview model (Figure 8.1) summarises the cost and commercial management processes adopted by the Quantity Surveyors in the UK.

Refer Appendix A for a detailed and complete set of cost management process diagrams.

##### 8.1.1.1 Stage 0: Strategic Definition

Investment options of client are appraised at this stage. Core objectives and specific needs of the project are identified. Project quantity surveyor is most likely to be appointed at this stage and inputs of quantity surveyor is utilised to appraise investment options and develop the strategic brief.

##### 8.1.1.2 Stage 1: Preparation and Brief

Design team for the project will be appointed by the Client. Detailed strategic brief is developed. Quantity surveyor prepares rough order of cost estimate (NRM1) to indicate likely cost of the project using historical data and advises client on the mode of finance and procurement options. Architect ascertains the space, quality, time requirements of the project and conducts feasibility studies together with QS and Engineer. Order of cost estimate is prepared by the QS to confirm the cost limit and crucial decision is made on whether to go ahead with the project. Once the project becomes viable works on planning permissions are initiated. In addition to that risk assessments are initiated at this stage and carried on till the end.

### 8.1.1.3 Stage 2: Concept Design

Concept designs are prepared by the architect for which structural, mechanical and services system alternative designs are proposed by respective engineers. Alternatives are appraised in terms of cost, technicality, planning and user requirements by design team members and optimum design is agreed and approved by the client. Subsequently, planning application can be submitted at the end of this stage. Formal Cost Plan 1 (NRM1) is prepared by the QS (using elemental analysis) and the cost limit is confirmed. Further, QS advises client on tender procedures. Risk assessment is also reviewed.

### 8.1.1.4 Stage 3: Developed Design

Stage starts with the finalised project brief. Basic designs are completed. Engineers prepare preliminary designs for the structure and services. QS updates the cost plan and produce Formal Cost Plan 2 (NRM1). In addition, QS carry out cost checks to ensure the cost limit or cost targets of each element is not exceeded and if so remedial actions are taken. Client starts to apply for pre-contract instalment to fund the project. Financial institution will evaluate the design and approve funds. Client approves the final technical and cost proposal of the project (after any amendments). Planning applications are submitted and approval will be granted by statutory authorities after checking conformity.

### 8.1.1.5 Stage 4: Technical Design

In the traditional procurement route many cost management process happens in this stage including tendering. Technical designs are finalised in this stage and approved by the client to produce the production drawings. Bills of quantities (NRM2) are likely to be produced at this stage, however, this not the case always. Many cost management practices do not produce bills of quantities at present; instead a Formal Cost Plan 3 or pre-tender estimate is prepared. Again, final cost checks are carried out by QS to reconcile any differences. When cost limit is exceeded client is notified and approve additional funds if possible otherwise re-designing is considered. Once the final drawings are ready full planning permission is obtained. Tender documents are prepared by QS and invitation for tender is sent to the eligible contractors. Meanwhile queries of bidders are answered by QS before tender submission. All received bids are evaluated to identify the most responsive bid and tender report is prepared by QS. Based on the tender report recommendations the contractor for the project is selected by the client. Cost checks are carried out to confirm the cost limit and post-tender estimate is prepared. Client may apply for a second instalment where the financial institution evaluates progress and approves funds. Finally, contract documents are prepared and the contractor enters into formal contract with the client.

### 8.1.1.6 Stage 5: Construction

This stage is when physical construction of the project takes place and contractor's role becomes significantly active. Contractor executes the approved designs and produce as-built drawings incorporating any variations. Variations are initiated by either the Architect or the Engineer. However, variations are valued by the QS. Contractor submits interim valuation usually on monthly basis (periodically as agreed in the contract) where QS checks the quantity of work, architect and engineer checks and certify quality of the work and the amount to be paid by the client is estimated by the QS. On the other hand, client applies for funding and pays the contractor as per the contract. In addition to interim valuations, other claims are also put forward by the contractor such as claims related to variations and delays. Side by side, QS monitors the works, evaluate progress of the project and report the status of the project to client.

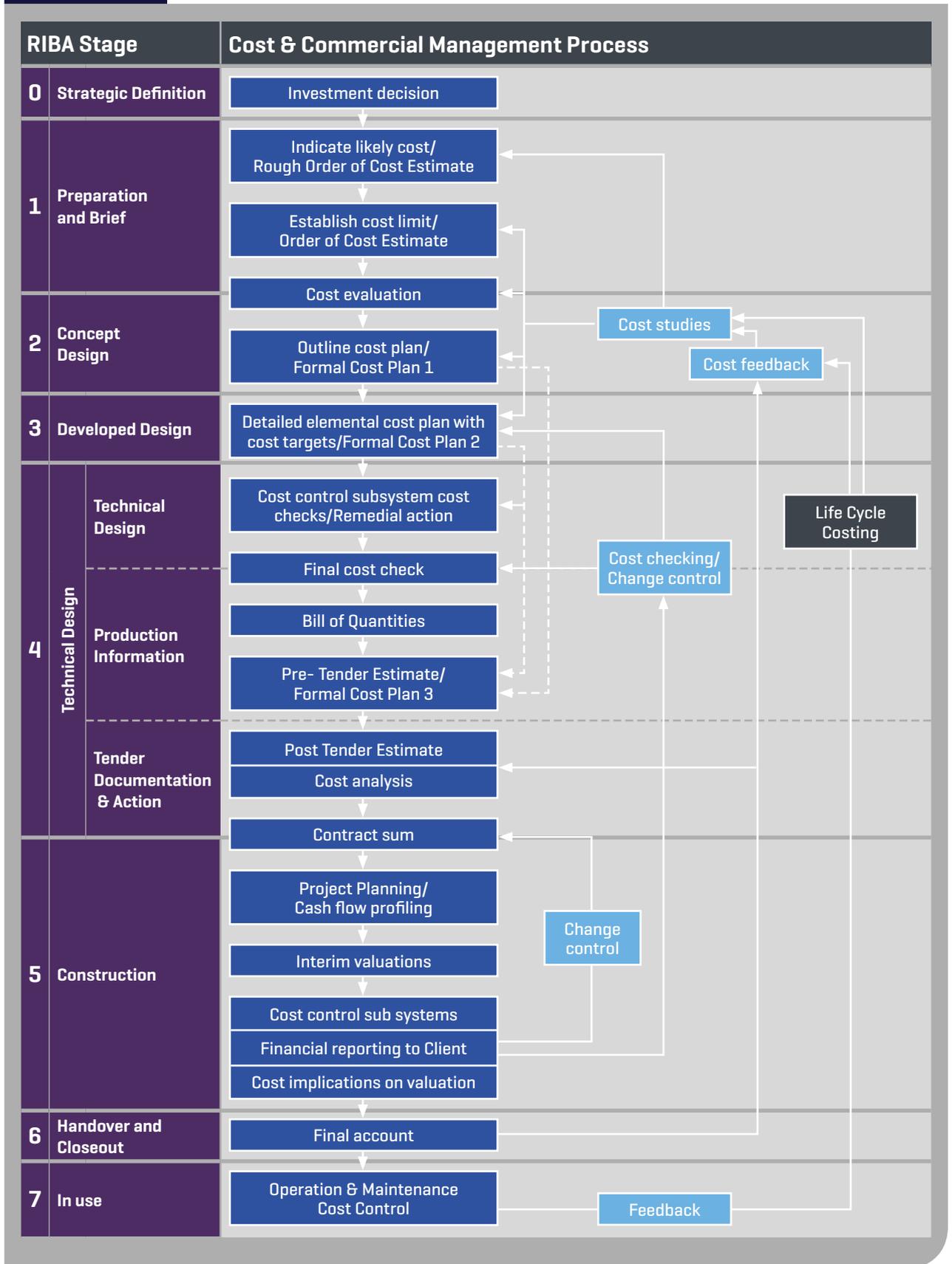
### 8.1.1.7 Stage 6: Handover and Closeout

The Building Contract is formally concluded at this stage. Contractor submits the final bill, then, the Architect, Engineer and QS carry out the final inspection and defects are identified. Half of the retention will be released and eventually, contractor rectifies the defects. QS Initiates the preparation of the final accounts for the project. Contractor handovers the project to the client with updated 'as-constructed' information. Disputes might also arise during the course of construction for which dispute resolution approaches can be initiated at that time and the process takes place parallel to monthly claims. These may or may not be resolved at the time of completion. Further, contractor also tends to produce cost analysis of the completed project from the final account for future use. The cost analysis for the project can be prepared from the successful tender using tender amounts also (if so, this can be completed at the tender stage as well).

### 8.1.1.8 Stage 7: In Use

Building is monitored throughout the defects liability period and defects list is prepared by QS. After rectifying the defects balance of the retention is released to the contractor and final certificate is issued. Also it is becoming significantly important to capture building energy performance in order to appraise the building sustainability and conduct whole life cost analysis. Finally, every commercial aspect of the project is documented and audited.

**Figure 8.1** Cost & Commercial Management Process (CCMP): UK – Overview



## 8.2 Cost and Commercial Management Process for China

The cost and commercial management processes for the industry in China are captured in to a detailed model that consists of a process overview and followed by set of detailed models for each stage of the procurement process. The following sub-sections present the overview process model followed by detailed process models for each stage.

### 8.2.1 Process Overview

The process overview model (Figure 8.2) summarises the cost management processes adopted by the Engineering Cost consultants in China.

Refer Appendix B for a detailed and complete set of cost management process diagrams.

#### 8.2.1.1 Stage 1: Decision Making Stage

Most critical investment decision is made in this stage, i.e. decision to build or not. such as build a power station, a new university campus or a new road network, etc. Such decisions are crucial for large and public sector projects. Large clients make an early stage estimate in house or requests design institute to complete it with their initial thoughts. They do not employ an EC firm unless they have project consulting licence awarded by the National Development and Reform Commission (NDRC). All large scale public investment need be approved by NDRC. EC firm in this stage is to carry out a feasibility study and programme comparison. It forms the basis for the investment limit for the project. Clients to decide on obtain necessary funding from one of the three main funding sources: government fund, bank loan or private sector investment, or a combination of bank loan or private sector investment.

#### 8.2.1.2 Stage 2: Design Stage

EC firm mainly starts to involve in later part of this stage. Some practices prepare cost estimates from conceptual design to detail design, although cost estimating may not be their main function. Main focus of such firm is on taking-off and preparation of bills of quantities. The quota system is used in the design stage, however, the quote system only provide average prices and only reviewed every five years. Further, every province has its own quota system (database) therefore location indices needs to be applied when preparing estimates. Licensed EC firms may commence Project Audits at this stage.

#### 8.2.1.3 Stage 3: Tendering and Bidding Stage

EC firms usually have another tendering agent to help them to link between design and construction stages. Their main job is to prepare tender documents and guide in the tendering procedure. The construction firm is required to be well informed of the tender prices and the means of winning the tender. Further, they also try to eliminate cost overrun of the project.

Traditionally, the project should be awarded to the lowest bidder but the process is now changing. The winning bid is normally lower than the investment limit. The contractor's strategy is to bid lower than the investment limit established for the project. Contract is awarded on the recommendations of the EC firm. A dual parallel process of project cost monitoring is adopted for projects through independent project auditing by another licensed EC firm. This is to eliminate disputes between the EC firm monitoring costs and/or the client with the contractor.

#### 8.2.1.4 Stage 4: Construction stage

In the construction stage, EC firm has the right to explain the contract and recommend necessary action. EC firm carry out many functions such as: issue monthly payment, check design changes, valuing variation, and monitoring cash flow etc. Generally the CE will reside on site monitoring the use of construction materials, payments and regularly report to company's head office.

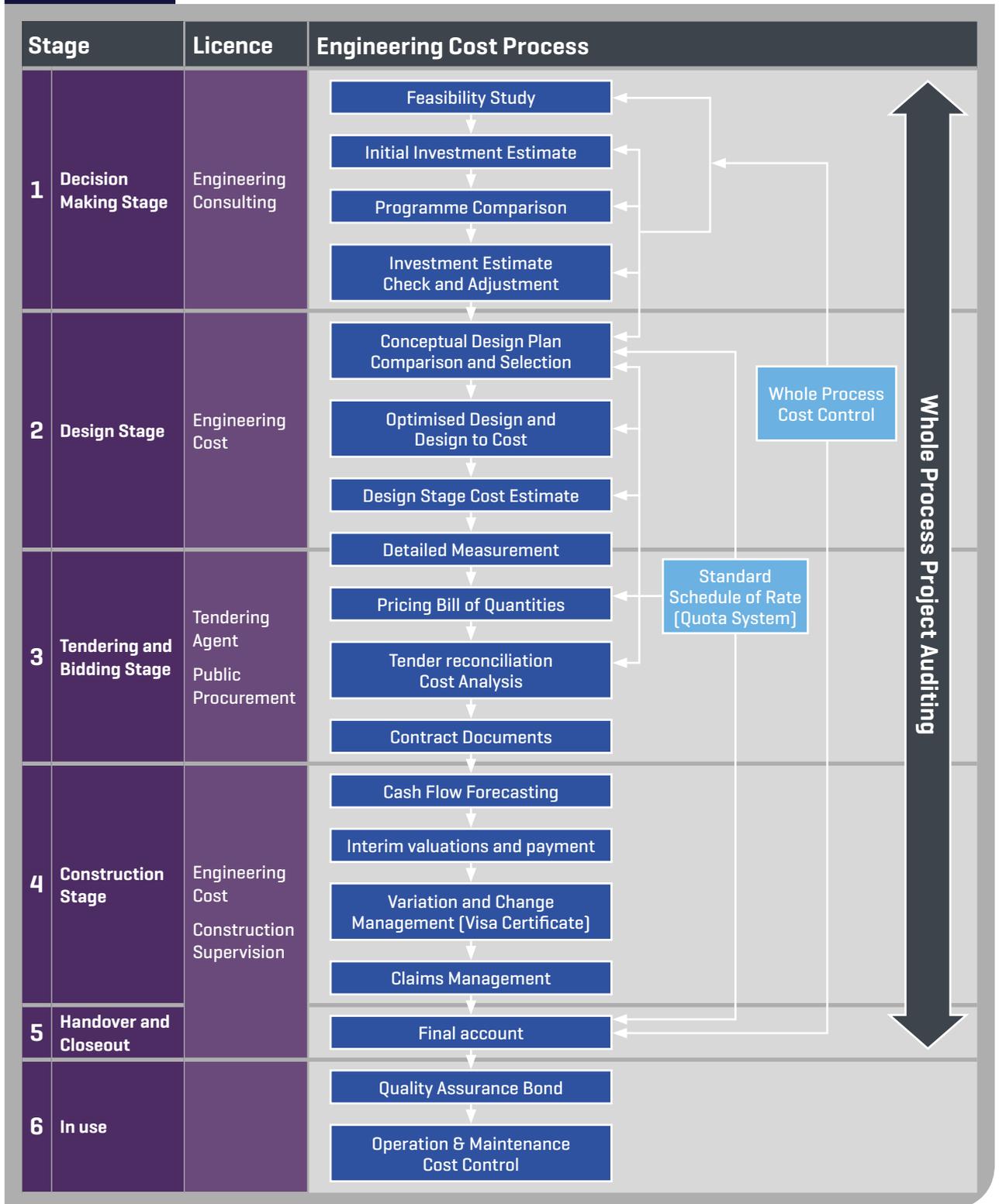
#### 8.2.1.5 Stage 5: Handover and Close Out

In this stage, (for most Cost Engineers is the final stage), CE resolves claims and prepare the final account, and then submit to the client to review. If it is a large scale of public project, it is quite common to have independent company to carry out a detailed final audit to make sure that the total cost is closer to the accurate cost and minimise disputes.

#### 8.2.1.6 Stage 6: In Use

Life cycle costing is not carried out as it is still new. None of the CE firms deliver LCC consultancies, therefore, are not keen in collecting running cost and energy data. Only the client has long term interest in the building use. Facilities management is a different discipline and is not part of EC business. Main function here is to certify release of retention upon examination and satisfactory completion of defects rectification.

**Figure 8.2** Engineering Cost Process (ECP): China – Overview



### 8.3 Comparison of UK and China Cost & Commercial Management Systems

The major difference between cost and commercial management systems of the two countries is the way the services are delivered by the cost management companies. It is a common practice in the UK that the cost management consultancy services are delivered by single cost management practice also known as Professional Quantity Surveying (PQS) company while in China it is heavily fragmented and regulated through service specific licensing system for the Engineering Cost companies as indicated in Figure 8.2. Accordingly, if a company possesses all of the above listed licenses then they can be the sole company who delivers the entire Cost Engineering services to a project, otherwise more than one company will be involved. Another interesting difference is that there are two parallel cost control processes exercised within the Engineering Cost system; one by project EC consultant and the other by an independent EC consulting firm – which is known as project auditor. Some large clients have their own in-house team to deliver the Engineering Cost (EC) services and then it will be audited by another independent EC company to ensure due process. In addition, many Cost Engineers in China are still using the traditional pricing method: the quota system to price BoQs and for estimating. This is similar to resource based estimating. In contrast, UK utilises a risk based market oriented estimating and pricing system supported by well-defined cost management processes supported by industry professional standards such as NRM facilitated through cost information systems such as BCIS, Wessex, SPONS, Hutchinson’s among many others.

A clear understanding of the similarities of the stages can be gained by mapping the UK Cost Management system against China Engineering Cost system which is demonstrated in Table 8.1. It indicates a close similarity between the stages though the services exercised and the depth of each stage varies considerably. Last three stages are very similar where interim valuations, cash flow forecasting, claims management, and final accounts are the major service delivered in both the systems. However, initial stages tend to vary significantly. It can be noted that as per the RIBA Plan of Work 2013 greater importance is given to initial stages as the decisions made at early stages have a greater influence on managing costs at subsequent stages. Hence, design stage is split into three different stages namely concept design, developed design and technical design where the technical design stage also include tendering in a traditional single stage procurement system. This split of design stage ensures multiple checks to eliminate subsequent variations. Cost plans are usually prepared for each stage of design and continually updated and reconciled throughout design development. For instance, different types of estimates/cost plans are prepared in different stages (in accordance with NRM1) includes: Order of Cost Estimate, Formal Cost Plan 1, Formal Cost Plan 2 and Formal Cost Plan 3/ Pre-Tender Estimate.

However, in Engineering Cost System only one design stage Cost Estimate is prepared in addition to the Initial Investment Estimate. This is a major difference in the depth of services exercised in each stage of the two systems. On the other hand, although operational and maintenance cost control is mentioned in Chinese EC process model, it is still in a stage of very early stage of adoption of practice. Most EC firms do not provide WLC/LCC services. Services such as Facility Management or Asset Management, which are quite common now in UK QS practice (larger scale firms) are not provided by EC firms in China. Moreover, life cycle costing, risk and value management in China still remains in theory rather than in practice.

**Table 8.1 Mapping Cost Management Process Against Cost Engineering Process**

Cost Management (The UK)	Cost Engineering (China)
Strategic Definition	
Preparation and Brief	Decision Making
Concept Design	Design
Developed Design	
Technical Design	
Construction	Tendering and Bidding
Handover and Closeout	Construction
In use	Handover and Closeout
	In use



## 9.0 Conclusions

### 9.1 The Need and the Research Approach

Cost and commercial management processes and practices in different parts of the world vary significantly. In the UK and the British Commonwealth these practices are mainly market oriented and matured over several centuries. The effects of globalisation and impact of foregoing recession have led most UK based cost consultancies to expand overseas. In contrast China, the modern world's economic powerhouse is still transforming its construction industry from a communist centralised planned economy using quota based systems to a market based system. UK-China cooperation agreements foster greater professional mobility and make understanding systems and processes in both countries vital for greater economic cooperation. However, there is a significant level of lack of common understanding of construction cost and commercial management systems of these two countries. Therefore, this research mapped the UK Cost and Commercial Management systems to Chinese Engineering Cost Systems in three phases as follows:

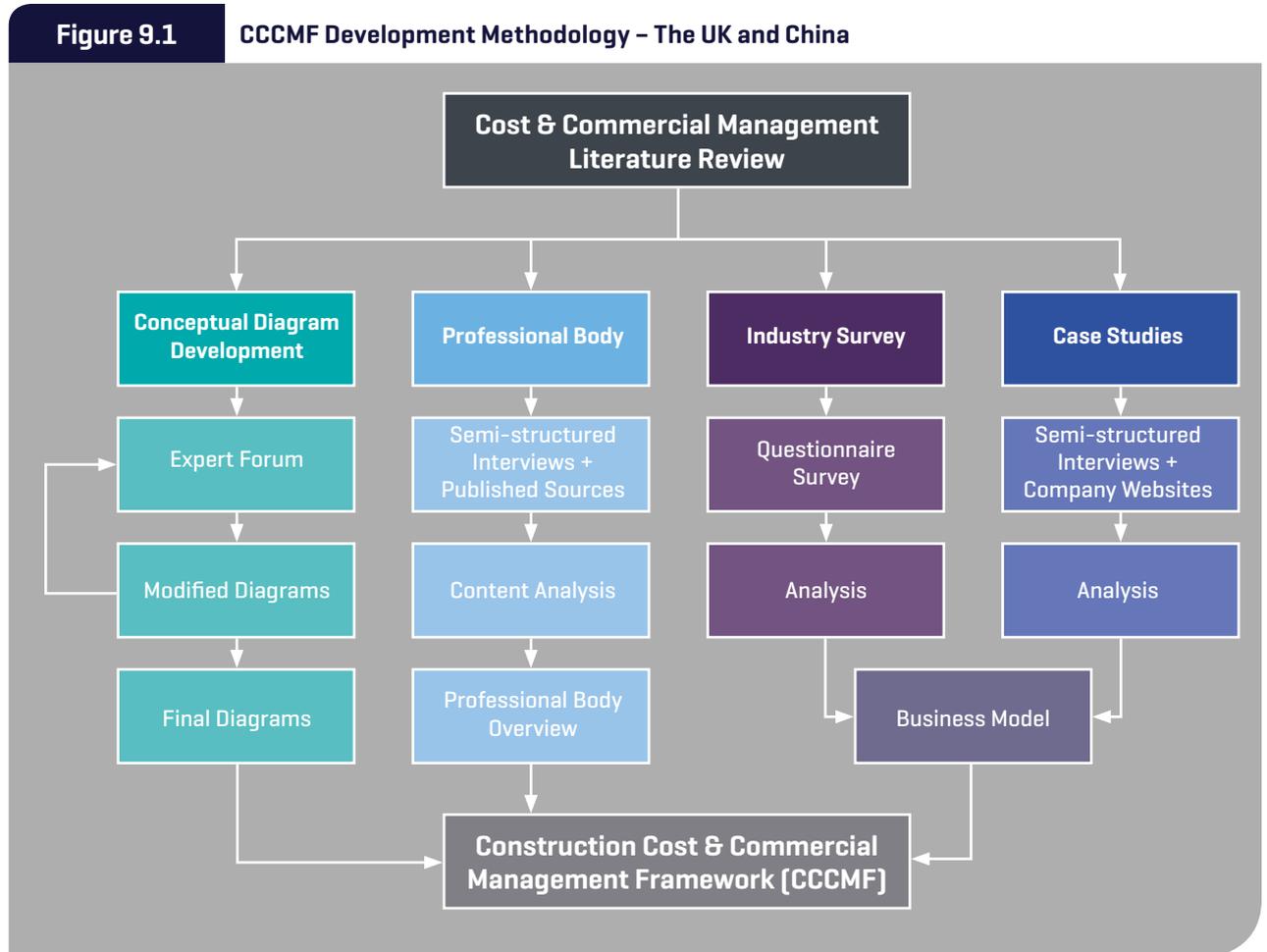
- **Phase 1: Detailed review of China and the UK cost and commercial management operations**

This phase consisted of a detailed literature review of the QS practices in the UK and Engineering Cost practices in China lead to the development of a conceptual cost and commercial management system model that classifies project stages and services delivered in each stage. Then, the models were verified through expert forum consisted of three experts from each country.
- **Phase 2: Detailed review of the structure and operations of CECA and RICS**

Phase two includes a detailed comparison of the RICS and CECA organisation structures, profiles, qualification pathways, accreditations, education and training systems which is captured through semi-structured interviews with three members from each professional body.
- **Phase 3: Business Comparison**

This phase consisted of a comprehensive questionnaire survey of 100 UK quantity surveying firms and China Engineering Cost Consultancies and three case studies in both the countries. The three consultancy companies selected for the case study represented large, medium and small companies for both countries. Semi-structured interviews, website reviews and document analysis were conducted for each case study. This phase investigated the nature and scope of the professional practices, enterprise management models utilised, and the future development and trends of cost management practices and engineering cost practices of the two countries.

Figure 9.1 illustrates the development methodology of the CCCMF. The same process was replicated for both the countries.



## 9.2 The Construction Cost and Commercial Management Framework (CCCMF)

The key element of the CCCM framework is the detailed process diagrams of Cost Management Process of the UK and Engineering Cost Process of China which are presented in Appendix A and Appendix B. Accordingly, the Cost Management Process of the UK comprises of 8 distinct stages as per RIBA Plan of Work 2013 – Strategic Definition Preparation and Brief, Concept Design, Developed Design, Technical Design, Construction, Handover and Closeout and In use, while Engineering Cost Process of China can be regarded to have mainly 6 stages namely Decision Making, Design, Tendering and Bidding, Construction, Handover and Closeout and In use.

Even though the stages look similar there are several variations between the two. Construction, Handover and Closeout and In-Use stages are very similar where interim valuations, cash flow forecasting, claims management, and final accounts are the major services delivered in both the systems. However, initial stages tend to vary significantly. It can be noted that as per the RIBA Plan of Work 2013 greater importance is given to initial stages as the decisions made at early stages have a greater influence on managing costs at subsequent stages. Hence, design stage is split into three different stages namely concept design, developed design and technical design where the technical design stage will also include tendering in a traditional single stage procurement system. This split of design stage ensures multiple checks to eliminate subsequent variations.

Apart from the stages there are variations in the way the services are provided. The major difference between cost and commercial management systems of the two countries is in the way the services are delivered by the cost management companies. It is a common practice in the UK that the cost management consultancy services are delivered by single cost management practice also known as Professional Quantity Surveying (PQS) company while in China it is heavily fragmented and regulated through service specific licenses for the Engineering Cost companies. Another interesting difference is that there are two parallel cost control processes exercised within the Cost Engineering system; one by project engineering cost consultant/QS and the other by an independent consultant/QS company – which is known as project auditor. Further, many Cost Engineers in China are still using the traditional pricing method: the quota system to price BQs and for estimating, which is akin to resource based estimating. In contrast, UK utilises a risk based market oriented estimating and pricing system supported by well-defined cost management processes such as NRM facilitated through cost information systems such as BCIS. On the other hand, although operational and maintenance cost control is mentioned in Chinese process model, it is very early stage for Cost Engineers to provide services such as Maintenance Management, Facilities Management or Asset Management, which are quite common now in UK QS practice. Moreover, life cycle costing, risk and value management in China still remains in theory rather than in practice.

### 9.2.1 Professional Bodies

The two professional bodies have distinctly different characterisations; RICS has a very long history of over 140 years and a broad spectrum of membership categories with a global profile compared to CECA which is about 25 years old focused and authoritative. For instance, the Enterprise license system that regulates the business scope of consulting companies and its service quality in China (namely, Jia Ji (Grade A) and Yi Ji (Grade B)) are administrated by the CECA. However, both the RICS and CECA have the power to influence and regulate the industry standards of the cost and commercial management systems. The RICS ability to exert such comes through indirect and non-legislative means whereas CECA have direct and legislative regulatory authority. The RICS governance structure is a more mature structure compared to organisation structure of CECA. It is a reflection of a long history of the RICS. More importantly, the qualification pathways for Quantity Surveyors and Cost Engineers of the two countries are distinctly different; RICS has a competency assessment facilitated through an Assessment of Professional Competence (APC) through document submission and a final viva voce examination whereas CECA conducts a qualification examination annually on four subjects – project cost management, project cost estimating system, Technology & Measurement and case study

analysis. Further, RICS offers three different membership categories namely, Associate, Chartered Member and Fellow as well as different routes to memberships which provide multiple options for both graduates and non-graduates to achieve different levels of professional memberships through different pathways. This has made RICS membership more flexible and adaptable to varying global requirements.

There is a core set of professional guidance developed by the RICS available for QSs, called the 'Black Book suite'. These are standard guidance documents providing different levels a professional guidance to its membership. The NRM suite is another important set of standards developed by the RICS which supersedes the SMM and sets standard in estimating on a cradle to grave approach. In addition to that RICS disseminates knowledge through an extensive series of CPD programmes. Both institutions actively involved in education and research with universities and provide limited amount of funding for research. In terms of internationalisation, RICS' strategy is four fold: Standardisation of measurements, Memorandums of Understanding, Reciprocal Agreements with other international professional bodies and Joint events with other professional bodies. These are endeavours that RICS utilise to promote its international profile. On the other hand, CECA is also very keen on internationalisation and supports Chinese companies that embark into international markets. However, the CECA encounter two key obstacles for internationalisation; language barrier and variation in cost and commercial management systems and standards between different countries.

### 9.2.2 Use of Cost and Commercial Management Techniques

Industry surveys were conducted to capture and compare business models of both the countries. Findings indicated that EC service profile looks significantly different from cost management profile of the UK firms. All twelve types of services identified are always or frequently used in the UK while prominent use was indicated in Measurement & Valuation, BoQs, Tendering and Final accounts followed by Interim Valuations, Valuing Variations and Claims in China. Further sixteen supplementary services were identified. Contract administration was the most commonly used service while insurance claim advice was the least used. Most of services classed as supplementary services in the UK QS service profile are not included in the China EC service profile. However, services related to Contract Administration, Dispute Resolution, and Cost Auditing were identified as services that are trending with firms in China.

During the early and design development stages UK firms demonstrated frequent usage of most of the identified cost and commercial management techniques while firms in China demonstrated low usage. This is backed up by the CCCM models developed through expert forum indicating difference in the depth of services delivered in early stage of design in the UK and China. During detailed design stage BoQs and Detailed Cost Plans are

used as the main tools of detailed estimating in the UK while in China BoQs are gaining increased popularity with firms moving away from traditional quota based estimating. This is an indication of China's transition from a centrally planned Quota System to a market oriented BoQ based estimating system. However, cost planning is not practiced in China in the way it is practiced in the UK. The practice in China is changing with British influence and cross fertilisation of techniques from foreign trained or experienced EC consultants returning to China along with influence from Hong Kong trained Quantity Surveyors and firms penetrating in to rest of China. Further, compared to UK practice and due to the absence of a clear elemental format cost analyses are not used in China. Techniques such as Whole life costing and Life Cycle Costing are gaining greater use in the UK industry while they are still in early stages of introduction to the Chinese construction industry. During post contract cost control, both the UK and China primarily use actual measurements for valuations with significant usage of BoQs. Further, there is prominent use of Cash Flow Forecasting and value of work done evaluations as cost controlling techniques in the UK while Chinese firms predominantly use Value of work completed as the basis of cost control with limited use of Cash Flow Forecasting. BoQ (contract rates) rates remain as the predominant method of valuing variations supplemented with Pro rata rates in the UK while use of BoQ rates and New negotiated rates have been indicated as equally important in valuing variations in China.

In terms of usage of tools and documents, both countries have some common as well as distinct set of tools and documents. Out of which BCIS and Price Books and databases stand out in the UK while NRM suite is gaining popularity. However, Black Book series published by the RICS and Embodied Carbon estimating data book (CapIT) are yet to widely penetrate into UK practice. The standard forms stack up in order of JCT, NEC and FIDIC in terms of popularity in practice. Likewise ten different tools and documents used for engineering cost practices were surveyed in China. The analysis indicates a prolific use of almost all surveyed except FIDIC conditions of contract which echoes limited portfolio in internationalisation for EC firms. There is significant level of software usage in the provision of cost management services right across all activities especially in the pre-contract stages in the UK. There are noticeably lower levels of software usage for Life Costing and Risk Management. There is very limited usage of BIM seen despite severe push from the government and the professional bodies. In a similar way to the UK practice there is limited usage of software for Scheduling, WLC/LCC and Risk Management activities in China backing up earlier findings on WLC/LCC and Risk Management while in case of scheduling it may fall within the practice of other disciplines. Furthermore, Excel is identified as the most popular software for most QS functions in the UK. It also indicates that Excel is the predominant software for WLC/LCC and Risk Management.

According to the future trend analysis, BIM was identified to be the most relevant future trend with UK firms. This might be reflective of the current trend in the industry in general while issues related to sustainability such as Green Buildings, Carbon Estimating and Environmental Assessment are also identified as important for the QS profession in the future. Similarly, EC firms also predict BIM to be the most relevant future trend for the profession in China. Moreover both the UK firm and Chinese firms agreed that internationalisation is challenging for construction business; internationalisation can increase profit margin and e-business implementations are important.

### 9.2.3 Business Models and Practice

The series of case studies enabled to probe in depth in to the practice of the cost and commercial management in the two countries. Accordingly, all three UK case studies indicated that they have similar business strategy in which 'client focused business' came up as the fundamental approach to business. Chinese firms had different strategies like expanding business, delivery of high-end services and transfer of new knowledge in developing new product and services on focus. In terms of core services, it can be noted that the UK firms deliver wide range of services in addition to cost and commercial management services like building surveying, party wall surveying, health & safety, development monitoring, heritage surveying, digital surveying, work place strategy, asset management, built management, energy demand management, workplace planning, mitigation of issues around environment and sustainability, repositioning of asset resale and redevelopment of the site and the like. Under cost and commercial management services irrespective of the size all three firms in the UK delivered a greater and diversified set of services beyond the basic services (like cost planning, cost estimating, procurement advise, cost control, valuations, final accounts, claims). On the other hand, in China, in parallel to the basic services mentioned above whole process cost control is a service provided by an independent Engineering Cost firm to audit the project. It could be expected that the UK firm to be well advanced in e-business though, it is not the case in many firms except for the large firms. There is still huge potential for development in this respect. However, measurement and quantification is semi-automated in all three UK firms while in China increasing awareness and enthusiasm to adopt technologies such BIM and e-business could be noticed. In terms of internationalisation two of the three firms both in the UK and China are keen on internationalisation and the UK firms have already established their presence in overseas. This is even true with the smaller and medium sized practices. However, Chinese firms face difficulty in venturing in to the international market due to language barriers, lack of suitably qualified staff with international experience and, lack of knowledge on international practice and procedures. Further, there seems to be lack of client side demand for such enterprise as well.



### 9.3 The Relevance and Applicability of the Work

The UK-China CCCM framework will bring about many benefits to the surveying profession in the UK and the Engineering Cost profession in China. It will facilitate cost consultancies of both countries to explore markets enhancing professional mobility. Professionals who wish to expand their business operations can achieve a good understanding of the cost management operations of both countries enabling them to bid for work or move between countries.

The CCCM framework will facilitate surveying practices to penetrate the fast growing construction industry of China. It will enable the RICS to further expand operations in China and to collaborate with CECA for mutual benefit. It will also help CECA and EC firms in China to better understand advanced and mature cost and commercial management practices of the UK.

It is anticipated that this research will provide huge benefits for all stakeholders. The key benefits can be summarised as:

- Better understanding of differences between UK Quantity Surveying System and China Engineering Cost System
- Provide the basis for the mutual recognition or articulations of the qualifications of the two institutions (RICS & CECA)
- Mutual understanding of the scope and range of core cost and commercial management services in the two countries and to promote exchanges and cooperation of professionals of both countries
- Cost and commercial management business case studies (three each from both UK and China) showcase service profiles and business models of companies
- Provide opportunities for cost consultancies in both countries to expand and enhance their global competitiveness.

### 9.4 Final recommendations

This research compares the two of the most popular mainstream cost management systems in the world promoting construction cost management consultants to better understand complex client needs. It helps them to increase their global competitiveness and business proves. It will be a catalyst for sustainable development and effective cost management innovation in both UK and China construction industries.

The report clearly indicates that there are significant differences in the practice of cost management services in the two countries. As such it is recommended that there should be greater in depth studies of the two systems. There are a plethora of publications documenting the UK quantity surveying systems both within RICS and in general in terms of accepted standard text. However, there are a limited number of such documentation or English translations of such documentation on the Engineering Cost system of China. Therefore, it is highly encouraged that there should be greater research and publication of the EC practice in order to better understanding the operations and processes of the Chinese construction industry.

It also strongly recommended that there should be closer cooperation and knowledge exchange between the RICS and CECA as two world leaders in cost management. There is much to gain for both institutions through collaboration in understanding respective practices and processes. This would lead to better mutual understanding and greater economic collaborations between cost management practices of the two countries.

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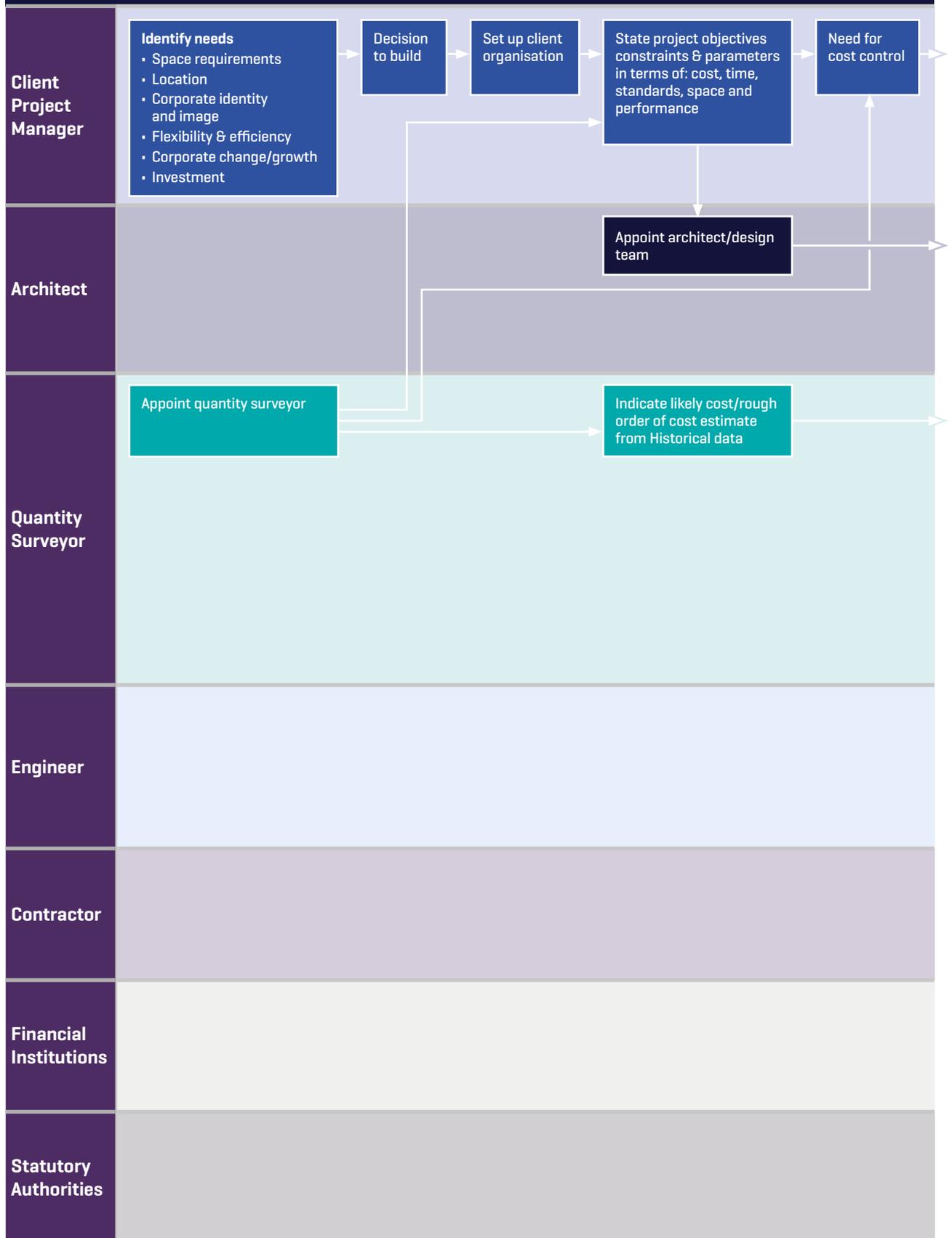
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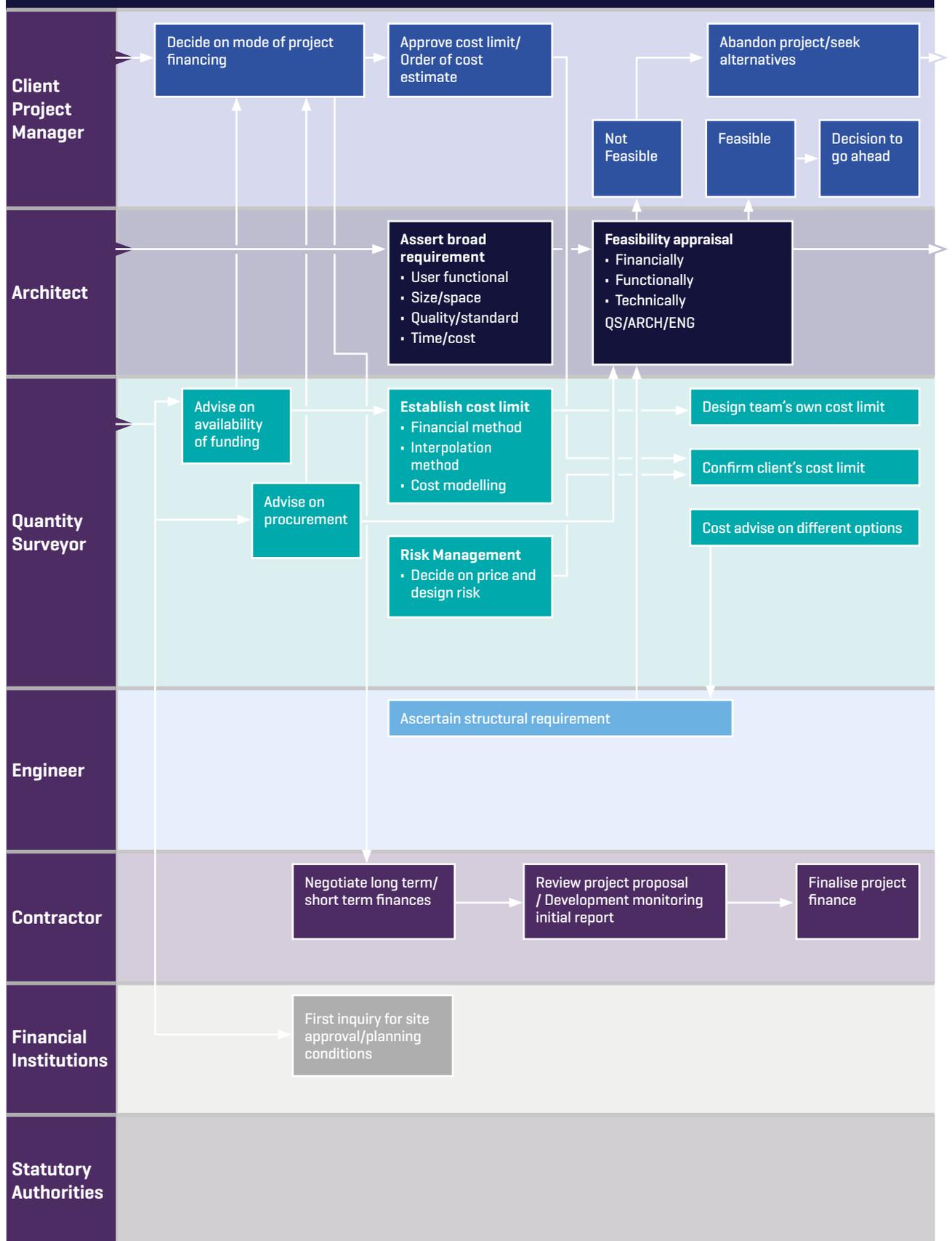
# 11.0 Appendix A



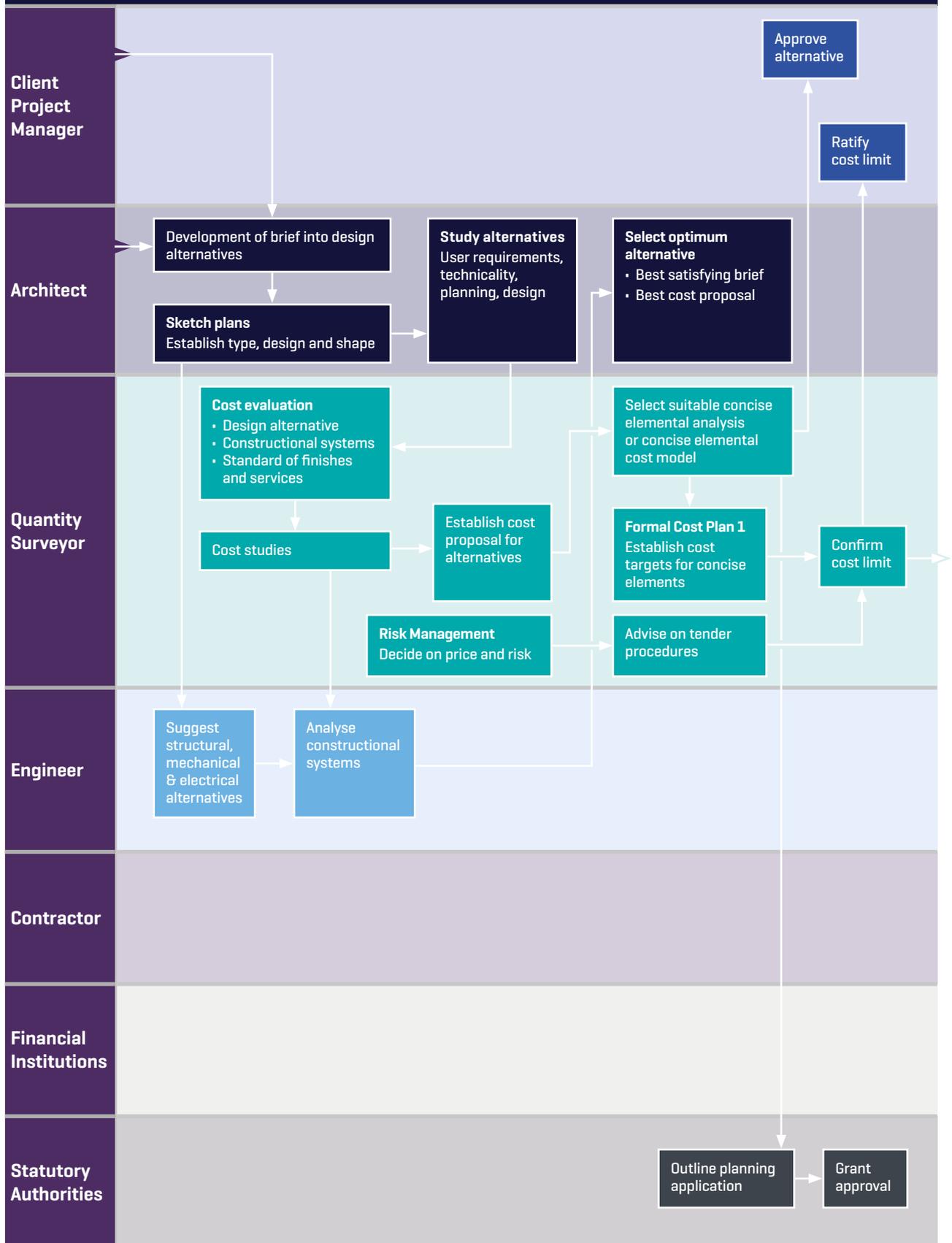
## Cost and Commercial Management Process (CCMP): Detailed 0 – Strategic Definition / 1 – Preparation & Brief



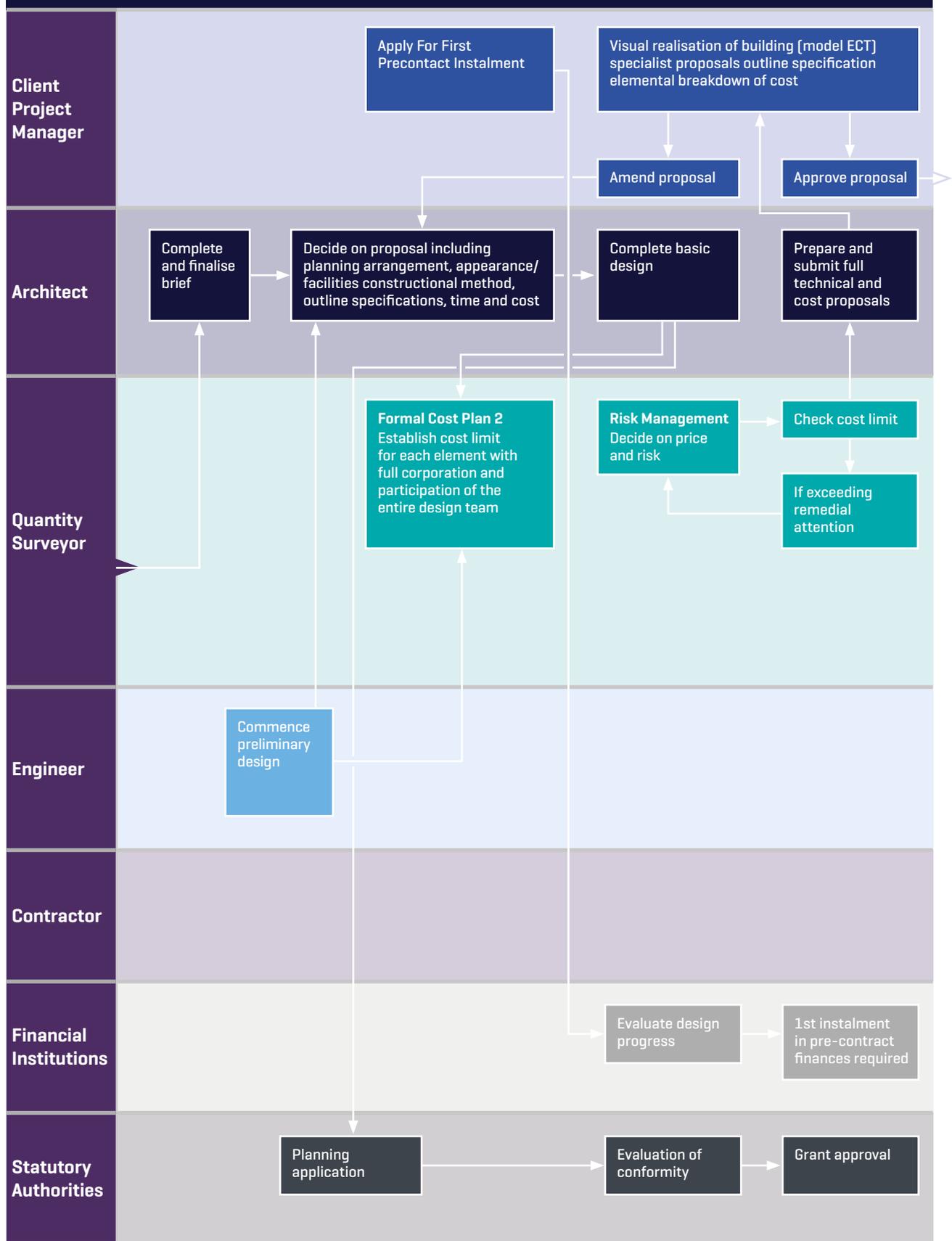
## Cost and Commercial Management Process (CCMP): Detailed 1 – Preparation & Brief



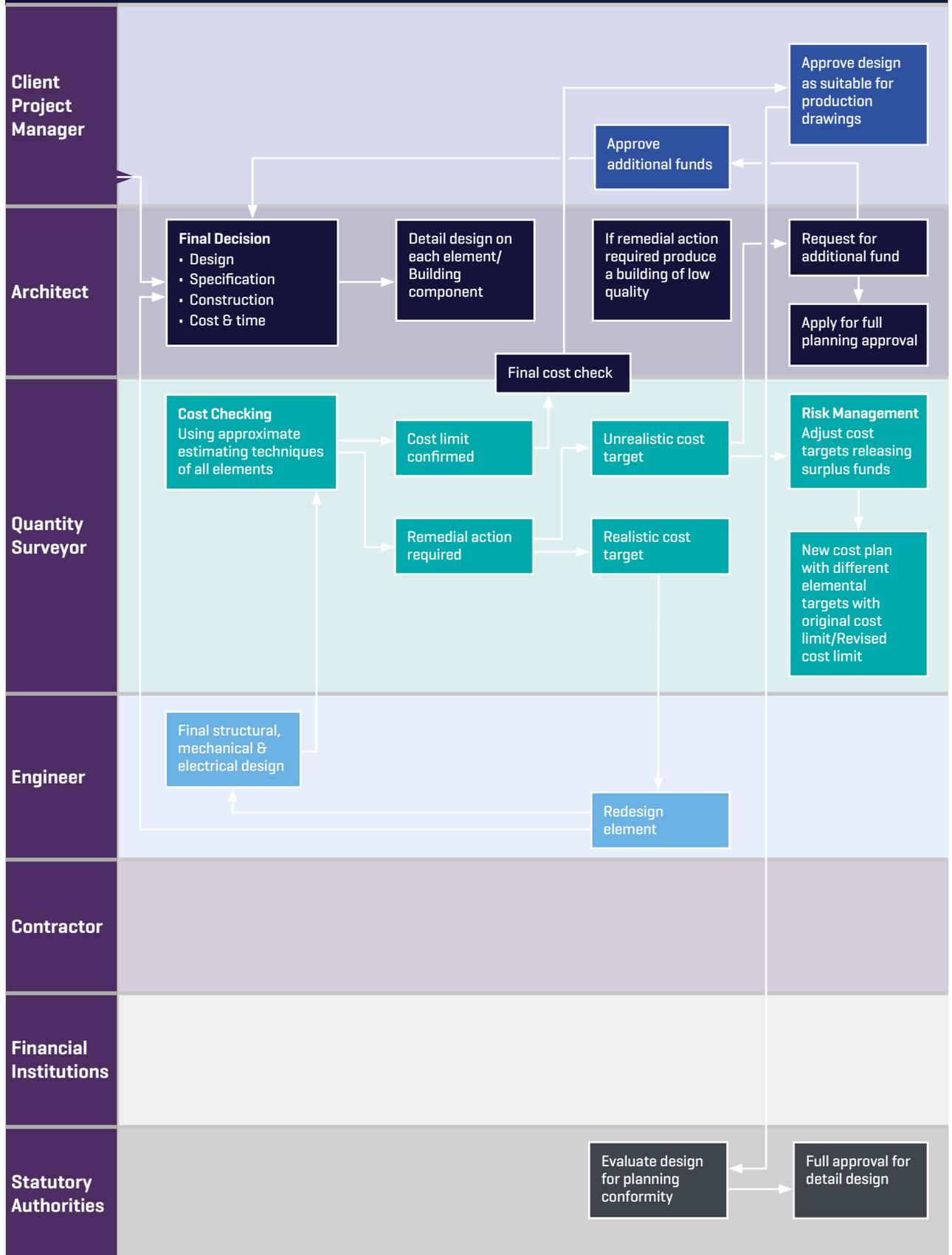
## Cost and Commercial Management Process (CCMP): Detailed 2 – Concept Design



### Cost and Commercial Management Process (CCMP): Detailed 3 – Developed Design

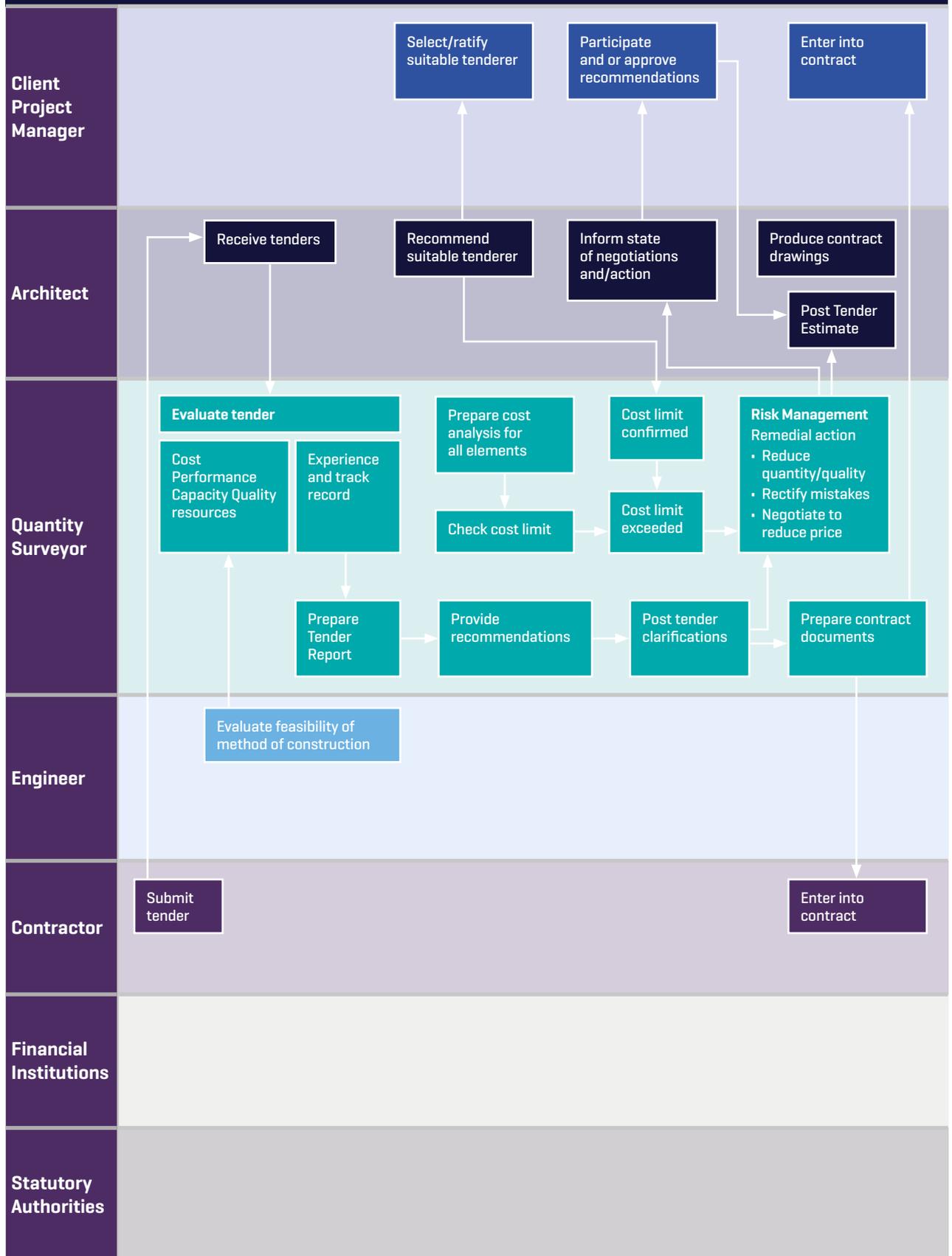


## Cost and Commercial Management Process (CCMP): Detailed 4 – Technical Design

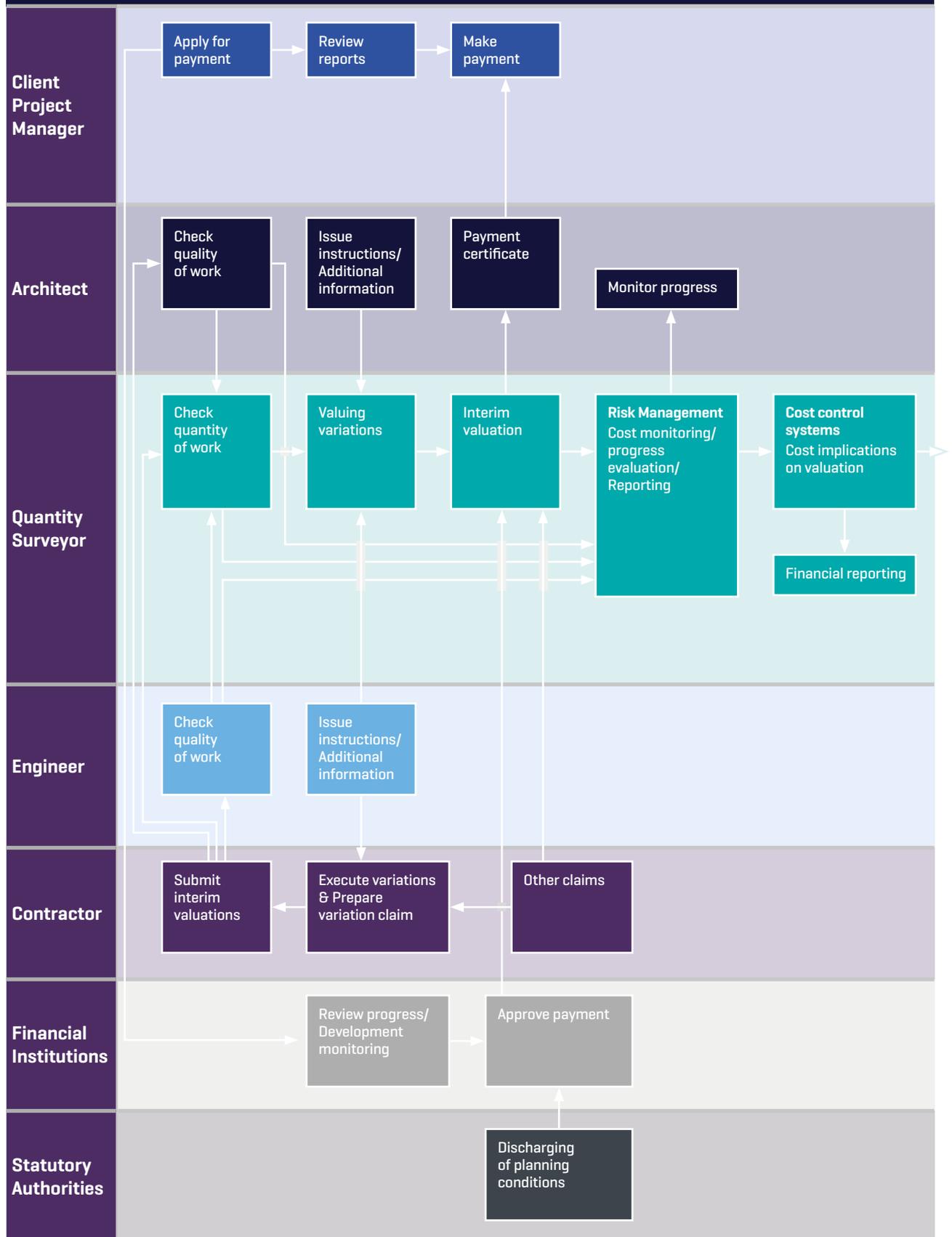




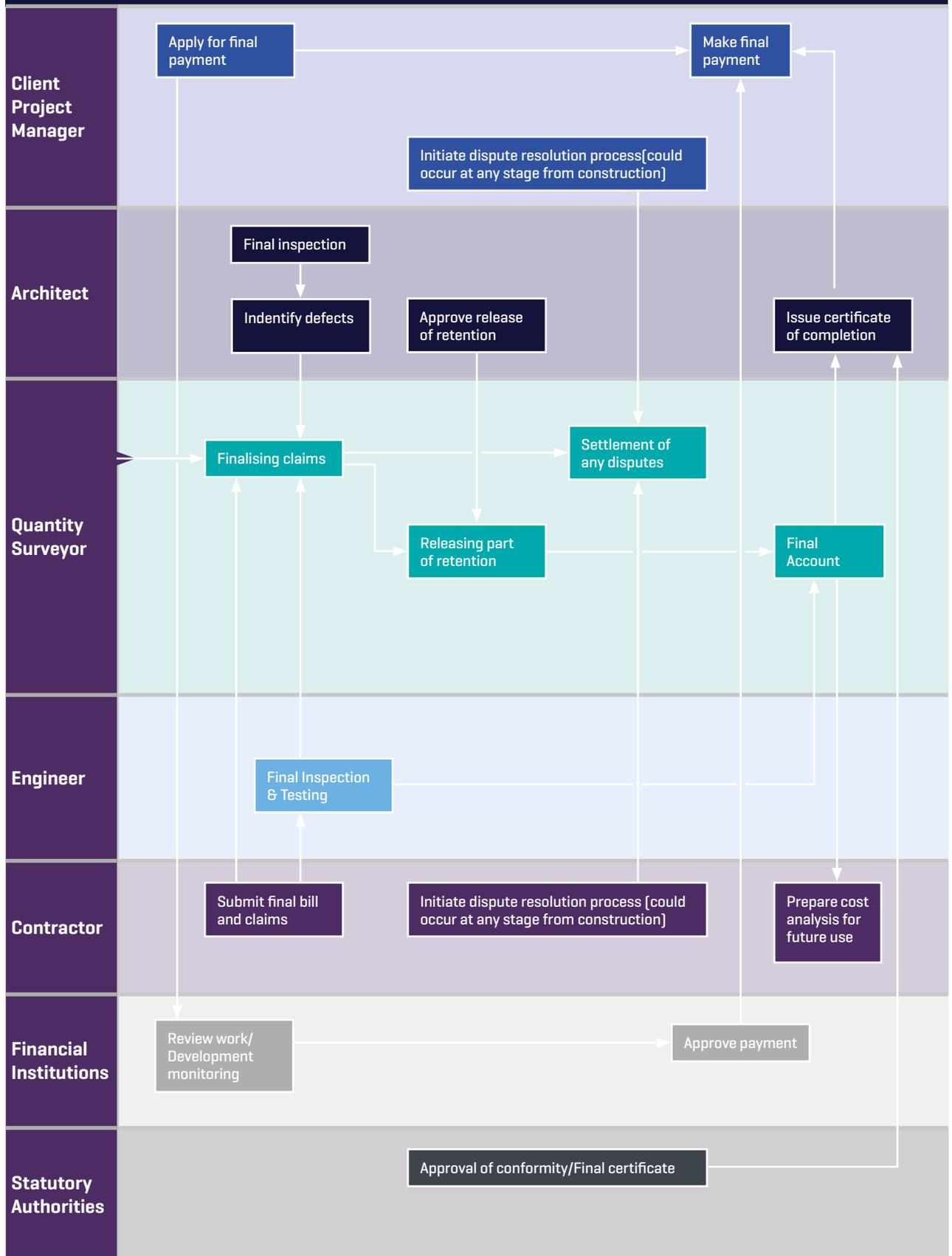
## Cost and Commercial Management Process (CCMP): Detailed 4 – Technical Design (tender action)



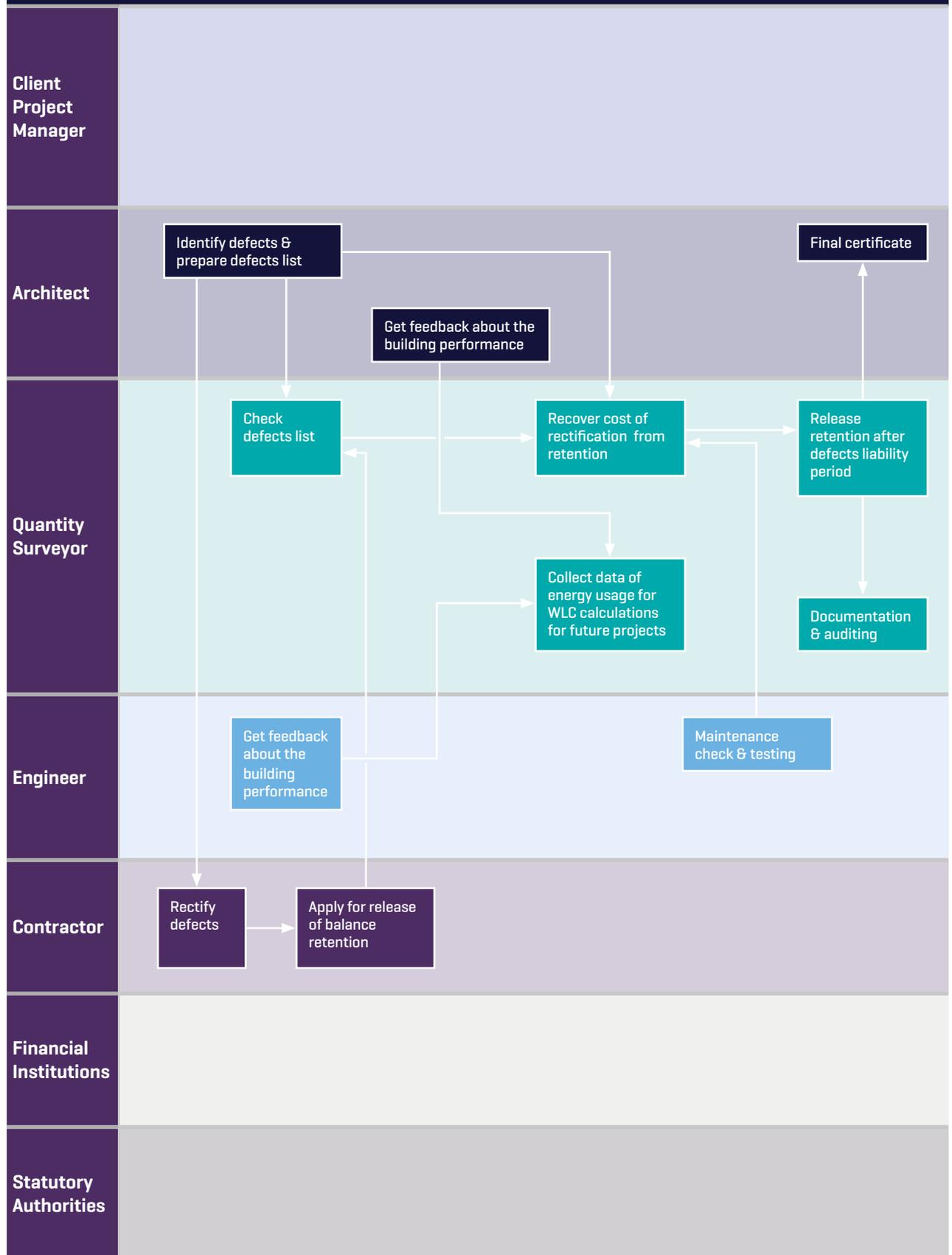
## Cost and Commercial Management Process (CCMP): Detailed 5 – Construction



## Cost and Commercial Management Process (CCMP): Detailed 6 – Handover and closeout

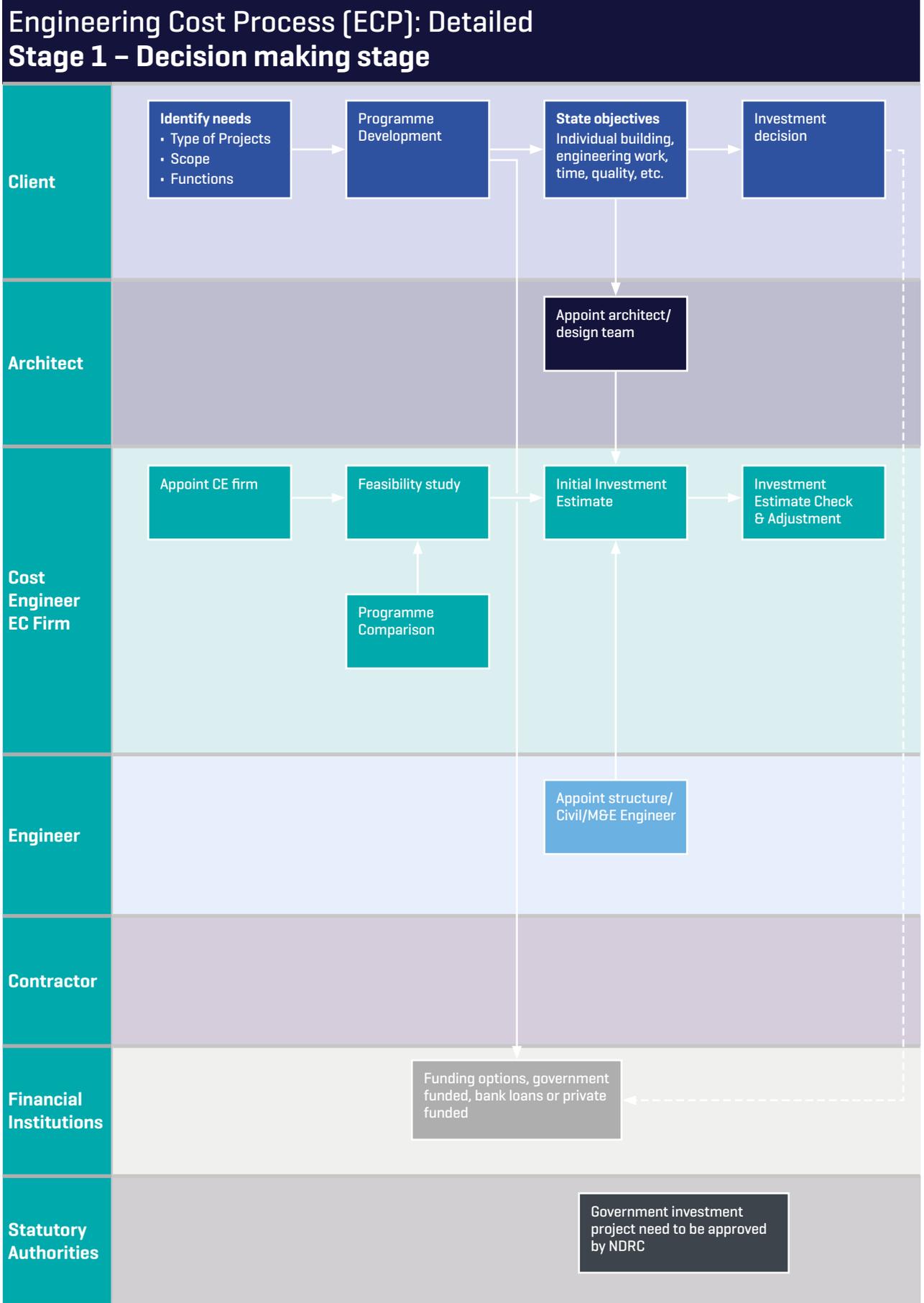


## Cost and Commercial Management Process (CCMP): Detailed 7 – In use

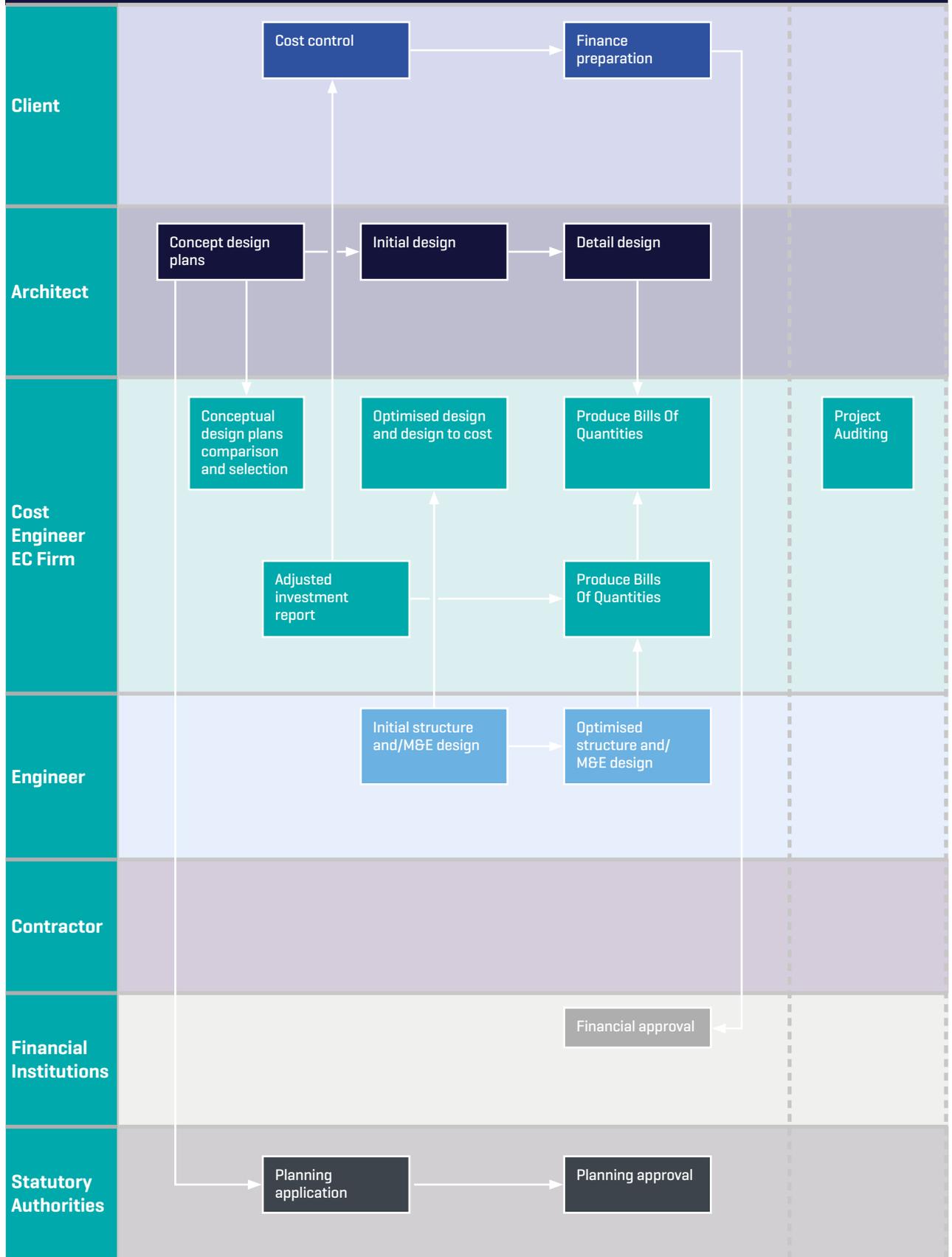


# 12.0 Appendix B

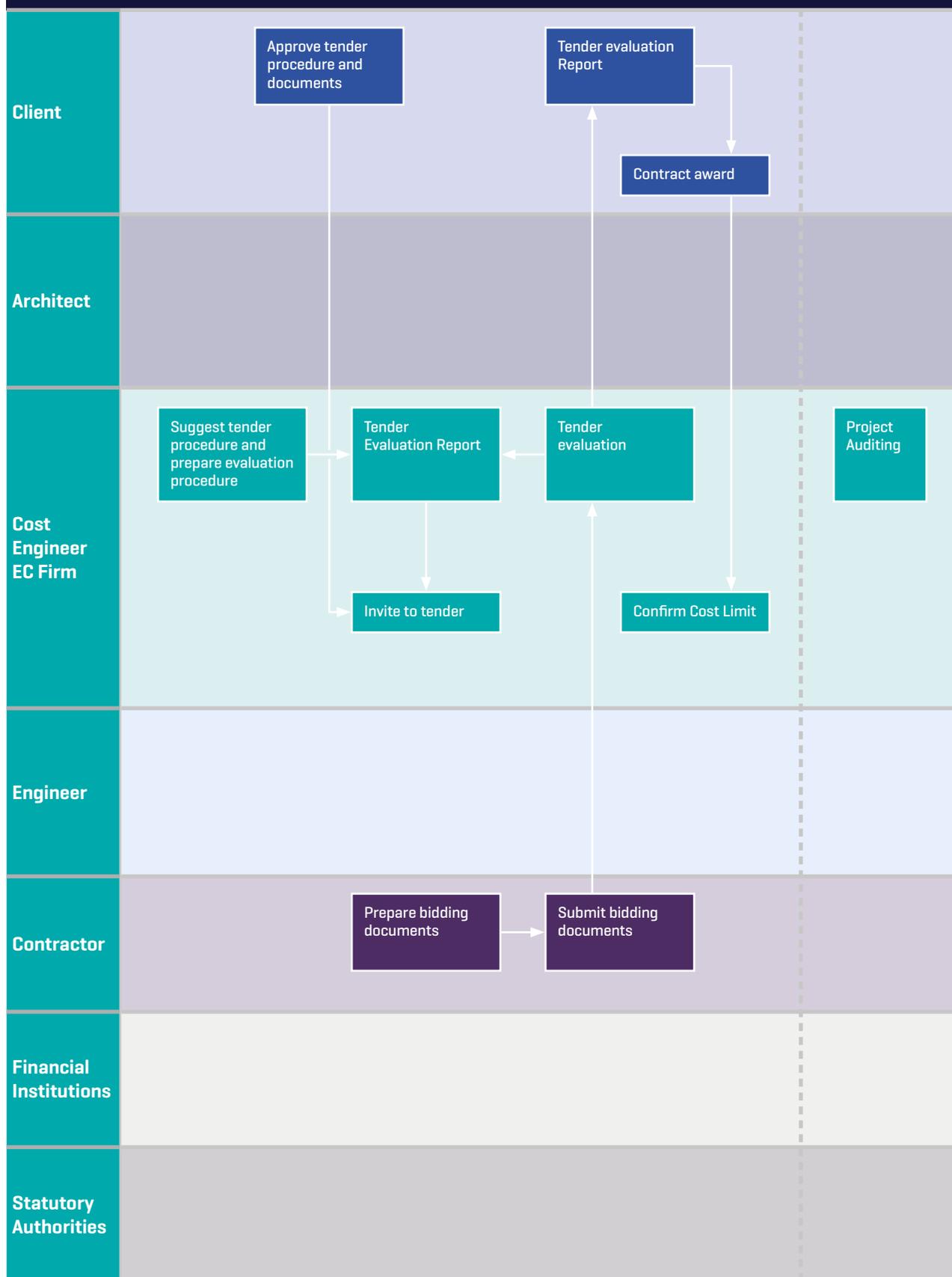




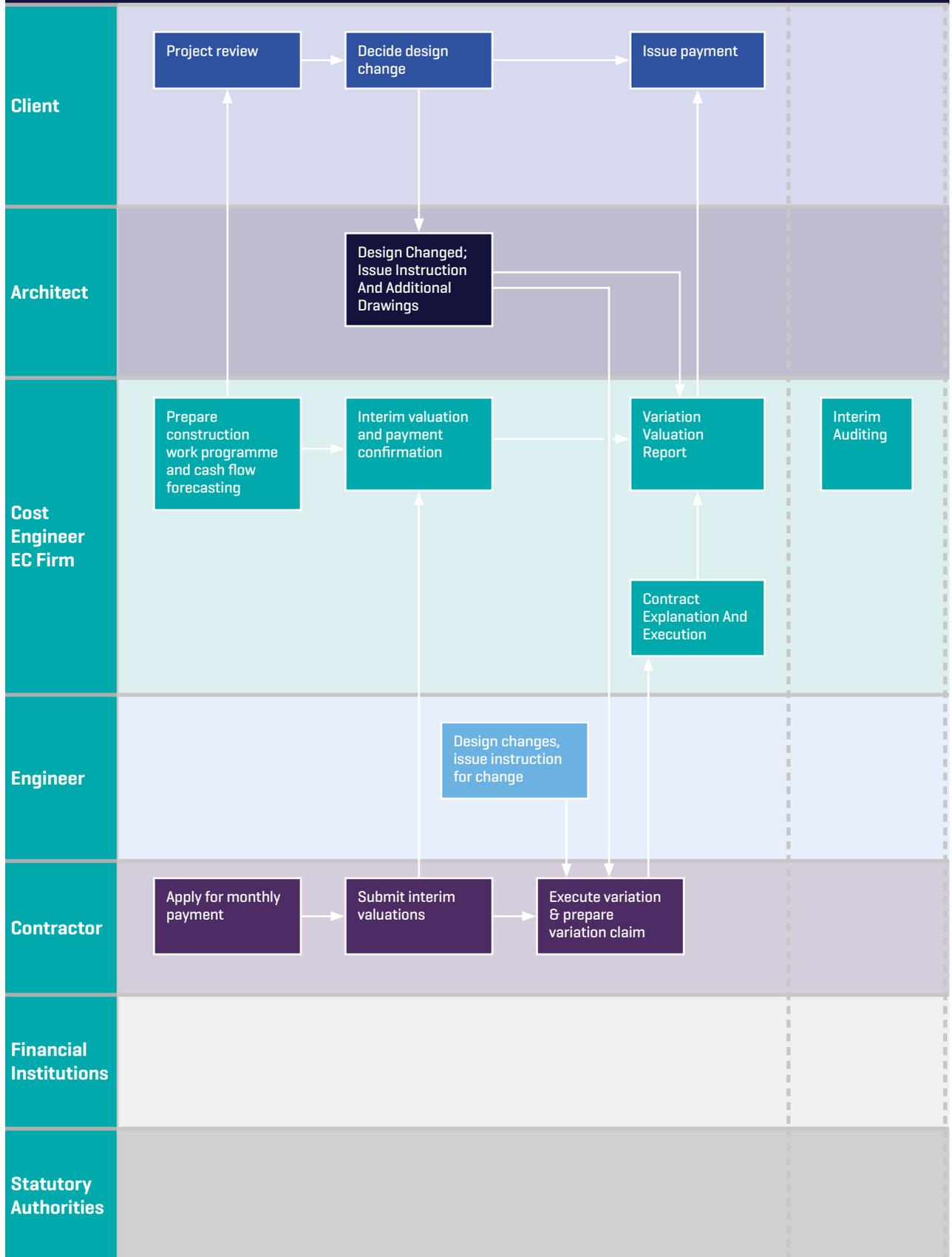
## Engineering Cost Process (ECP): Detailed Stage 2 – Design stage



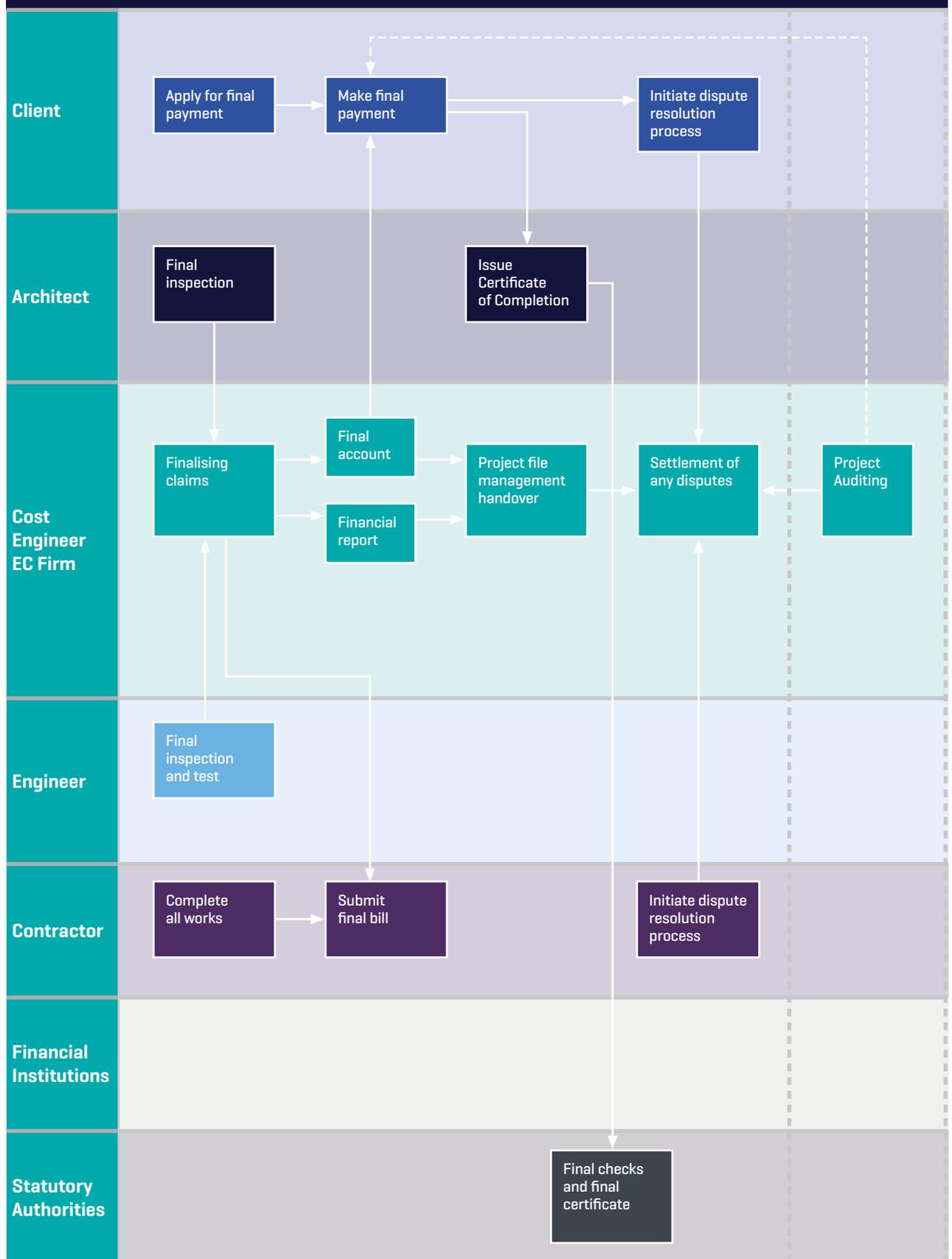
## Engineering Cost Process (ECP): Detailed Stage 3 – Tendering and bidding stage



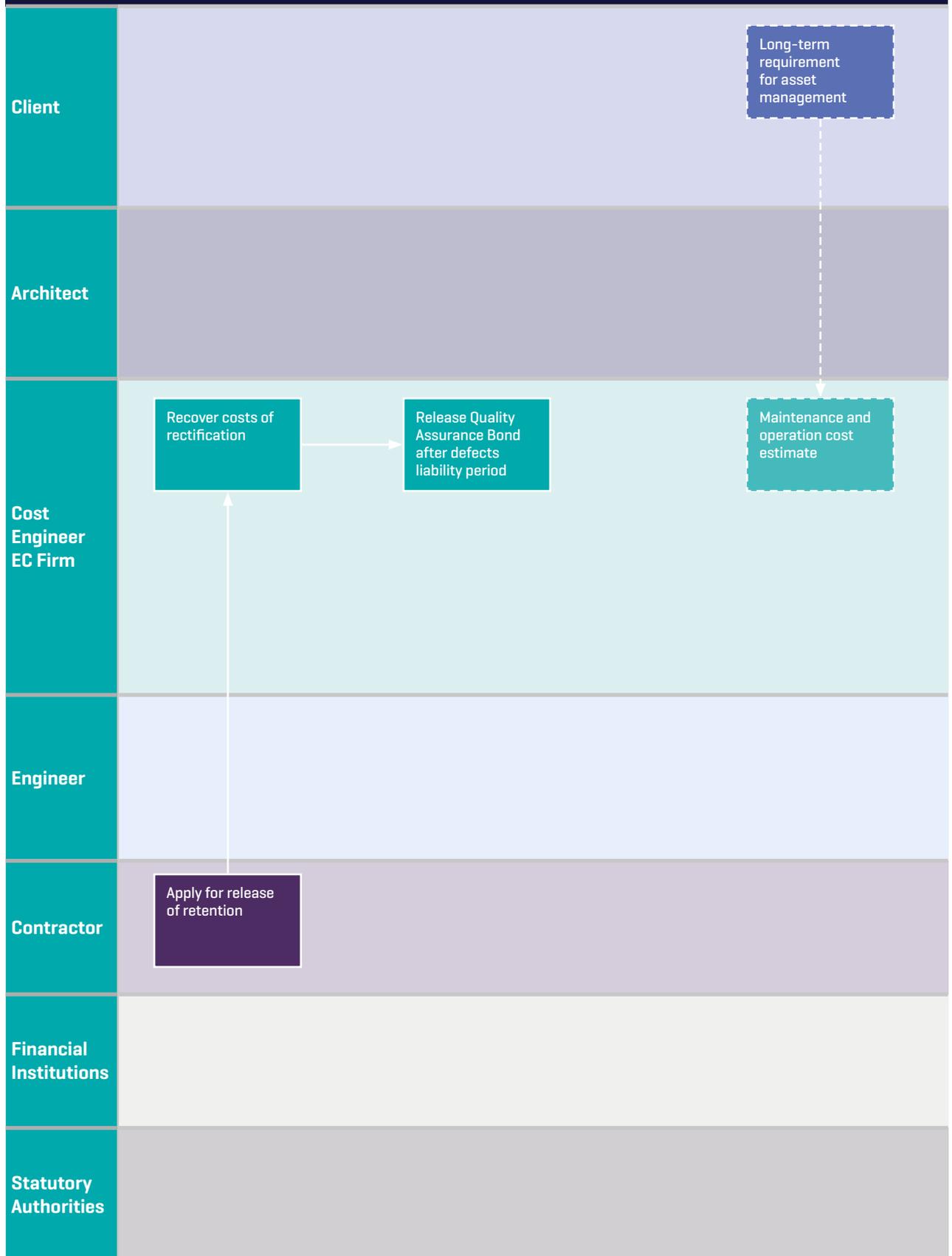
## Engineering Cost Process (ECP): Detailed Stage 4 – Construction stage



## Engineering Cost Process (ECP): Detailed Stage 5 – Handover and closeout stage



## Engineering Cost Process (ECP): Detailed Stage 6 – In use









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