PRICING DOCUMENTATION FOR CONTRACTORS' ESTIMATORS – ESTABLISHING A MORE EFFECTIVE APPROACH

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ABSTRACT

This thesis concerns the effectiveness of pricing documents used during competitive construction tendering from the perspective of the contractors' estimator. The aims of the research are:

- To identify, the effectiveness of current practice by understanding the processes that are currently adopted by the industry, the problems encountered, their frequency and extent and to evaluate the consequential impacts upon both the contractor and client.
- To formulate solutions to reduce the frequency and extent of the problems identified so pricing documentation is more useful to the contractors' estimator.

The research compares the requirements of the contractors' estimator with the format and quality of pricing documentation they receive. The findings suggest that, from the perspective of the contractor's estimator (the end user of pricing documentation), current documentation is not effective. Current methods adopted by the industry may have a detrimental affect on the pricing process by increasing the measurement workload, causing ambiguity, increasing the level of price and quantification risk, increasing cost (through duplication of the measurement task and priced risk), reducing its accuracy and increasing the likelihood of post-tender dispute. As central coordinator of the pricing process the main contractor is exposed to the majority of this price and quantification risk. The client is also exposed to increased cost and price risk.

The findings also suggest that solutions could be implemented to reduce the frequency and extent of the problems identified. This thesis addresses a number of key issues:

- It brings attention to those involved in the preparation of pricing documentation how its format alters the effectiveness of the pricing process. It also proposes a number of changes in the format of pricing documentation that could be adopted to reduce the frequency and extent of problems identified.
- It presents a comprehensive methodology based on the triangulation approach which could be utilised to propose improvements in outsourcing documentation at other times, in other building industries or other industries where pricing documentation is adopted.

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Abbreviations

ACE	Association of Cost Engineers
BCIS	Building Cost Information Service
BEC	Building Employers Confederation
BSRIA	Building Services Research Information Association
BQ	Bill of Quantities
CESMM	Civil Engineering Standard Method of Measurement
CIOB	Chartered Institute of Building
CNBR	Co-operative Network for Building Research
ECA	Electrical Contractors Association
EPC	Estimating Practices Committee
FASS	Federation of Associations of Specialists & Subcontractors
GDP	Gross Domestic Product
HVCA	Heating and Ventilating Contractors Association
NFB	National Federation of Builders
NFBTE	National Federation of Building Trades Employers
RIBA	Royal Institute of British Architects
RICS	Royal Institution of Chartered Surveyors
SECG	Specialist Engineering Contractor's Group
SMM	Standard Method of Measurement
SMMDU	Standard Method of Measurement Development Unit
SOCs	Small or Occasional Clients
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom

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CHAPTER 1:

INTRODUCTION

1.1 Introduction

This chapter gives an introduction to the research project.

The chapter begins with an overall explanation of the thesis and its principal aim. A research problem is then introduced including the key findings emanating from the research project. Consideration is also given to the importance of carrying out the research and the methodology adopted.

The structure of the thesis is illustrated to show the relationship between each of the respective chapters. Specific definitions and limitations of the research are finally discussed before summarising the chapters' contents.

1.2 Background to the research and principal aim

The majority of work generated within today's economy is not carried out by the original client. Instead, the work is outsourced to external organisations. The total outsourcing market is valued at some £379 billion (Lynch, 2001, p.8), equating to approximately 65% of GDP (Gross Domestic Product).

The type of work that is outsourced can vary from professional services, consultancy and management at one end of the spectrum to the physical works at the other. British Telecom, Railtrack, The National Health Service and Yorkshire Water are all typical examples of organisations within the United Kingdom (UK) that outsource large proportions of their work (Lynch, 2001, p.8; Taylor, 2000, p.20 & Railtrack, 2000, p.10).

In a competitive market, clients will usually carry out a comparison of each competing organisation prior to awarding the work. This allows the client to evaluate which offer best meets their particular needs. Pricing documentation is invariably used to assist in this process. Effective pricing documentation plays a vital role in articulating the client's requirements, allocating risk, facilitating a price from the bidder, informing the contractors' adjudication process (Pasquire, 1994, p.50) and portraying this back to the client (Taylor, 2000, p.20). It also forms the basis of contractual relations and terms of payment (Packer, 1996, p.29; Ferry & Holes, 1967, p.5).

This research focuses on the UK building industry with the principal aim of:

1. Establishing the current effectiveness of pricing documentation from the perspective of the contractors' estimator – the end user of pricing information.
2. Proposing changes in the format of pricing documentation to improve its effectiveness to the contractors' estimator.

1.3 Research problem and key findings

The use of established methods of preparing pricing documentation has fallen substantially over the last fourteen years (RICS, 2000 b, p.5). A gap exists within the literature in terms of understanding the consequential effect on the contractors' estimator and the effectiveness of pricing documentation adopted in its place.

Although the trend for the client-side to carry out measurement has reduced over time (RICS, 2000 b, p.5; Pasquire, 1992, p.11) it is argued that the burden of measurement has remained constant (Birchal & Coffey, 1994, p.36; Coffey & Watson, 1992, p.7; Eccles, 1992, p.7). According to Pasquire (1992, p.11) and Kodikara (1990, p.2) some contractors still require quantified information whilst others would appear to find this problematic (SMMDU, 1978, p.28; HVCA, 1990, p.66; Davies, 1992, p.61; Ardley, 1992, p.63; RICS, 2000 c, p.37; Abdel-Razeck & McCaffer 1987, p.242; Swaffield, 1994 c, p.22 and Shakeshaft, 1994, p.46). Despite mixed views within the literature, no detailed analysis has been undertaken to establish which types of contractor find this useful and whether they require quantities to be prepared on their behalf.

Previous research has focused on the use of bills of quantities by the main contracting organisation. However, bills now play a less significant role in the pricing process (RICS, 2000 b, p.5). Previous research has also focussed on the main contractors use of this information at the post-tender stage as opposed to the tender stage.

Analysis of the literature reveals that, in particular, the needs of subcontractors have been overlooked. This has been recognised by previous work and recommended as an area for further research (Skinner, 1979, p.214; Pasquire, 1991, p.221). This gap in understanding is exacerbated by current practice as the majority of the work is now consistently subcontracted (Skinner, 1979, p.9; Pasquire, 1991, p.221; Kodikara, 1990, p.94; Abdel-Razeck & McCaffer, 1987, p.231). The overall lack of understanding of these trade contractors' requirements has arguably resulted in the loss of, what was originally seen as, the strength of the quantity surveying profession (Symonds, 1995, p.20; Skinner, 1979, p.182 and Bishop & Powell, 2001, p. 21).

Previous research has also failed to evaluate the quality of bills that are produced in practice. A limited survey of types of work *let* by quantity surveyors (RICS, 2000 b, p.6) fails to reveal the workload of the contractor's estimator and thus appropriately judge the true worth of any proposals. The literature cites a number of isolated reports of abuse in practice (Rabbets, 1992, p.18 & 22 and Emmett, 1990, p.24) but gives no indication of its extent or type. A more detailed analysis is required to determine the actual percentage, type of work typically measured in bills and their quality. The effectiveness of bills is also important to determine so that the root cause of problems may be understand and extent of quantification and price risk taken by both the contractor and client may be evaluated. Previous research has failed to gain sufficient understanding of the pricing process in its entirety. At the micro level, Pasquire (1991, p.86) identified, by *management task*, which aspects of the documentation were critical for departments within the same contracting firm and therefore needed to be measured for them. No such exercise has been undertaken at the macro level to determine the current needs of main contractors and subcontractors throughout the supply chain. This is expected to be a relatively complex chain of events, one that carries substantial risk and could potentially change with background circumstances e.g. procurement method and type of contractor.

The primary aim of the research is thus to understand and suggest:-

> **Whether the effectiveness of pricing documentation can be improved for the contractors' estimator.**

A number of research questions are seen to underpin this overall aim and form the objectives of the research project:-

1. **What processes are commonly adopted in the preparation of pricing documentation?**

2. **How effective is current pricing documentation as indicated by those problems commonly encountered by constructors during the pricing of tender documentation?**

3. **What is the frequency and extent of each category of problem, its impact upon the relative accuracy of the pricing process and the extent of risk taken by the main contractor?**

4. **What is the impact upon the client of the exposure to risk of the constructor in terms of the current pricing documentation?**

5. **Can solutions be formulated to reduce the frequency and extent of the problems identified?**

6. **Can revisions to the processes commonly adopted in the preparation of pricing documentation be proposed and evaluated?**

7. **Can revisions to the pricing methods commonly adopted (in light of the above) be proposed and evaluated?**

These research questions have been addressed by building up a profile of current practice. In depth analysis has enabled a number of problems caused by current practice to be categorised and evaluated. Current pricing documentation is found not only to be ineffective for the contractors' estimator but also to have a detrimental affect on the industry.

A key finding of the research is the discovery of two distinct classifications of contractor (based on the needs of the estimator). Each type of contractor has a different set of requirements - essentially the "problem" of effective pricing documentation and thus the solution is divided in two:-

- *Specialists* (mechanical and electrical contractors) prefer to quantify the work themselves rather than have this quantified on their behalf by an external party. In practice the information provided is inconsistent and causes confusion.
- The *non-specialists* (typically including all other trades) prefer the work to be quantified on their behalf by an external party. They express dissatisfaction if the work is not quantified for them.

The research suggests the abolition of Plan & Specification forms of procurement and consistent supply of quantified information for the non-specialist. It further suggests, in contrast to the Standard Method, that work should be prepared in a consistent non-quantified format for the specialist and proposes Appendix A of the RICS Building Services Procurement Guide as an appropriate solution (RICS, 2000 c, p.42-54). Changing the format of pricing documentation to suit the needs of these two groups of contractor's estimator solves the research problem. The recommendations of the research are opposed (in part) to both current practice and procedural advice.

The research further reveals that approximately 76% of the current industry workload is at odds with the needs of the contractors' estimator. Approximately 41% of the total industry workload is not quantified for the non-specialists resulting in duplication of the measurement task - equivalent to the entire project being measured 3 to 7 times over (instead of just once). In addition, approximately 5% of non-specialist workload is poorly prepared revealing a level of abuse in practice. The specialist contractors are also found to be dissatisfied with the format of pricing documentation, as approximately 29% of the total industry workload is prepared in an inconsistent format.

The overall workload of the industry, subsequent cost, likelihood of post-tender dispute and level of risk are all significantly increased by current practice. In addition, these factors are further exacerbated through the supply chain and result in the main contractor taking the majority of the risk.

Finally, the results of the research reveal the industry to be in a similar predicament to that of the early eighteenth century at the time when the quantity surveyor first emerged. The findings strongly support the production of quantities for non-specialist trades by a single party – a task traditionally undertaken by the quantity surveyor. In this respect both the role of the quantity surveyor and the measurement debate have come full circle – from a period of non-quantification back through to the renewed need for a single source.

1.4 Justification for the research

The UK building industry plays an important role in the wider economy. It employs 1.9 million people (DTO, 2001, p.149) and forms 10% of the GDP (Egan, 1998, p.9). The efficiency of the construction market is also of importance in times of economic growth (Abdul, 1998, p.480). It is therefore important that prices for building work are obtained as effectively as possible. The literature recognises a number of disadvantages when prices for building work are procured ineffectively:-

- Additional quantification is required by the tendering contractor (RICS, 2000 b, p.23; HVCA, 1990, p.64).
- An inability to value the works accurately (Skinner, 1981, p.29; RICS, 2000 c. p.23 & 37; Swaffield, 1994 c, p.22; HVCA, 1990, p.66).
- An increase in the likelihood of post-tender conflict is caused (Skinner, 1979, p.214; Langford, Kennnedy & Sommerville, 1992, p.65; Davies, 1992, p.61; Dodd & Langford, 1990, p.385).
- Poor utilisation of the contractors' expertise (RICS, 2000 c, p.9 & 26; Latham, 1994, p.30; Atkinson, 2001; Ardley, 1994, p.62).
- Impaired ability (of the quantity surveyor) to provide a value added service to the client as a result of inaccurate cost data (Skinner, 1981, p.29; RICS, 2000 c, p.23 & 37; Coffey & Watson, 1992, p.7).

In addition to the above, justification for the research may be addressed on a number of fronts:-

- The relative importance of subcontractors in the process of construction procurement:
  - Previous researchers' have themselves recognised the gap in previous work in terms of identifying the needs of the subcontractor (Coffey & Watson, 1992, p.7; Skinner, 1979, p.214; Pasquire, 1991, p.221; RICS, 2000 c, p.6; Shash, 1993, p.114).

- This gap is further exacerbated as the extent of work that is subcontracted has since increased substantially (Abdel-Razeck & McCaffer, 1987, p.231).

- The relative neglect of the research problem by previous work:
  - Previous research has focused predominantly on the post-tender stage in an attempt to prolong the useful life of pricing documentation for the main contractor (Pasquire, 1991, p.3 & Kodikara, 1990, p.4).
  - It has failed to gain a comprehensive understanding of the tender stage and, furthermore, the overall pricing process within the supply chain (i.e. inter-company). It has only addressed the transfer of tender information within main contracting organisations (intra-company) at the micro level (Pasquire, 1991, p.86). This research gains an understanding at the macro level.
  - Previous research has also been superseded by changing practices within the industry e.g. the use of bills of quantities (RICS, 2000 c, p.5) - particularly the work by Skinner (undertaken in 1979).

- The lack of robustness in the research methodologies adopted by previous research:
  - Previous research has not addressed the overall pricing process in as much detail as the current research project (table 6.2, p.389, section 6.7 refers). With the exception of Skinner (1979, p.63), the testing-out stage of previous research has been largely restricted to a matter of approaching the same subjects that were involved within the problem solving stages. This research is based on a far greater number of interviews (almost 5 times that of the next largest study) and a greater number of respondents at the testing-out stage (438 more respondents than the next largest sample and more than 3 times the sample size of the RICS Contracts in Use Survey, 2000 b, p.6). This research represents the most comprehensive review of not only the specific

research problem but also a number of periphery issues e.g. format of the information received by estimators (table 4.7, p.261).

- The usefulness of potential applications of the research findings:
  - This research proposes a number of solutions to reduce the occurrence of problems encountered in practice.
  - Changes to existing procedural advice and contractual arrangements are also recommended. The outcome of the research has practical applications that will, therefore (provided they are successfully implemented), have a material affect on the effectiveness of pricing documentation (e.g. increased dependability on the documentation, reduced level of risk, reduced likelihood of post-tender dispute and demonstrable value of the professionals involved).

1.5 Methodology

A review of the literature exposes a specific research problem that has not been previously addressed. As a result, the research is initiated without any preconceived views on whether the effectiveness of pricing documentation may be improved.

Theory needs to be developed on an empirical basis – from the process of carrying out the research itself. In order to achieve this the research methodology is broken down into three main stages. Each is designed to test the findings of the previous stage and, as such, the stages are inextricably linked to one another. For example, stage two tests the findings of stage one and, similarly, stage three tests the findings of stage two. Each stage has an overall objective and employs a main research technique in order to achieve this:-

1. Stage one, involving a number of interviews with contractors' estimators, gains an in depth understanding of how prices are currently procured in practice, what problems are encountered, their relative frequency and impact. Tentative proposals to overcome these problems are also identified.
2. The second stage, an industry survey, takes the findings of stage one and tests them further. The observations of current practice, problems and tentative solutions are tested on a larger sample using a semi-structured questionnaire. This allows structured responses to be collated but also gives the respondent the freedom to comment on further issues that may not have been captured (Denzin & Lincoln, 1994. p.224).
3. Stage three, the empirical testing stage, serves as a final check on the proposed solutions. These are tested on an even greater sample using a structured questionnaire survey.

SPSS (Statistical Package for the Social Sciences) analysis is employed to test the results of both questionnaire surveys. The Mann-Whitney U test has been applied (at the 5% confidence level) to measure how the responses from different representative bodies compare (Foster, 1998, p.19).

The overall characteristics of the methodology are critical in achieving it's aim - a gradual testing of the reliability of the results on more representative samples, re-testing of previous findings and inherent triangulation (Phillips & Pugh, 1987, p.37; Sarantakos, 1993 p.56; Miles & Huberman, 1994 p.435). In more general terms, the research may be defined as *non-causal* as it merely correlates the views of estimators - the end users of outsourcing documentation. It also involves *minimal researcher interference* as the researcher purely observes and collates data from the subjects under investigation. Finally, the interviews and questionnaires are undertaken within the *natural environment* i.e. the subjects are not subjected to a false or contrived setting and are conducted over a *cross-sectional time horizon* – a 'snap-shot' in time.

1.6 Plan of the thesis

The overall thesis follows a logical structure. Chapter 2 introduces the core research problem and 'sets the scene' of the research. It describes the existing body of knowledge and gaps in previous work emanating from this.

Chapter 3 of the thesis then establishes how the research may be conducted so that a sufficient quantity of reliable data is obtained to address these questions.

Chapter 4 presents the results of the research against the three research stages (interviews, industry survey and empirical testing) and, within each of these stages, against the seven research questions.

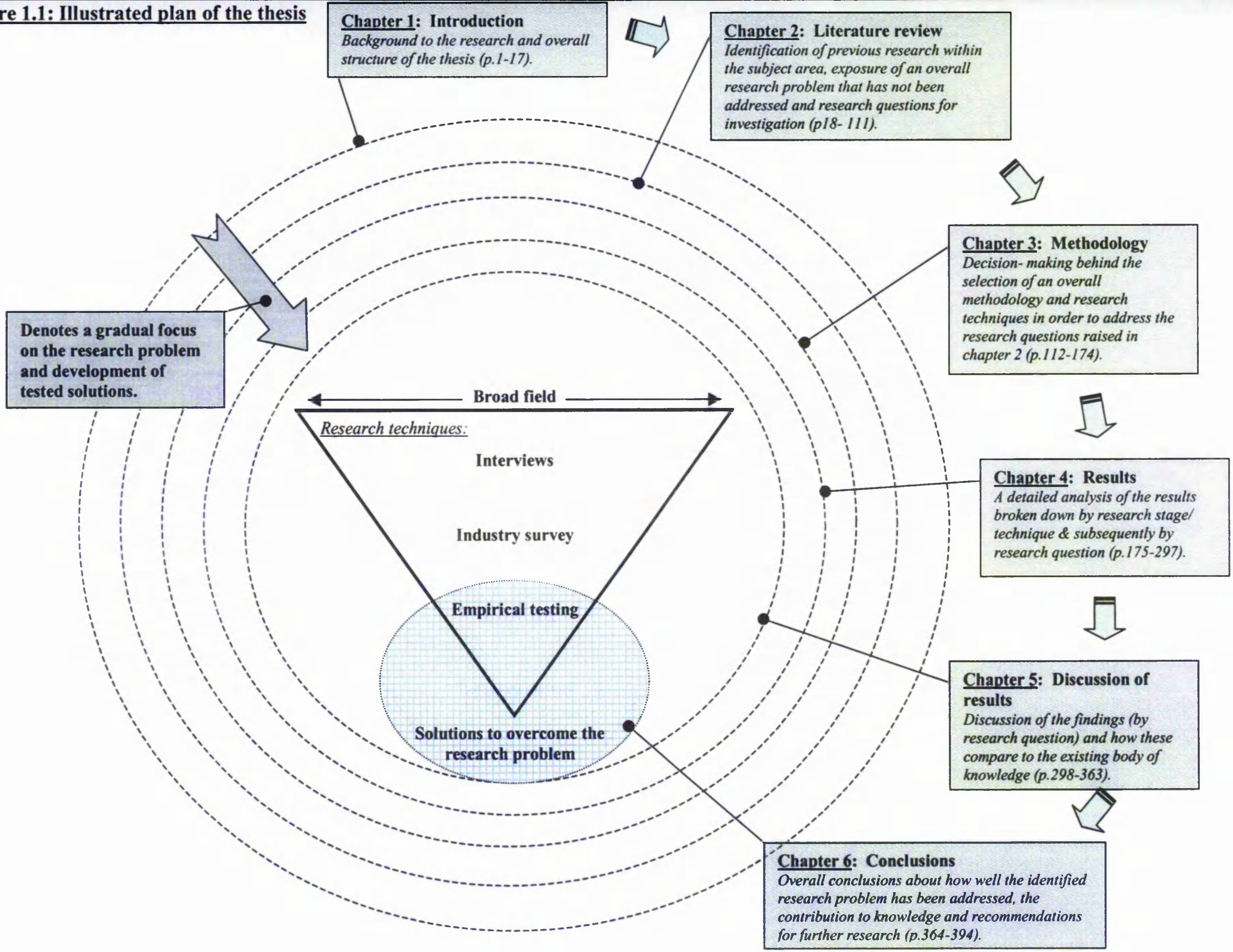
Chapter 5 places the results in context with an overall discussion of findings. Consideration is also given to how they collectively address both the research questions and overall research problem.

Chapter 6 presents a conclusion based on the results of chapters 4 and 5 and indicates how the body of knowledge has been altered.

An overall structure of the thesis is illustrated in figure 1.1 (p.14) showing how each of the chapters gradually focuses on the research problem.

The text within each chapter is structured around the seven research questions (p.6). This enables each of the research questions to be tracked throughout the entire thesis - from their identification within the literature review, the research techniques applied within the methodology, results and finally; what the conclusions are. Each chapter contains an introduction and summary to reinforce the aims, resultant findings and serve as a link between previous chapters.

Figure 1.1: Illustrated plan of the thesis



1.7 Definitions

A number of working definitions have been adopted within the thesis and are stated below to ensure their clarity.

The term *focal theory* (Phillips & Pugh, 1996, p.58) has been used to describe the problem that the research attempts to address i.e. *whether the effectiveness of pricing documents can be improved for the contractors' estimator*. In contrast to a hypothesis - a statement that intends to be proved or disproved by the research (Emery & Cooper, 1991), the focal theory describes the area where the efforts of the research are directed – the outcome being somewhat of an unknown (Leedy, 1989, p.61).

A number of terms are frequently used that are specific to this research. Although they are described at their first mention it is worth clarifying their meaning within this section:-

- The *effectiveness* of pricing documentation has been reviewed from the point of view of the contractors' estimator – the end user. Conclusions about the effectiveness of pricing documentation are therefore drawn from the estimators' perspective.

- *Established principals* refer to recognised practices within the building industry, in this case the Standard Method of Measurement etc (SMM7).

- Finally, *Bills* and *bills of quantities* are used synonymously within the thesis to describe the primary documentation used in the tendering process.

1.8 Delimitations of scope and key assumptions

This section considers the delimitations of the research - explicit boundaries surrounding the research project (Perry, 1995, p.15). These are self-imposed limiting factors as opposed to factors beyond the researcher's control e.g. time/ and or resources (limitations).

The research only relates to the UK building industry. Although the findings are potentially transferable to other countries (section 6.8, p.391) the research is restricted to the UK. The findings are also restricted to the *building* industry (as opposed to the likes of civil engineering). However, as stated within section 6.8, the principal findings and methodology may also be transferable.

Although the interviews are restricted to locations around the Leeds, Hull and Manchester areas (for practical reasons) the testing out stages of the research (industry survey and empirical testing) are not restricted by geographic location. Relatively large samples have also been used (table 6.2, p.386).

The results are restricted to the opinions of three representative bodies selected as being appropriate to test the views of two classifications of contractor – specialists and non-specialists. The non-specialist's conclusions are limited to views from the National Federation of Builders (NFB) and specialist views restricted to the Heating and Ventilating Contractors Association (HVCA) and Electrical Contractors Association (ECA). The rationale behind their selection is explained in section 3.4.3.1 of the methodology chapter (p.144).

The findings of the research relate specifically to the views of estimators working within contracting organisations – contracting firms being the units of analysis. As the end users of pricing documentation, the research aims to improve the effectiveness of pricing documentation for this group. This final point ties in with the definition of *effectiveness* as stated in the previous section (1.7, p.15).

1.9 Summary

This chapter lays the foundations for the thesis. The background and principal aim of the research are initially introduced and serve to place the research in context. An overview of the existing body of knowledge then reveals a number of unanswered research questions and overall research problem. The key findings of the research are subsequently detailed. The overall justification in conducting the research is then considered before describing the methodology adopted, how the thesis is set out, definitions and delimitations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

2.2 Literature review

2.3 Research problem

2.4 Boundaries of the research problem

2.5 Parts of the research problem studied previously

2.6 Research questions

2.7 Summary of findings

2.1 Introduction

The aim of this chapter is to critically appraise the existing literature and identify an area of research worthy of investigation:-

> "........to build a theoretical framework upon which the research is based......identifying the worthy research issues." (Perry, 1994, p.16)

As the research begins without any preconceived aims or objectives, the literature review effectively forms the first stage of the methodology. A review of the existing body of knowledge enables a research problem to be identified.

The initial section provides an overview of the chapters' contents (section 2.1.1, p.20). Section 2.2 (p.23) provides a critical appraisal of the existing literature and working definition of '*measurement*' in the context of this research. By summarising and appraising the overall achievements of previous work common shortfalls are seen to emerge. Collectively these form an overall research problem (section 2.3, p.102).

Boundaries of this research problem are then subsequently defined in section 2.4 (p.106). This is followed by a review of those areas that have already been addressed (section 2.5, p.107). A number of unresolved research questions still remain and are listed in section 2.6 (p.109). Collectively these form the basis for the *thesis* and provide direction to the research project. Individually they form a set of objectives against which the subsequent success of the work may be evaluated.

The overall structure of the chapter is illustrated in figure 2.1 (p.21). This shows a gradual development of the research problem and subsequent questions that are derived. A summary of the literature review findings is finally provided in section 2.7 (p.110).

2.1.1 Contents and structure of the chapter

To summarise, the literature review chapter is broken down into the following areas:-

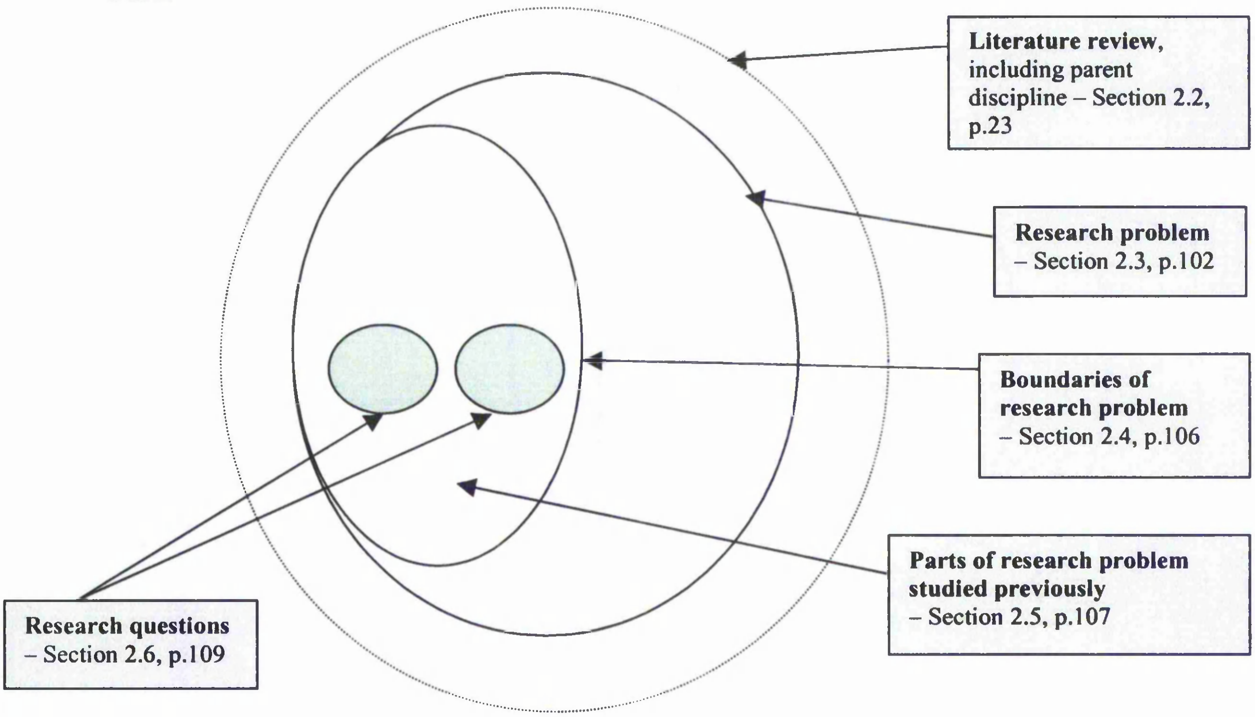
Table 2.1: Contents of the literature review chapter

Section Title	Ref	Contents
Literature review	2.2 (p.23)	• This section provides an initial review of the parent and immediate disciplines. In the context of this research, the parent discipline is defined as developments in the measurement of building work from the early 17th Century up to the publication of the first Standard Method of Measurement (SMM) in 1922. The immediate discipline is then explored – *how the effectiveness of documents used in competitive construction pricing can be improved for the contractors' estimator.* This section reviews chronological developments in Standard Methods of Measurement, bills of quantities and management practice up to the present day. This section merely cites the factual progress that has been made and does not attempt to form any conclusions or identify any common shortfalls within the literature.
Research problem area	2.3 (p.102)	• A number of research problems or gaps are seen to emerge from the review. In isolation these form the objectives of the research and, collectively – the overall *thesis*. This section provides a summary of previous research and logically explains common shortfalls including their significance.
Boundaries of the research problem	2.4 (p.106)	• During the process of defining the research problem the boundaries are also inferred. It is important that these are explicitly defined as they determine the extent to which subsequent generalisations can be made (Perry, 1994, p.15). This section seeks to clarify the boundaries of the research project.
Parts of the research problem studied previously	2.5 (p.107)	• Having defined the research problem, elements that have been addressed by previous research and their relative success are then reviewed (Perry, 1994, p.12 and Phillips & Pugh, 1996, p.59). This section clearly delineates what progress has been made by previous research in addressing the research problem. Those elements that have still not been addressed effectively form the potential areas that a contribution could be made by the current research project.
Research questions	2.6 (p.109)	• A number of research questions emerge from the above that still remain unanswered. These form the objectives of the project and provide direction to the rest of the research.
Summary of findings	2.7 (p.110)	• The chapter concludes by summarising the main findings of the literature review.

2.1.2 Overview

Having described the overall structure and contents of the chapter it is important to note, conceptually, how the literature review evolves. Figure 2.1 helps to demonstrate this point.

Figure 2.1: Gradual development of the focal theory and its relationship to previous work



Source: Perry, C. 1995. "A structured approach to presenting PhD theses: notes for candidates and their supervisors." p.17.

The literature review and parent discipline are initially reviewed (within section 2.2) and subsequently define the research problem – section 2.3 (a sub-set of the literature review). This is denoted by the larger circle of the literature review (section 2.2) encompassing the smaller circle of the research problem (section 2.3).

The focal theory is then further narrowed as the boundaries of the research problem are explicitly defined (section 2.4). Elements of the research problem that have been previously addressed are explored in section 2.5. Those research questions that remain unresolved are identified within section 2.6 and form the basis of the research objectives.

The focal theory of the research is therefore seen to progressively narrow its direction in relation to previous research efforts and identify gaps within the literature.

This illustration is repeated in the summary of findings (section 2.7, p.111) where the results of the literature review are populated.

2.2 Literature review

2.2.1 Parent discipline - Historical background to the production of pricing documentation up to the early 20th Century

The organisational structure and practice of the UK building industry was well established by early seventeenth century. This was based on the division of labour between skilled artificers (tradesman/ craftsmen) and dated as far back as the middle ages. These skills were divided into trades such as masons, joiners, carpenters and plumbers (Symonds, 1995, p.14).

Common practice at this time was for the client to employ each of these craftsmen directly by entering into a number of separate trade contracts. Materials were paid for as they arrived and, the craftsmen were paid day rates according to their particular skill and trade. The client paid for whatever resources were required to complete the works irrespective of efficiency or output. Pricing documentation was not in existence at this point in time.

This practice progressed into the payment of craftsmen based on the actual quantity of work completed. This method of procuring the works was termed 'after-measurement'. The contractors were therefore directly incentivised to complete each unit of work with maximum efficiency as the work was measured and paid for on the basis of agreed rates for completed work.

Although the date of this 'after-measurement' is not precisely determined within the literature, it is certain that the Great Fire of London in 1666 gave a boost to the concept of building measurement (Thompson, 1968, p.66). The subsequent boom in building work also increased the demand for literature on the subject. As one of the six officials appointed to survey the ruins of the fire, William Leybourn was at the forefront of this movement. His original publication of 1667 – *Platform for Purchasers, A Guide for*

Builders, and a Mate for Measurers – was republished in 1685 and gave recognition to the growing importance of after-measurement. Although originally *'intended for persons concerned in the letting, buying, selling or building upon grounds then in the Ruins of the City of London'* Leybourn, included a section on the very subject:

> "I have been importuned to add something concerning the measuring of several works belonging to building." [preface to the second edition]

Within the same year Stephen Primatt published The City and Country Purchaser and Builder. His publication included a section entitled '*Surveying and Measuring superficies and solids, as a necessary thing to be known to the builder.*' The demand for measurers of building work was so great at this time that many of the tradesman themselves became specialist measurers of their own trade and acted as a check against the client's measurer. As their level of experience grew they too emerged at the fore of their particular area of expertise. Mandey, one such example, was originally an apprentice glazier and published *"A new and exact way of Mensuration"(1682).* The publication marked an important milestone in the development of measurers as it provided proof of the emergence of a distinct group of specialist London measurers. The publication also cited the first recorded dispute relating to a 'method of measurement':

> "Some years ago it was my hap to measure the bricklayers work of an house, wherein Mr Leonard Sowersby, the late notorious measurer was concerned against me. We had oftentimes measured together before that time, and also since in several places: But here we happened to disagree about measuring the chimneys very considerably, which gave me occasion to delineate the chimneys on paper, and to shew him wherein he was mistaken." (Mandey, 1682, p.379)

Sowersby measured around the brickwork and multiplied by the height whilst Mandey contended that:

> "The truest way was to measure as a solid, and deduct the vacancies." (Mandey, 1682, p.379)

Mandey went on to proclaim a professional status for the measurer - more of an independent arbiter. He neither favoured the builder or client but instead represented a fair position:

> "I thought it might be a service to the publick to correct this error, that so neither the gentlemen – nor he that pays for the work, nor the workman that doth it – may receive any injury." (Mandey, 1682, p.379)

In many respects, Mandey's independent professional status was a little premature. The normal practice at that time was for two measurers – those who usually worked for the client and those who usually worked for the tradesmen. Measurement at this time was still confined to the measurement of completed works – 'after-measurement.'

In the eighteenth century – after the boom of the late seventeenth century; there is doubt whether the measurement of building work survived with such expertise. However, many were attracted to the profession as the fashionabillity of architecture grew. Many of these architects were in fact architect-builders and turned to measurement when they were unable to find work purely as architects. These surveyors were men of eminence and were seen to be leading their profession. They would earn a living by measuring their own work or that of fellow architects. Only the elite of the architects at that time were able to obtain full-time work solely as architects. By the mid-eighteenth century some of the architect-measurers had begun to call themselves quantity surveyors. One such architect-measurer, John Payne, produced *'A True Bill of Materials required for the Improvement of the Barrack of Horse at Trim'* – essentially a bill of quantities from drawings prior to commencement of the work. Quantity surveying had therefore progressed to measurement before buildings were constructed (Ashworth, 1995, p.24).

With specialist knowledge of their own trade, both the architect-measurers and the trade measurers would turn to act as 'builders-measurers' when the demand arose. In order to obtain a sufficient workload, each measurer was required to display a level of competence by belonging to the Guild of their own trade. This practice was particularly well documented in Scotland where measurers would be *sworn* into their Guild having gained the recognition of existing members. Being sworn in meant that the measurer held certain standing and their views would be accepted as valid in any legal proceedings. However, once accepted into the Guild, standards had to be maintained – the defrocking of a sworn measurer in 1750 serving as a warning to fellow practitioners.

An important development occurred in Scotland in 1773 when the Edinburgh Town Council recommended that a comprehensive list of sworn measurers should be drawn up. The aim was to draft the first Standard Method of Measurement (for 'after-measurement') - formally drawn up by practitioners. However, despite being ahead of England in this development, Scotland lacked the specialisation typified by the development of England's big cities. As a result, the Scottish Standard Method of Measurement failed to gain any widespread acceptance.

English practice, in contrast to the strict rules of Scottish after-measurement of finished buildings, was free to develop unhindered at this point in history. Throughout most of the eighteenth century this measurement was undertaken by building craftsmen as a sideline to their main employment. The demand for this evolving practice and the accompanying literature was high – *The Complete Measurer* paying credence to this – still being in print as late as 1850.

Between the years of 1770 and 1850 a number of surveyors were becoming more specialised in their measurement techniques and differentiating themselves from the general builders' measurers. They were also developing new skills to estimate the cost of buildings *prior* to their construction.

A further development, increasing the relative importance of measurers in London, was the type of work being undertaken and its subsequent effect on the organisational structure of the building industry. The construction of a number of Barrack Offices helped to develop what was termed the '*contracting in gross*' method of procurement. The new style of contract - making a single contractor responsible for the works as opposed to a number of trades, was a fundamental change from the practices of the middle-ages. It also helped to establish the quantity surveyor as the crucial link, between client and contractor.

The quantity surveyor, with a grounded skill in the measurement and valuation of building works, was now providing cost control services and overall financial management. The contractor was able to pass on savings not only by employing and controlling all the trades in-house but also avoiding numerous quantity surveyors by paying for one more skillful quantity surveyor. Those attracted to these prestigious roles were the elite of the measurers at that time. The Houses of Parliament were the first major building to be built using a bill of quantities - between 1841-44. In recompense, Henry Arthur Hunt, the quantity surveyor responsible for producing the bill of quantities and settling the final account was rewarded the sum of £7,000 (Thompson, 1968, p.90). Not only was the profession developing into a much-demanded service provided by an elite but also proving to be highly lucrative. A growing number of quantity surveyors began to establish themselves as true professionals and were in much demand from a client base as varied as building contractors to Railway companies. Such was the integrity of these quantity surveyors that, should an error be found in the quantities, they would usually guarantee to reimburse the contractor the difference.

However, as with most professions, not all quantity surveyors shared the same professional standards. Some refused to provide the same surety of their bill – this caused confusion within the industry as to the exact status of bills of quantities. Architects would also differ in their approach to bills – some treating it as a fixed price and others agreeing to vary the final payment upon re-measurement of the quantities. As a result, a growing number of quantity surveyors wished to disassociate themselves from their less scrupulous colleagues and clarify the status of bills. Many of the leading practitioners, themselves members of the Royal Institute of British Architects (RIBA) of 1834, began to voice their opinion within the Institute. Doubts about the compatibility of quantity surveyors within the RIBA led the quantity surveyors to break away and form the Quantity Surveyors Association. The other group of quantity surveyors - emanating from a trade background and originally recognised by the 1878 Act of Parliament as the

Institution of Surveyors was represented by the latterly named Surveyors' Institution – granted a Royal Charter by Queen Victoria in 1881 (RICS, 2000 a, p.17).

The like-minded bodies, sharing their desire to spread best practice and adopt *standard* methods of practice, set up a Joint Committee in 1912. The objective of this Joint Committee was to establish a comprehensive set of Standard Rules of Measurement of Building Works. Assisted by the NFBTE (National Federation of Building Trades Employers) and the Institute of Builders in 1918, the Joint Committee sought to address the needs of contractors. The culmination of their efforts was a significant milestone in the quantity surveying profession - the first Standard Method of Measurement was published in 1922. This date also marked the amalgamation of the Quantity Surveyors Association (from the architectural side) and the Surveyors' Institution (from the surveying side). A further name change occurred in 1930, to the Chartered Surveyors' Institution, before adopting today's title of the Royal Institution of Chartered Surveyors (RICS) in 1946 (RICS, 2000 a, p.17).

2.2.1.1 Definition of '*measurement*'

Before reviewing developments within the field of *measurement* it is important to define the term in the context of this research project. As an expression frequently used within a number disciplines (physics, astrology, math, land surveying etc) the term requires clarification.

A number of researchers have generated their own definitions of measurement within a construction documentation context:-

> "The analysis, quantification and communication of all development, design and construction costs" (Hutchinson, 1992, p.11)
>
> "A process of analysis or separation" (Ferry & Holes, 1967, p.32)
>
> "..........the procedure of measuring consists of making descriptive statements about the various building elements from which quantities of resources used or to be used can be deduced". (Ferry & Holes, 1967, p.32)
>
> "The quantities of resources and all associated descriptions compiled prior to and during the works in order to plan and procure the actual resource requirements". (Pasquire, 1991, p.43)

Ferry & Holes (1967) and Hutchinson (1992) recognised measurement as being a *process* or *procedure* and that *communication* was a key factor. Defining what is being communicated is also seen to be important. Rather than the *cost* as suggested by Hutchinson (1992), a by-product of construction, it is perhaps more relevant to refer to the elements of the construction itself (Ferry & Holes, 1967). In the context of the subject area it is necessary to describe the components rather than purely just quantify them (Ferry & Holes, 1967). It is also essential to include the reason(s) to measure within any definition as these directly impact upon its format and content. Ferry & Holes (1967, p.4 -7) recognised fifteen purposes of measurement. These may be summarised as procurement, estimating, planning, controlling and valuing; these also correspond with the management functions and tasks identified by Pasquire (1991, p.86).

Taking these factors into account the following definition may be adopted to define *measurement* in the context of this research project:-

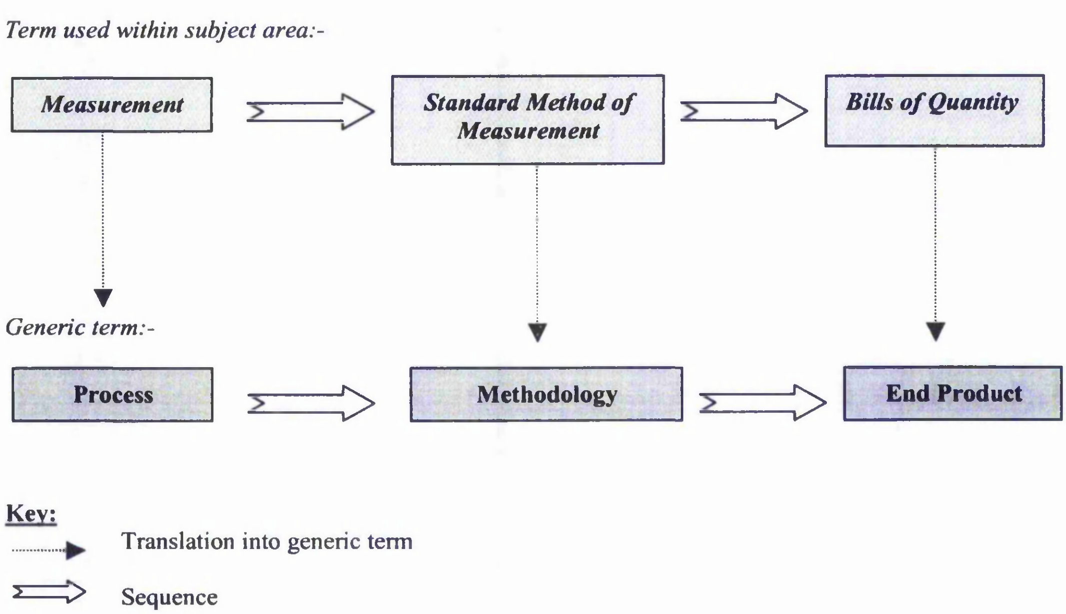
> ***The process of abstracting, quantifying and describing the components of construction for the purposes of procuring, estimating, planning, controlling and valuing construction work.***

Inevitably this definition covers all occasions to measure throughout the entire construction process. In this research we refer merely to the tender stage.

Further, as *measurement, Standard Methods of Measurement* and *bills of quantities* are often referred to synonymously within the literature (McDonagh, 1992, p.1), it is worth clarifying their differences.

Measurement may be defined as the *process*, Standard Methods of Measurement as the *methodology* behind this process and bills of quantities as the *end product* that measurement achieves. The following illustration serves to explain this point:-

Figure 2.2: Translation of terminology used within the subject area into generic terms



2.2.2 Developments in pricing documentation from the early 20th Century to the present-day

2.2.2.1 Introduction

The following section of the literature review covers the focal theory of the research – *the effectiveness of documents adopted in competitive construction pricing.*

Having reviewed developments from the middles-ages to the early seventeenth century, this section deals with the timeframe from the publication of the first Standard Method of Measurement (in 1922) to the present-day.

Previous researchers have categorised their own literature reviews into generic headings, for example, Standard Methods of Measurement, Co-ordinated Project Information and bills of quantities (Skinner, 1979, p.6; Pasquire, 1991, p.23 and Kodikara, 1990, p.15). Such an approach of categorising the review of literature into generic headings was considered, however, as the issues are inextricably linked to one another they have instead been reviewed in chronological order. For example, Pasquire's proposal to change the Standard Method of Measurement (*the methodology*) would alter the way that measurement was undertaken (*the process*) and naturally affect the bill of quantities (*the end product*).

This approach enables the literature to be reviewed as developments occurred in reality and provides the reader with an appreciation of the background to changes brought about at any one point in time. A review of the literature by *'generic heading'* is also provided within the summary of the chapter. A tabulated summary of the entire literature review has been compiled (table 2.7, p.101) and is useful to refer to throughout the review.

The terms '*client-side*' and '*contracting-side*' are adopted within the following section of the literature review. These refer to the proposed developments as being either instigated and/ or mainly representative of the clients' or contractor's viewpoint.

2.2.2.2 SMM1 – 1922

An insight into events prior to the publication of the first edition of the Standard Method of Measurement was provided in the parent discipline (section 2.2.1, p.23-28). Its publication in 1922 was of significant importance as, for the first time, it provided clear guidance to practitioners. It also established a benchmark to evaluate compliance with professional standards and provided clients and contractors with a level of service expected of a competent quantity surveyor (preface to first edition, 1922).

The methods of measuring laid down in the first edition were primarily based on the leading practitioners based in London. Although input had been gained from fellow practitioners, only four contractors represented the NFBTE.

2.2.2.3 SMM2 – 1927

The second edition was a natural development of the first. The committee, after only five years, took the opportunity to clarify and expand upon the methods of measurement. The committee consisted of many of the original quantity surveyors and the same four contractors. Representation from the contracting sector was again limited (preface to second edition, 1927).

2.2.2.4 SMM3 – 1935

The 1935 edition sought to reflect changing building practice, forms of contract and clarify a number of clauses that were open to interpretation. The committee sought opinion from a wider cross-section of the building sector and, from the positive response obtained, confirmed the growing use of the Standard Method (preface to third edition, 1935).

2.2.2.5 SMM4 – 1948

Delayed by the Second World War, the fourth edition was published some twelve years later. Notable differences included the General Rules section (detailing the overall philosophy and rules of measurement) and incorporation of Heating, Ventilating and Electrical work (preface to fourth Edition, 1948). Revisions one to four of the Standard Method presented measurement rules on a trade-by-trade basis.

The industry, from this time onwards, now accustomed to the concept of Standard Methods of Measurement, began to play a more proactive role in attempts to improve pricing documentation. Subsequent Standard Methods are now seen to be separated within the literature by a variety of differing proposals – some aimed at improving the *process* (the Standard Method), others at the *end product* (bills of quantities) and the remainder, purely observations.

2.2.2.6 Elemental Bills – Early 1950s

The Department of Education proposed a new format to the bill of quantities in the early 1950s these were termed *Elemental Bills*. It was not proposed that the method of measurement should differ – merely how the information was grouped (i.e. the end product). Instead of being grouped in trade order it was proposed that the bill should be grouped according to each elemental section of the building to which it belonged e.g.

walls, roofs. Each of these elemental sections, by definition serving a unique design function, was then subdivided by trade. It was perceived that this would aid the tendering and planning process and assist cost control (Department of Education and Science 1957; Seeley 1965).

Two main problems were experienced with this proposal, one a matter of how its implementation was managed and, the other, a matter of principal. In terms of implementation, no industry wide standard list of building elements was ever published. Interpretation therefore varied in practice and resulted in inconsistent bills being produced. For example, lists published by Hertfordshire County Council and the Ministry of Education contained different definitions of what these building elements should be and hence their respective number – 15-20 and 30 respectively (Rose, 1956; Nott, 1963). Secondly, a subcommittee of the Quantity Surveyors Committee reported the reaction from builders to be "unfavourable" and that tendering was made more complicated (Skinner, 1979; Seeley, 1965). This was further supported by a Working Party (Quantity Surveying Techniques Working Party) set up by the Cost Research Panel in 1959. They found that the Elemental Bill increased the work required by the estimator and reported that trades were confusingly spread across numerous elements of the bill (Kodikara, 1990, p.17).

2.2.2.7 Sectionalised Trade Bills – Early 1960s

As a refinement to Elemental Bills, Sectionalised Trade Bills were proposed in the early 1960s. A client generated idea; Hertfordshire County Council again put this forward. The bills were firstly grouped into trade order then, once in trade order, further subdivided into functional elements of the building (Nott, 1963) – effectively a halfway house between the traditional trade format and splitting trades by functional element. Although respective trades were disseminated into each element of the building they were still identifiable. However, in a similar vein to the Elemental Bills, the view from the industry was negative. The same Cost Research Panel investigated and concluded that the format did not sufficiently reflect how costs were incurred by the contractor (1962; Kodikara, 1990, p.18). Sectionalised Trade Bills were not widely adopted by the industry (Skinner, 1979, p.11).

Both the Elemental Bills and Sectionalised Trade Bills, despite attempting to meet the needs of the contractor, were essentially '*client-led*' proposals and, as such reflected the client's perception of how the documentation could be improved. They also reflected the prevailing thought at this time - to develop a bill of quantities orientated towards the needs of the contractor (Skinner, 1979, p.11). However, without a detailed appreciation of what these needs were they failed to obtain a favourable reception.

2.2.2.8 SMM5 – 1963

Amidst considerable debate within the industry, the fifth edition of the Standard Method took on-board feedback and recognised the need to clarify and amplify previous measurement rules (preface to fifth edition, 1963). The Standing Joint Committee also took the opportunity to add additional work sections in an attempt to reflect changing working practice and technology - Prestressed Concrete, Structural Steelwork and Heating and Ventilating.

It was also recognised that, although each trade was unique, many shared common measurement rules. As such the measurement rules were being duplicated in each trade section. The fifth edition reflected development work aimed at abstracting these generic rules into a 'common arrangement.' Originally published in imperial (1963), edition five was reissued in 1968 as a conversion to metric.

2.2.2.9 Operational Bills – Early 1960s

A completely different approach was adopted at this point to try and improve the effectiveness of tendering documents. Although, again instigated by the '*client-side*', it was recognised that, in order for the bills to be useful to the contractor they should better reflect how the builder plans and controls the work. A mere change in the format of the bill, witnessed by the Elemental and Sectionalised Trade Bills, was no longer considered to be a viable option.

It was argued that existing bill items did not relate to how costs were incurred and inadequately communicated the operations required to assist the pricing, planning and control of building work (Forbes & Skoyles, 1963, p.429). In an attempt to address these issues the Building Research Establishment developed the *Operational Bill* (Forbes & Skoyles, 1963, p.429).

Based on earlier work by Forbes and Skoyles (1963) the bills attempted to reflect '*operations*' that were carried out in practice e.g. different brickwork lifts measured separately. These operational sequences were also represented by precedence diagrams to further aid the planning process.

Further, instead of measuring the building work as fixed in position (inclusive of labour, plant, material, overheads and profit) the resources of labour and material were measured separately (Skinner, 1979, p.14). This was in line with previous criticisms by Sumner-Smith (1920). Sumner-Smith contested that, as the labour resource was not separated from materials, this resulted in unit rates being "roundabout, cumbersome, intricate, and unsatisfactory" (Forbes & Skoyles, 1963, p.429).

The Operational Bills were trialed on building contractors but were considered to be too intrusive of the contractor's decision-making process (Carr, 1965, p.550). Many decisions expertly made by the contractor, in terms of resource requirements, were being inadequately prescribed by the quantity surveyor on the client-side.

Two main disadvantages were identified. Firstly, as the quantity surveyors' knowledge of resource requirements was limited, the bills did not reflect the contractor's method of working, secondly, in light of this and in order to obtain the full advantage of the contractors expertise, it would be necessary to consult each contractor on how they proposed to carry out the works prior to preparing the bill. If a number of contractors were involved in the tendering process (typical within a competitive environment) then the cost of bill production would outweigh any potential benefits (Kodikara, 1990, p.20).

In an attempt to overcome the latter problem, two types of bills were trialled (Forbes & Skoyles, 1966; Firmstone & Skoyles 1967) – an initial bill and a more detailed secondary bill. The sole aim of the initial bill was to select the preferred contractor based on minimal information. The more detailed secondary bill was then priced by the successful contractor. However, this approach resulted in additional work and cost on the client-side (in terms of bill production). According to Carr (1965, p.550) this more than doubled the cost of conventional bills. Additionally, it allowed the contractor to re-price based on more detailed information.

Difficulties were also experienced in producing drawings for Operational Bills (Kodikara, 1990, p.20) and the level of inconsistency between bills due to poorly defined generic operations – a re-emergence of the problems experienced by the earlier Elemental Bill and Sectionalised Trade Bills (Rose, 1956; Nott, 1963). The bills were also not considered to be useful at the post-tender stage (Kodikara, 1991, p.21; Willis, 1988 b, p.374).

2.2.2.10 Banwell - 1964

A common view began to emerge from the industry at this time – that the utilisation of bills could be extended to meet the contractor's needs during the post-tender stage. It was argued that bills had the potential to better suit the demands of costing, bonusing, ordering, programming and control post-tender. This was endorsed by Banwell who recognised that the existing format was unacceptable to meet these needs.

2.2.2.11 Ferry & Holes - 1964

In 1964, The Research and Information Group of the Quantity Surveyors Committee decided to take a fresh look at measurement. The aim of the commissioned report, entitled "*Rationalisation of Measurement*" was exactly that - to try and rationalise the process of measurement. Although the report was recognised as being at a conceptual level (Skinner, 1979, p.13), a number of important principles were outlined. Ferry & Holes did not, however, offer any practical means of achieving them.

Fifteen occasions were identified when measurement took place within a typical construction project – confirming the potential to 'rationalise' the process. These were classified into three types of measurement - *re-measurement of the same work by the same person*, *measurement by different people from the same contract document* and *measurement of the same work by different people as a result of changes*. More detailed work by Pasquire (1991, p.86) later confirmed some of their proposals to rationalise the measurement process.

A number of measurement principals were proposed by Ferry & Holes. They identified the need to separate:-

- *'formed'* products (defined as those of predetermined size, shape and material e.g. brick, roof tile) and 'formless' products (granular or liquid product e.g. concrete).

- *'single product elements'* – products that fulfil a functional role on their own e.g. door, lintel.
- *'site formed elements'* – when the size and shape is determined by on-site construction, for example, concrete work.
- *'primary work'* – an item of in-place work which arises from a primary design decision about a functional element - a brick wall or roof tile.
- *'secondary work'* – additional labours required to the primary work such as surface treatments and cutting.
- work made with varying processing costs (time, gang size) whether these be different products or the same products.

They also recognised that it would be difficult for an external quantity surveyor to anticipate the operational requirements of each firm (confirming the previous failings of Operational Bills). In light of this, Ferry & Holes proposed that measurement should be presented to the contractor in the form of net quantities of finished work. This view was therefore directly opposed to the philosophy behind the Operational Bill.

2.2.2.12 Higgin & Jessop - 1965

Higgin & Jessop undertook a holistic view of communication within the building industry. Instead of purely looking at the tender documentation they reviewed the overall effectiveness of communication throughout the entire construction process. In line with Banwell, they confirmed that:-

> "Some different presentation of the information to the builder could help materially in enabling us to plan our work and control costs." (Higgin & Jessop, 1965, p.25)

2.2.2.13 Standardisation of coding structure and phraseology - Fletcher & Moore - 1965

In 1965 an RICS Working Party recommended that urgent consideration be given to standard description in bills (RICS, 1965). In direct response to this Fletcher & Moore produced a standard phraseology for bills (Fletcher & Moore, 1965). This was endorsed by the RICS and seen as a fundamental contribution towards standardisation within bills of quantities (Skinner, 1979, p.13).

2.2.2.14 Potts Report - 1967

A report published by Potts in 1967 - *"Action on the Banwell Report"* further supported the industry's view that bills did not reflect the cost of operations (Potts, 1967; Skinner, 1979, p.13). However, in a similar vein to Banwell (1964) and Higgin & Jessop (1965), Potts did not offer any proposal of how this could be achieved.

2.2.2.15 Operational Format – Activity Bills - 1968

In 1968, the 'Operational Format – Activity Bills' were proposed by the British Property Federation (BPF) - a major client within the UK building industry (incorporating Marks & Spencers, St Martins Property Land Securities and Norwich Union).

The Activity Bills were seen as an intermediary measure between the Elemental and Operational Bills (Kodikara, 1990, p.21). The bills were produced using the existing Standard Method of Measurement but instead sequenced the work in the order they were perceived to be undertaken - from a precedence diagram (Skoyles, 1968). Despite a favourable review of implementation by Lear (1966) they shared similar problems to their predecessors i.e. no standard method of producing them (Kodikara, 1990, p.22). Again, these were not received favourably by the industry (Skinner, 1979, p.15). Lear

(1966) also pointed out that the measured data had to be regenerated for post-tender use as it was not in a satisfactory format - i.e. broken down into labour plant and material (Kodikara, 1990, p.22).

2.2.2.16 Nelson - 1970

Nelson joined the industry wide debate in 1970 by stating that bills did not provide the requisite information for the post tender-stage. Nelson argued that site staff spent considerable time assembling information from scratch and recalculating quantities. Three main problems were cited, uncoordinated information, aggregation of quantities on a 'similar material' rather than on an operational basis and the need to convert quantities from their unit of measure. He endorsed the earlier work of Forbes and Skoyles (early 1960's) and recommended the adoption of the Operational Bill.

2.2.2.17 Standard Method of Measurement Development Unit (SMMDU) - 1971 - 1978

The RICS and NFTBE set up a Joint Working Party in 1971 and, acting on their recommendations, a Development Unit was formed in 1973. The impetus to set-up the Joint Working Party was based on an earlier report published by the Measurement Convention's Working Party in 1969. The report identified that the existing Standard Method (SMM5) was neither relevant to current practice nor that envisaged by the end of the century.

The Development Unit realised, such was the extent of change required to the Standard Method, that the next Method of Measurement (SMM6) would serve purely as an interim measure. Additional work would then be required to develop this further.

The establishment of the Development Unit proved to be a significant event within the history of the Standard Method (SMM7).

2.2.2.18 SMM6 – 1978

By the time of its publication in 1978, the Work Sections in SMM6 reflected varying stages of development (the Work Sections being generic measurement rules shared by more than one trade). The measurement rules had been redrafted by the Development Unit in an attempt to keep pace with changing technology and practice (preface to sixth edition, 1978). SMM6 was also accompanied by a non-mandatory Practice Manual.

Although only published as an interim measure, the number of measured items was cited as being one of the main criticisms of SMM6. Bills were regarded as being too detailed and contained items below the level at which costs were incurred. In practice, contractors would often not price all the items but bracket them together to give one single rate (Bennet, 1983, p.84).

Despite these reservations SMM6 was widely adopted by the industry (RICS, 1986, p.14).

2.2.2.19 Derek W. H. Skinner - 1979

A year after the publication of SMM6 Skinner published a PhD thesis entitled "*An analysis of the utility of Bills of Quantities in the process of building contracting.*" Skinner's research marked a significant change in direction and provided, for the first time, a detailed examination of the usefulness of bills from the main contractor's viewpoint.

Developments prior to this date had been predominantly '*client-led*' and were not based on such a detailed review of the main contractor's needs. This invaluable insight proved helpful to subsequent research efforts (Pasquire, 1991, p.31; Kodikara, 1993 a, p.263).

Skinner took on board, what had now become, the industry wide debate that bills had the potential to better suit contractors needs post-tender. Skinner regarded the bill as an information source to the contractor and carried out a detailed examination to identify how the information could better serve "*the many functions of contracting in addition to that of tendering and payments*" (Skinner, 1979, p.1). Skinner argued that, by examining how closely bills satisfied the needs of the main contractor (in the first instance) the extent to which they served the client would be derived – not the other way around (Skinner, 1979, p.3).

Three factors were used to evaluate the usefulness of the bill (Skinner, 1979, p.50):-

Table 2.2: Factors used to evaluate the usefulness of bills

Factor	Definition
Format	• The presentation, structure and arrangement of the bill.
Adequacy	• The suitability of the information for a particular purpose without the need to make additional allowances or amendments.
Independence	• The absence of the need to seek additional information.

The research methodology was divided into two stages. Stage one was termed the principal study and sought the opinion of those using bills. A detailed study within one contracting firm was undertaken and interviews held with estimators, planners, buyers, agents and contracts managers.

Stage two, termed the validation study, tested out the findings of stage one on a larger audience. Three samples were taken, one from quantity surveyors working for contracting firms and two from a cross-section of estimators, planners, buyers, agents and contracts managers. One of the latter samples was taken from the same company as the quantity surveyors and, the other, a random selection of the NFBTE. As the NFBTE had contributed to the fifth Standard Method and were represented on the Standing Joint Committee, their views would serve to validate how effective their input had been.

Fifty-four different individual tasks were identified when bills were used. Skinner documented the extent of use throughout the life of a construction project. This confirmed the view of the industry and showed that, overall, the use of the bill post-tender exceeded its use at the tender stage for any given contractor. However, as the utility at the tender stage was not multiplied by the number of tendering contractors, the total utility was distorted. Although this did not change the overall result Skinner accepted this point (1981, p.7).

Skinner revealed that although bills make a substantial contribution to the construction process, neither the format nor content are ideally suited to the needs of tendering or production (1981 p.29).

Skinner also raised the urgent need to revise the Standard Method to take account of cost significant factors and to produce simpler bills (1981, p.32). Skinner further identified the wealth of information contained within unit rates that estimators required for post-tender control (1981, p.20), points later addressed by Pasquire (1991, p.218) and Kodikara (1990, p.263).

The second stage of the study discovered some concerning findings. The contractors' quantity surveyors and estimators disagreed significantly on the adequacy of the pricing information contained within the bills (1981, p.15). The contractors' quantity surveyors considered the information to be adequate and the estimators, that it was inadequate.

> "This disagreement is cause for concern since the principal aim of the bill is to serve as a tendering document. The nature of the disagreement is also disturbing since those who produce bills of quantities, being of similar training and qualification to the contractors' quantity surveyors, are unlikely to have any clearer understanding of the contractor's specific information requirements. The significant differences in opinion.......indicate that the requirements of production may not be well understood by those who prepare the bill." (1981, p.15)

The research therefore revealed that quantity surveyors, even if they worked for contracting organisations, may not fully appreciate the needs of contractors' estimators. Skinner recognised that this matter could be of fundamental importance.

Particular concern was raised over the bills inability to successfully price and pay for nominated subcontractors' work, at that time, possibly accounting for as much as 50% of the contract sum (1981, p.29). It was recognised that this, in turn, detracted from the main contractors' ability to price their own attendance and overhead costs.

Skinner also cited the failure of designers to reflect technological changes within their contract documents.

In terms of further research, Skinner recommended that claims involving subcontractors should be investigated to establish if the root cause of such problems lay in the tender documents (1979, p.214). He also recognised the need to investigate how the individual sections of measured work were utilised (1979, p.215).

Although not included in the recommendations for future research, Skinner recognised that the majority of work was sublet and that no attempt had been made to investigate the usefulness of this information from the subcontractors' viewpoint (1981, p.9). He also observed that main contractors subcontracted similar packages of work. The types of work subcontracted, which followed well-established patterns within the industry, were found to be common to companies of all sizes (1981, p.9).

Since the publication of Skinners' research a great deal of change has occurred both in terms of technology and prevailing practices of the industry. It is important to bear these factors in mind when considering how applicable the findings are to the current day. It must also be appreciated that the research was based upon SMM5.

2.2.2.20 Standard Method of Measurement Development Unit (SMMDU) and Co-ordinated Project Information - 1978 - 1988

In parallel to developments in the Standard Method, the Government sponsored a review of project information in its entirety:-

> "Up to now, drawings, specifications, and bills have been prepared in quite different unrelated ways........all the different parties tending to go their own way with the result that the builder may end up with conflicting or incorrect information and insufficient detail and explanation." (Moore, 1984, p.30).

This review was carried out by the Project Information Group (PIG). A report published in 1978 highlighted the problems arising from poor documentation and identified that as many as 25% of failures (predominantly at site level) were due to poor documentation. Although the Government dropped out, the work was continued by the RIBA, RICS, ACE (Association of Cost Engineers) and BEC (Building Employers Confederation) - Moore, 1984, p.31.

The overall aim of the umbrella body, the Co-ordinating Committee for Project Information (CCPI), was to:-

> "Ensure the preparation of......co-ordinated standard conventions for the production of drawings, specifications and measurement, to facilitate the preparation of effective project information." (SMMDU, 1984, p.1)

Three working groups were set-up to prepare a Code of Practice for drawings, project specifications and a Common Arrangement for specifications and bills of quantities. The SMMDU became the working group for measurement conventions.

Taking these developments into account, the SMMDU were given the following objectives for SMM7:-

- To enhance co-ordinated conventions.
- Develop rules for time-related and fixed-cost items.
- Provide compatibility with the Civil Engineering Standard Method of Measurement (CESMM).

- Consider the scope for widening the use of measurement information.
- Provide proposals for SMM7 that would provide:-
    - Simpler bills when the design is complete (and define this).
    - Consider a method of measuring work when the design is less complete.
- Develop rules for the measurement of mechanical and electrical work.
- Develop a model format for bills of quantities.
- Develop a practice manual to the Standard Method (Willis, 1988 a, p.25).

A cross-section of specialist parties were consulted during SMM7's ten-year development period and Advisory Panels set-up by the Standing Joint Committee to give feedback on the published discussion documents. For example, the Plumbing and Mechanical Engineering Installations Advisory Panel were represented by (among others) the ECA & HVCA (SMMDU, 1982, p.28).

A number of field trials were used as a testing ground for SMM7. However, by its own admission, the Development Unit only gave a brief opportunity to evaluate the effect on estimating and did not attempt to appraise any effects on the final account side (Willis, 1988 a, p.26).

The first discussion document (SMMDU, 1978) gave examples of draft Work Sections and a number of key findings relevant to this research:-

- The recognition of different levels of design and thus the need for varying levels of measurement.
- That "take-off" dimensions prepared by the quantity surveyor were rarely used after the preparation of the bill. Contractors had to prepare a similar set of detailed measurements for ordering materials and planning the works – a point later confirmed by Pasquire (1992, p.5) and Kodikara (1993 b, p.341). However, the Development Unit reported that this would only be of value if it were based upon a substantially firm design.
- Services were the most difficult section to deal with.

- Services contractors were responsible for much of the design work.
- There was little acceptance of the use of bills of quantities by engineers or by services sub-contractors. These factors would make it difficult to produce widely accepted rules for measurement.
- The intention of the bodies representing services contractors that bills of quantities should only be produced for fully designed projects.

Three years later, the distinguishable classification tables were published for discussion and included examples of concreting, waterproofing, sheeting and tiling (SMMDU, 1981, p.7). The publication also provided examples of draft bills and specifications.

A subsequent publication in 1982 provided detailed examples of the Preliminaries section (SMMDU, 1982, p.4). It also gave consideration to differentiating between firmly designed work and work that was not firmly designed (Bennett, 1983, p.84). The final publication, before the Standard Method itself, detailed a draft Practice Manual (SMMDU, 1984). Two principal purposes for bills were also clearly defined within this publication:-

- To assist contractors in preparing estimates for building contracts.
- When priced, to assist in the valuation of variations.

The eventual publication of the Seventh Edition in 1988 marked the end of the work of the Development Unit (actually wound up in 1984). SMM7 incorporated the work of the CCPI and the traditional work sections were re-arranged in Common Arrangement of Work Sections (CAWS). In total about 300 of these generic Work Sections had been developed and grouped into two higher levels, 115 at level two and 24 main classes at level one - representing trades that were normally subcontracted (Allot, 1988, p.22). For example:-

Level 1	Group	e.g. D	Groundwork	300 nr
Level 2	Sub-group	e.g. D3	Piling	115 nr
Level 3	Work Section	e.g. D30	Cast in place concrete piling	24 nr

(Building Project Information Committee, 1987, p.6)

According to Allott (1988, p.23), CAWS have been well received by the industry.

The intentions of the SMMDU may be summarised within General Rule 1 of the Standard Method and outline the ethos behind its publication:-

> "The Standard Method of Measurement provides a uniform basis for measuring building works and embodies the essentials of good practice. Bills of quantities shall fully describe and accurately represent the quantity and quality of works to be carried out." (SMM7, 1988, p.11)

As a prerequisite, the Standard Method requires a substantially complete design and adoption of the traditional procurement approach.

SMM7 was regarded as a significant landmark in the development of measurement practice within the UK building industry (EC Harris & Partners, 1988, p.29).

The only further edition since that date was published ten years later in 1998 - to take on board the UNICLASS building industry classification ISO/CD/12006/2 (RIBA, 1997, p.83). This revision did not change the principals of measurement.

Reflecting on its achievements, the issue of 'shorter bills' (as an objective of the Development Unit), generated considerable debate within the industry at the time. Disappointment at not achieving the target reduction was aired predominantly by quantity surveyors on the client side (Ashworth, 1988, p.23). In defense, the contributors stated that a *target* of 50% was set and that this was not a promise (Willis, 1998 c, p.20). In support of this, oversimplification had caused concern on the contracting side in terms of increased risk (Bennett, 1983, p.84), increased time to prepare an estimate (Rimmer, 1982, p.24) and although items that may be not be cost significant to the project as a whole they would be highly significant to the individual subcontractor concerned (Eccles, 1982, p.11). The latter point is critical if considerable variations are experienced post-tender.

Sims arguably took a more balanced view:-

> "When jobs are designed in advance of bill production and clients do not change their minds we can start to shorten bills – until then SMM7 is the best option." (1984 a, p.20)

In a similar context to Skinner's work it is important to appreciate the timing of the work undertaken by the SMMDU and changes within the industry since that date. The majority of the work was undertaken over a two-year period from 1982 –1984 and the work on specialist trades was carried out during 1982 and early 1983 (SMMDU, 1981, p.73).

Despite being in existence for more that twelve years, no proposed review of the Standard Method is currently planned (telephone conversation with N.R. Wheatley on 7th January 1998 – Honorary Secretary on the Standing Joint Committee). However, views from the industry would suggest that a review is necessary.

> "The average life of an SMM is about 10 to 12 years, it will not be until the turn of the century until a new edition would be contemplated......it has been geared to provide a uniform mode of measurement for the 1990s." (Willis, 1988 a, p.28).
>
> "The speed of change should reflect the speed of response" (Bucknall Austin, 1988, p.30).

This view is supported by Barnes:-

> "Methods of measurement must be reformed and updated much more quickly in the future if it is to be relevant." (Barnes, 1988. p.33).

Successive Quantity Surveying Divisional Presidents of the RICS have themselves questioned its relevance to the current market – Powell (1998, p.60), Wade (1992, p.5) and Rainbird (1992, p.14). The relevance of SMM7 is further assessed at various stages within the literature review.

2.2.2.21 BPF System – Schedule of activities – 1983

Although the developments by the BPF interrupt the efforts of the Standing Joint Committee they have been separated within the literature review for continuity.

In 1983 the BPF generated a further proposal, this time altering how the works were procured. The suggestion, termed the BPF System – Schedule of Activities, consisted of a list of milestone activities to be priced by the contractor. Upon completion of each activity the contractor would then be entitled for payment. It was envisaged that this would assist in assessing extensions of time, help the contractor monitor the works, assist in cost control of the work and in valuing variations (Kodikara, 1990, p.23). In reality only a limited number of projects were carried out using the BPF System (Kodikara, 1990 – interview with A. Tyler, 1987, p.24).

The BPF system relied on the client taking the lead role as project manager and the production of a Schedule of Activities in lieu of a bill (Badder, 1987, p.33) - similar to management practice within the USA (Nisbet, 1987, p.24). The BPF system also assumed that all the relevant information could be supplied by the main contractor but did not include a way of obtaining data from subcontractors (Kodikara, 1990, p.25). Furthermore, the system required the design to be complete at tender stage (Luder, 1984, p.21). This was considered to be too much of a straight-jacket by not making best use of the contractor's expertise (Sims, 1987, p.20).

The contractors themselves were reluctant to adopt the new system for a number of reasons. They had grown used to bills being produced using the existing Method of Measurement, still had to measure the works anyway and then refit the price to the activity, found difficulty in obtaining subcontract prices (as they would just provide a total price and the main contractor would have to split into activity) and, finally, were unhappy about the cash flow derived from the completion of milestones (Kodikara, 1990, p.25). If incorrect assumptions were made by the main contractor on how to split the subcontractors price between activities, the main contractor would be exposed to negative cash flow. Sims (1984 b, p.22) did not consider the advantages to warrant adoption and also expressed concern that the system could be manipulated to the benefit of the contractor. The RIBA shared this view (Building, 1984, p.22) and considered that the system was only relevant to specific types of construction projects – comparatively simple commercial and industrial buildings.

Although it was agreed that the employer would benefit from knowing his cash flow commitments from the outset (derived from the schedule of activities) the building process was not that predictable. Factors would intervene to supersede the original plan. In this respect the schedule of activities was perceived to be misleading to the employer (Sims, 1984 a, p.18).

The BPF System was regarded as a further example of a client-led system suited to the needs of the client. In the words of Kodikara:-

> "...........dictated by the client for their advantage" (1990, p.27)

The contractors did not find this useful for pricing. According to Kodikara (1990, p.27) they would measure the work in the conventional manner (closely following the Standard Method), then back fit the price to the activities within the schedule.

2.2.2.22 Chartered Institute of Building – 1983

The Estimating Practices Committee (EPC) of the CIOB (Chartered Institute of Building) shared the industry's view that once a contract had been let, the contractor did not maximise the full potential of the bill. Assisted by Clay (1983) a questionnaire survey was conducted. The original views of the EPC were confirmed and it was concluded that the use of bills post-tender could be significantly enhanced. However, the research did not identify what factors were inhibiting this post-tender use nor how to remove them.

2.2.2.23 Builder's Quantities for Contractors' Management – Christine L. Pasquire – 1991

Later research by Pasquire addressed this issue and developed an understanding of how the usefulness of bills may be improved at the post-tender stage for contractors' management.

McCaffer had argued that bills did not relate to the practical requirements of production (purchasing, planning, bonusing) and as such were unsuitable as a "*contractors' management tool*" (McCaffer & Pasquire, 1987, p.17). This resulted in additional work by the contractor to either translate the bill into a suitable format or compile fresh documents.

At the time of Pasquire's research, there had been a decline in the production of bills by the client-side, increased adoption of the design function by the contractor and widespread debate within the industry that the post-tender use of bills could be improved. The change in industry practice, away from client produced quantities, provided an ideal opportunity to explore how measured work could be better presented as a main contractors' management tool. As main contractors had great need for quantitative data it was essential that this was presented in the most suitable format (Pasquire, 1991, p.215).

Pasquire hypothesised that a study of data flow within main contracting organisations would reveal compensating work undertaken by the contractors' staff and, if this was presented in a more suitable format, such compensating work could be reduced.

The research focussed on small/medium main contractors' as the larger contractors were considered more likely to have the resource to develop their own solutions. The overall aim of the research was to develop a set of measurement rules for contractors that reduced compensating work post-tender.

Pasquire adopted a triangulated research methodology. In total, seven main contracting firms were involved in developing the measurement rules. Interviews were initially undertaken in three of these firms in order to obtain an in depth knowledge. Draft measurement rules derived from this stage were then tested by carrying out a number of field studies (five in total, each from a different firm). This testing was undertaken by Pasquire herself and, as such, the rules were not directly used by the practitioners (1991, p.20). However, the practitioners were given the opportunity to evaluate the results of the testing stage.

In addition, opinion was sought from eight experts within the industry. Although the same contracting firms were utilised throughout and three of the experts belonged to the same companies being researched, Pasquire considered the results to be sufficiently valid. Five of the experts were external to these firms and the re-testing stages utilised different staff within the same firm. The measurement rules also underwent three reiterations before they were considered to be sufficiently robust.

Pasquire examined the use of measured quantity data within each firm and how it was used by different departments. In order to achieve this a number of 'management tasks' were firstly identified (by function) - estimating, purchasing, planning, surveying, site management and higher management. By splitting the use of measured data into three categories (below) the relative importance of the measured data could be mapped and evaluated (1992, p.5):-

1) Those not requiring measured data,
2) Those needing measured data where the format was non-critical, and;
3) Those needing measured data where the format was critical.

The contractors' staff were interviewed and observed undertaking these tasks. A number of data interfaces were identified where, as the information was unsuitable, the data had to be transformed before it became useful to the end user. The greatest interface was found between client prepared information and that required by the contractor (1992, p.3). This may be seen to support Skinner's finding in that the views of quantity surveyors, with regard to the adequacy of pricing information, differed considerably to those of the contractors' estimators.

Pasquire also discovered that (1992, p.6):-

- Much of the data passed between management functions needed to be re-worked in order to perform specific tasks.
- Contractors' quantity surveyors were found to use dual sets of data, bills as a means of evaluating revenue and internal costs to evaluate cost.
- The way in which costs were incurred by the contractor did not correspond with the format of the bills.
- Purchasers considered that, even at the best of times, the accuracy of bills was questionable. They would frequently have to re-measure from drawings to order materials.
- Main contractors have a basic 'need' for measured data. If bills were not supplied by the client they would either create their own or request a quantity surveying firm to produce one for them.

To relieve the amount of re-work experienced between the management interfaces Pasquire proposed the adoption of 'take-off' sheets. In a move away from the traditional focus on material content, Pasquire proposed breaking each item of work into the resources involved and detailing these on the 'take-off' sheet (1991, p.135). The resources were also expressed in terms of 'buying units' (how the resources were procured) and included a method statement about any assumptions made by the estimator.

These findings were consistent with Sumner-Smith's criticisms (1920s) that labour and materials should be separated and that materials should be measured in buying units – a point further confirmed by Harold Hussey (Pasquire, 1991, p.3, oversize) during the expert interviews and Skoyles (Pasquire, 1991, p.17, oversize). According to Pasquire this change in format generated an approximate saving of 63% in time across all management functions (1991, p.219).

Pasquire's research also confirmed earlier conceptual work by Ferry & Holes (1967), in that, when work is quantified much of the vital information may be lost e.g. size, shape, location. Pasquire's proposal enabled this information to be retained after quantification had occurred. The findings provided a contribution to how the needs of production could be better portrayed within bills of quantities.

However, it is important to establish the limitations of Pasquire's research in order to review the findings in context. The results of the research are only intended for internal use by main contracting organisations, in particular, small/ medium sized main contractors (1991, p.5). Further, the rules of measurement are also only applicable to the following trades – demolition, excavation, concrete, brickwork, joinery, drainage, external works and alteration. All other work was found to be subcontracted and is not covered by this research (Pasquire, 1991, p.216).

In terms of recommendations for further research, Pasquire recognised the high proportion of work undertaken by subcontractors and recommended the production of measurement rules for this sector of the industry. According to Pasquire, the development of measurement rules for subcontractors was recognised as potentially having a wide application (1991, p.221)

2.2.2.24 Data flow in building contractor organisations - G. W. Kodikara. – 1990

The work carried out by Kodikara represents the third major element of academic research undertaken within the subject area.

Although published a year earlier than Pasquire's, Kodikara's research was actually carried out subsequently and continued along similar lines with the aim of streamlining the measurement procedures to suit the Sri Lankan building industry (Pasquire, 1991 p.220).

The overall aim of the research, similar to that of Pasquire, was to propose solutions to reduce the amount of repetition and '*re-work*' involved in the post-tender use of estimating data. '*Re-work*' was defined as any modification to the data to make it useable. The research reviewed the flow of estimating data, how it was used and reasons for poor data management.

Kodikara recognised that attempts by the client or consultant to improve bills on behalf of the contractor may not be successful. He viewed the bill as:-

"......a client document for client purposes." (1993, p.341)

With the exception of Pasquire's work, Kodikara argued that all previous research had merely addressed client perceptions of how the bill could be improved. He recognised that the Operational Bill, which infringed on the contractor's decision-making capabilities, was not desirable as production decisions would be undertaken on the contractor's behalf. Kodikara favoured the presentation of information in a different format citing Pasquire's 'buying units' as a prime example (1990, p.3).

Kodikara proposed that, as previous research had not quantified the *extent* of use (defined as that element directly useable without alteration) of the estimate or the reasoning behind its low use, there was merit in reviewing how its presentation could be improved (1990, p.4 & 5).

Kodikara, in a similar vein to Pasquire, adopted a qualitative methodology. Four main stages were evident within the methodology which sought to gradually develop proposals from an in depth understanding of the problems (1990, p.5):-

1. Identification of the problem (literature review and interviews).

2. Formulation of solutions (proposals).
3. Investigation of the validity of the solutions (conduct test projects, use on a live project and assess professional acceptance).
4. Deduction of conclusions and recommendations.

The initial research was based on ten interviews. These were selected on the basis of how well they represented the industry as a whole. A number of characteristics were adopted in an attempt to achieve this (whether they were government or privately owned, turnover, type of work undertaken, experience and location).

Structured interviews were then conducted and the flow of data observed between the same management functions (1990, p.83) as identified by Pasquire.

Kodikara identified substantial re-working and re-generation of data between these management functions. This was in line with similar findings found within the UK Civil Engineering industry at the time (Zakieh, 1991, p.255). A more detailed analysis was then undertaken in an attempt to establish the root cause of these problems. The bills were divided into '*information packages*' and eight of the original ten interviews re-visited. Eleven '*information packages*' were identified in total comprising - times/ durations, preliminaries, material specifications, work descriptions, working methods, quantities, quantity units, unit rates, provisional sums, prime cost sums and temporary works.

Each contractor was visited several times and the management functions asked to quantify the extent of *re-work*. For example, if 60% of the quantities had to be *re-worked* (altered before they were useable) then only 40% would be directly useable – the '*extent of use*' (Kodikara, 1990, p.120).

Kodikara confirmed the original hypothesis and revealed that the *extent of use* of the estimate at the post-tender stage amounted to just 50% i.e. approximately half the information required substantial *re-work* before it was in a suitable format (1993, p.263).

In particular, the information packages of 'quantities', 'quantity units' and 'unit rates' were considered to be the most appropriate for further investigation. These were recognised as the key elements within bills if the amount of post-tender *re-work* was to be reduced.

To achieve this, Kodikara proposed that the 'quantities', 'quantity units' and 'unit rates' should be split down into their resource components within the bill i.e. labour, plant and material (1993, p.261).

This proposal was tested on two 'live' projects - existing projects that had already been estimated were re-priced using the new method. The findings of this exercise were then presented to the same professionals approached within the original interviews. Based on their opinion it was considered that the *extent* of post-tender use would be improved by a further 50%. That is, 75% of the measured data was now useable without modification instead of the original estimate of 50%.

A final acceptance study was then undertaken to observe the industry's willingness to adopt such a proposal - 33 external candidates (1990, p.242). The feedback showed that ninety-two percent of professionals accepted that the proposal would improve the *extent of use* of the estimate.

In keeping with Pasquire's findings, Kodikara also discovered that bills were still produced by main contractors even when they were not produced by the client-side. This confirmed the main contractor's basic need for quantified data.

In summary, Kodikara recognised the potential to improve the post-tender usefulness of estimating data for contracting organisations. Kodikara's contribution was to quantify the *extent* of this improved usefulness in light of proposed solutions (i.e. how much more of the information was directly useable). Although in some respects the eventual proposals were similar (by splitting the quantified work by resource and buying unit) both Pasquire and Kodikara quantified different benefits. Pasquire quantified the approximate amount of time saved and Kodikara quantified how much more of the information would be directly useable without alteration. Kodikara also proposed, in principal, the use of a classification and coding systems between the management functions to improve the flow of data (1990, p.263). He further revealed that any revolutionary change to the conventional format would not be welcomed by the Sri Lankan industry and that any new proposal should be developed within the limitations of conventional practice (1990, p.263). Similarities in inefficient data management were found to be common between the UK and Sri Lanka.

The proposals put forward by Kodikara may be seen to be limited in their application as they are only intended for internal use by main contracting organisations. In addition, Kodikara did not address the needs of subcontractors and, in fact, the analysis by information package tells us little about the requirements of particular trades within the main contracting organisation. As subcontract trades represent what may be termed ‘higher level’ buying units (as opposed to individual resources) i.e. how the work is procured, the research is of limited practical use. In contrast, Pasquire’s research provided specific advice and rules about certain trades reflecting how the work is procured in practice.

How generalisable the results are to the UK building industry may also be brought into question. In terms of the methodology many of the findings were re-tested on the same subjects raising doubt over the validity of the results (Sarantakos, 1993, p.77). However, the final validation exercise sought to address this concern by obtaining external opinion.

Furthermore, Kodikara identified that the format and presentation of estimating data was just one of a number of reasons for inefficient site control, site monitoring and cost control. He also recognised a number of other potential reasons (1993, p.344):-

- Unorganised allocation of staff.
- Insufficient site staff.
- Large amounts of variations which affected the bill and programme.

Kodikara did not attempt to weight the comparative significance of these issues.

Two main factors are seen to diminish the appropriateness of both Pasquire's and Kodikara's proposals:-

1. The extent of post-tender changes, superseding the original quantities and resulting in re-measurement.

2. The pricing practices of contractors' estimators.

In practice, a great deal of changes are made during the construction phase of projects making the original measurements out of date (Bennett, 1983, p.84 & Rimmer, 1982, p.24). The SMMDU recognised that improvements to the format aimed at improving the post-tender use would only be of benefit if based upon a substantially firm design (1978, p.29). Inaccuracies within the tender documents (a point expressed by the purchasers within Pasquires research) may also limit how useful the measured data would be. However, it is accepted that the adoption of Pasquire's proposals would enable the data to be presented in a more useful format and that the extent of any such changes would be more readily assessed.

Research by Skitmore & Wilcock (1994, p.139) may also be seen to further limit the application of their findings. An investigation of smaller builders (a sector of the market addressed by Pasquire) revealed that only about half the items would be priced in the detailed prescriptive method anticipated by the literature. The other half would be priced by experience and therefore not require a detailed resource breakdown. The method of pricing adopted was found to be dependent on the value of the extended item – a high value necessitating the more detailed prescriptive approach. Such items priced on experience, would preclude the documentation of detailed resource splits for subsequent management (as they would not be calculated) and therefore reduce the effectiveness of these proposals.

2.2.2.25 Measurement Research – The Nottingham Trent University - 1992

The Nottingham Trent University began its' commitment to building measurement research in 1992. Under the general heading of *The Future of Measurement*, the research questioned the relevance of existing advice and methods of teaching to the demands of the industry.

Two conferences were held entitled *"The future of measurement"* (1992) and the *"Measurement and contractors conference*" (1994). These conferences obtained a cross-section of views from around the industry and are cited within the relevant sections of the literature review.

An initial study examined how quantity surveying graduates were taught to measure at university and how this corresponded with the requirements of their subsequent employers (Swaffield, 1994 b, p.1). Two hundred and fifty-nine questionnaires were distributed, two hundred to randomly selected graduates from the RICS membership database and fifty-nine handed to graduates at their degree awards ceremony.

An overall response of 32% was obtained – 84 in total. 88% of these respondents believed that measurement teaching was biased towards bill production and 92% that they had not received enough training in computer applications. The survey also revealed some interesting results with respect to the measurement of mechanical and electrical work. Only 62% had been taught how to measure mechanical services and 51% electrical services. One third were taught neither. Even when they were taught how to measure these trades, 82% believed that they were not taught enough measurement of mechanical services and 86% for electrical services. Comments indicated that they were very rarely, if ever, asked to measure mechanical and electrical services by their employer. One graduate working for a mechanical and electrical quantity surveying firm further commented that the demand for mechanical and electrical bills appeared to be negligible - the majority of work being let on a drawings and specification basis. Overall, the survey revealed a shortfall in the education of mechanical and electrical services (1994 b, p.3).

Further research at Nottingham identified that the value of conventional practices may be in doubt in some trades (Swaffield, 1994 c, p.21).

The research recognised that, in practice, most main contractors do not price the work themselves but pass this on to subcontractors to price on their behalf (as confirmed by Skinner, 1981, p.9; Pasquire, 1991, p.221 & Kodikara, 1990, p.94). It was hypothesised that the way in which these trade subcontractors priced the work was dependent upon their material or labour content. Twenty-four subcontractors were interviewed and the results analysed on the basis of belonging to either a high labour of high material group (identified by using pricing books - SPONS 93, Griffiths 93, Wessex, 91).

Interviews were conducted with high labour trades (painting, plastering and excavation) and high material trades (identified as electrical, plumbing and structural steelwork). The high material trades tended to price bills and preferred to have these produced for them. In contrast, high material trades did not price the bill. These specialist trades tended to be involved in the design more frequently and instead produced a price using their own methods. This therefore brought into question the relevance of conventional bills for these high material/ specialist trades. It was suggested that bill production for these trades may be a waste of effort and that they would also be inappropriate for valuing variations and interim valuations.

Two alternatives were proposed: firstly, the adoption of a lump sum procurement method through nomination or, secondly, trying to change conventional bills to suit their internal methods of preparing a price. The former would result in less control and more risk to the client and the latter, greater cost of production if indeed there was sufficient commonality between these trades.

Although the research identified potential differences in trade practices they were, however, based on a limited sample of the industry - particularly of the different types of contractor (1994 c, p.23). The proposals were also not tested. However, the research raised further questions relating to the varying needs of the subcontractors themselves and the root cause of such needs. It additionally provided some rationale for the low demand for mechanical and electrical bills identified during the graduate survey as, in practice, the subcontractors did not appear to be using them.

2.2.2.26 Estimating practices of smaller builders – Skitmore & Wilcock, 1994

Later work on the methods of pricing adopted by 'small' main contractors (defined as employing 114 people or less) was undertaken by Skitmore & Wilcock (1994). The research investigated how main contractors' estimators actually price bill items. The results were based on the views of eight practising builders' estimators.

Skitmore & Wilcock identified that, as the estimators were familiar with the prescriptive literature, they tended to rationalise their explanations accordingly. However, by delving deeper the researchers revealed marked differences between normal practice and that reported within the literature. Only half the items were found to be priced in the detailed method anticipated by the literature and the remainder priced mainly by experience (1994, p.151).

The total value of the extended item (i.e. quantity multiplied by rate) was identified as the main factor in determining the rating method. If the extended value was high then the detailed method would be adopted and, conversely, an 'experienced' view given if low in value. The 'experienced' view resulting in a value being derived subjectively based on 'gut feeling' as opposed to a detailed analysis of the price. Skitmore & Wilcock recognised that little descriptive material was available concerning the processes employed by main contractors in determining a tender price (1994, p.139).

The research also had implications for the findings of Pasquire (1991) and Kodikara (1990). Although their proposals related to the post-tender stage they relied on this tender information being presented in a more suitable format. The adoption of the 'experienced' method of pricing work (amounting to half the items) would mean that this detail would be missing. To comply, this would either mean adopting the detailed method for all the items when they were priced originally or completing the information once the tender had been won. The former would increase the cost of tender production (Skitmore & Wilcock, 1994) and the latter, the post-tender cost. The research did not attempt to address the pricing practices of subcontractors.

Further research by Akintoye & Skitmore (1991, p.316) also tends to suggest that larger companies are more consistent in their approach to estimating than smaller companies are.

2.2.2.27 Measurement Rules for Contractors' Quantities – 1996

Recognising the trend away from formally prepared bills, Tweeds (a quantity surveying practice) proposed their own standard method. In the preface to the publication, Christopher Powell (ex-QS Divisional President of the RICS) stated that the industry did not possess a Standard Method of Measurement for builder's quantities prior to this publication. Inevitably this comment did not take account of the work by Pasquire (1990) and, instead of being formulated upon formal academic research, the work was developed in-house.

The standard method proposed by Tweeds did not differentiate between those trades subcontracted and those retained in house as identified by Pasquire (1991, p.221) and Skinner (1979, p.9). Nor did it attempt to split the items of work by resource or into individual 'buying units' (Pasquire, 1992, p.6 & Kodikara, 1993 a, p.267). No mention within the literature has been made with regard to the successful adoption of this proposal.

2.2.3 Changes to the background of the building industry

The previous section (2.2.2, p.31-65) provided a review of developments in pricing documentation from the early 20th century to the present day and of research carried out and published during this period.

In order to consider these developments and this research in context, they must be reviewed in conjunction with changes that have occurred to the building industry as a whole. This will enable the relevance of the proposals to be evaluated and provide a measure of their *effectiveness* against current practice.

Three main areas have been established for review:-

1. Changes in management practice.
2. Changes in Information Technology.
3. Current pressures surrounding the industry.

2.2.3.1 Changes in management practice

Changes in management practice are further subdivided into three main areas:-

1. Changes in the structure of the industry.
2. Changes in the methods of procurement adopted.
3. Changes in the management of specialist trades.

2.2.3.1.1 Changes in the structure of the industry

The structure of the UK building industry has significantly changed over recent years. In the five years between 1979 and 1984, the number of one-man firms increased by 136% and the value of work they undertook increased by 254%. Firms employing 7 or less workers grew by 116% in number and, similarly, the value of work they undertook increased by 500%. Over the same period the number of firms employing eight or more staff decreased by 23% and by 35% in the number employed (Abdel-Razeck & McCaffer, 1987, p.227).

Changes to the structure of the industry have also transformed the workload and areas of risk encountered by main contractors estimators:-

> "The estimator's task has been made more difficult by the changes in structure of the construction industry and change in risk areas e.g. estimating attendances, vetting, selection process, risk of disruption (p.242)..............Causes of inaccuracy in estimating the cost of a job using subcontractors are clearly different to those using the company's own labour and plant (p.236)" (Abdel-Razeck & McCaffer, 1987).

These trends in subcontracting are further supported by Shash (1993, p.114). In a survey of 300 top UK contractors (response rate of 28.3%, 85nr), Shash revealed that most of their work was subcontracted - 24% of the contractors subcontracted 75%-100% of their workload and 61% over 50% of their workload. Shash also discovered that the percentage of work subcontracted was higher when their workload was diverse and confirmed that most contractors did not specialise in a single type of construction.

2.2.3.1.2 Changes in the methods of procurement adopted

In addition, significant change has occurred in the way that the work is now procured. The RICS has intermittently commissioned surveys of contracts in use within the building industry. These surveys provide snapshots of the type of contracts used by quantity surveying firms to procure work. The last survey was undertaken in 1998 and published in January 2000.

The findings are summarised in table 2.3. Overall the use of bills has halved within the last 15 years – from 58.7% in 1984 to 28.4% in 1998 (by value). With the exception of 1991 (at 29.0%), the number of contracts using bills was recorded at an all time low (34.6% in 1984 down to 30.8% in 1998).

Table 2.3: Trends in the use of bills of quantities

Measure	1984 %	1985 %	1987 %	1989 %	1991 %	1993 %	1995 %	1998 %
By Value	58.7	59.3	52.1	52.3	48.3	41.6	43.7	28.4
By Number	34.6	42.8	35.6	39.7	29.0	34.5	39.2	30.8

Source: RICS. Contracts in Use – A survey of Building Contracts in Use During 1998. 2000. p.5.

The survey also recognised an increase in the use of Contractor Design Portion Supplements within lump sum traditional contracts; 14% of JCT80 Contracts incorporated the supplements in 1995 compared with a rise to 48% in 1998 (2000 b, p.11).

As summarised in table 2.4, the adoption of Design & Build methods of procurement has increased over the same time period:-

Table 2.4: Trends in the use of design and build forms

Form	Percentage by number		Percentage by value	
	1995	**1998**	**1995**	**1998**
JCT with contractor's design	10.0	18.9	21.0	27.1
GC/ Works design & build	0.3	0.2	1.6	0.2
ICE design & construct	0.1	0.4	0.3	9.6
Other design & build	1.4	1.3	7.2	4.6
Total	**11.8**	**20.7**	**30.1**	**41.4**

Source: RICS. Contracts in Use – A survey of Building Contracts in Use During 1998. 2000. p.15.

However, it is important to recognise potential limitations within the results of the surveys. Firstly the survey only obtained the views of quantity surveyors. In no way do the results represent the workload *received* by contractors (which in reality emanates from a number of sources) – just the format in which the information is sent out (2000 b, p.7).

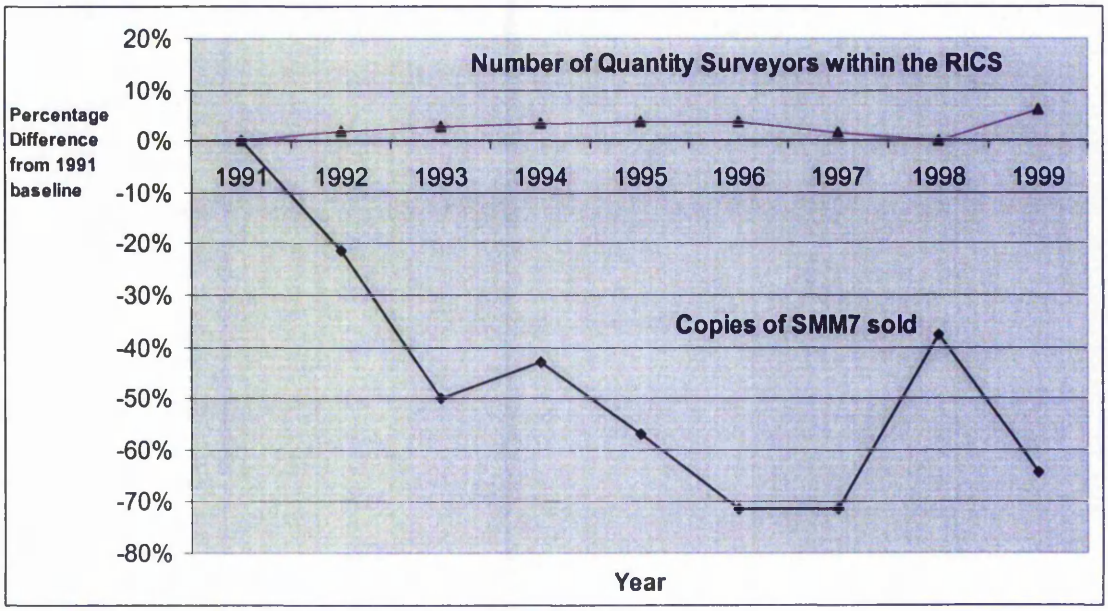
The number of responses should also be taken into account when assessing how representative the results are. These have steadily dropped over time from 440 in 1984, 194 in 1995 and down to 151 in 1998. The current survey is therefore relying on a relatively limited number of responses and on just over a third of those obtained for the 1984 survey (Morrison, 1986, p.14).

By its own admission, the latest survey appeared to have achieved a slight bias towards higher value schemes (RICS, 2000 b, p.9). This may well have skewed the results slightly e.g. in reality the use of bills may be higher on such schemes and therefore not be truly representative of all work let by quantity surveyors.

In summary, the survey was based on the work let by 151 quantity surveyors and was potentially skewed towards higher value schemes. The survey did not identify the value of this work actually measured or its quality.

The following graph (figure 2.3) provides further analysis of the overall use of SMM7. The graph compares the number of copies of the Standard Method that have been sold (seventh edition) against the number of quantity surveyors within the RICS over time. When compared against a 1991 base, the number of quantity surveyors is seen to remain relatively constant (rising by 2,063 or 6% in 1999). In sharp contrast the number of copies of the Standard Method sold fell by 4,500 or 64% in 1999 from the 1991 baseline - the blip in 1998 coinciding with the re-issue to incorporate UNICLASS (section 2.2.2.20, p.49). Despite a slight increase in the number of quantity surveyors within the industry the number of copies sold has fallen. The actual figures are also displayed in tabular form in table 2.5 (p.71).

Figure 2.3: Comparison between the number of quantity surveyors within the RICS and the number of copies of SMM7 sold



Source: Copies of SMM7 sold obtained from Umang Desai (RICS IT Department – 23/03/2001). Number of Quantity Surveyors within the RICS obtained from Derry Thorburn (Information Officer, RICS Library – 05/04/2001)

Table 2.5: Comparison between the number of quantity surveyors within the RICS and the number of copies of SMM7 sold

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Copies of SMM7 sold	7,000	5,500	3,500	4,000	3,000	2,000	2,000	4,360	2,500
Reduction in number from 1991 base	0	-1,500	-3,500	-3,000	-4,000	-5,000	-5,000	-2,640	-4,500
% reduction from 1991 base	0	-21	-50	-43	-57	-71	-71	-38	-64
Number of QS's in the RICS	32,516	33,131	33,450	33,639	33,779	33,754	33,028	32,498	34,579
Increase in number from 1991 base	0	615	934	1,123	1,263	1,238	512	-18	2,063
% increase from 1991 base	0	2	3	3	4	4	2	0	6

Source: Copies of SMM7 sold obtained from Umang Desai (RICS IT Department – 23/03/2001). Number of Quantity Surveyors within the RICS obtained from Derry Thorburn (Information Officer, RICS Library – 05/04/2001)

2.2.3.1.3 Changes in the management of specialist trades

Changes in the management of the building industry may be seen to have occurred at both the macro and micro level.

At the macro level, changes in the structure of the industry have resulted in higher proportions of the work being subcontracted and changes in methods of procurement adopted. At the micro level changes have also occurred in the way that individual trades are managed, in particular, the 'specialist' trades.

2.2.3.1.3.1 Definition of specialist work

As the term 'specialist' has a number of connotations (Latham, 1994, p.27) it is worth clarifying its definition in the context of this research. The Construction Management Forum Report (Latham, 1994, p.27) recognises specialist trades to be:-

1. Piling.
2. Structural Steelwork.
3. Lifts and escalators.
4. Curtain walling (and other forms of cladding).
5. Flooring and suspended ceilings.
6. Information Technology and Communications networks.
7. Heating and Ventilating systems.
8. Air Conditioning.
9. Hot and Cold Water Services.
10. Fire Engineering.
11. Public Health Engineering.
12. Lighting and Power.
13. Building automation, security and energy management systems.

They were further categorised (Latham, 1994, p.27) into:-

- Product Orientated (1-6)

  Where the contractor typically responds to a performance specification and the skills of the contractor are in the quality, compliance, value-for-money and delivery of the product.

- Systems Orientated (7-12)

  Where the contractor typically carries out a design from inception. This is either in response to a performance specification or is worked up from a conceptual design prepared by a consultant.

In the context of this research we refer mainly to the latter - the systems orientated trades. To summarise, trades typically considered to be 'specialist' would include:-

1. Mechanical work (Latham, 1994, p.27; Shakeshaft, 1994, p.43)
2. Electrical work (Latham, 1994, p.27; Shakeshaft, 1994, p.43)

Note: Mechanical and electrical work is also commonly referred to as building services work within the literature (RICS, 2000 c, p.6, 44 & 48).

Despite the identification of a number of types of trades that are considered to be 'specialist', the literature does not offer a succinct definition of what 'specialist' actually means. A working definition of the term specialist is therefore provided. It is proposed that the deciding factor between specialist and non-specialist trades relates to the superiority in knowledge held by the specialist (on the constructing-side) over and above that of the client-side (client and client design team). Thus a specialist knowledge may be defined when:-

A significant gap in knowledge exists between the constructing-side and the client-side of the construction industry relating to the method of designing and/ or carrying out the work.

Therefore the definition does not make reference to whether someone is *particularly good* (Concise Oxford Dictionary, p.1334) at carrying out the work rather that the knowledge is *uniquely* held by one party over and above that of the other party (Concise Oxford Dictionary, p. 1335). It also refers to the gap as being *significant*.

For example, plastering and painting both require *specialist* skills that are held by a limited number of the construction workforce. However, (the knowledge) the techniques and methods of carrying out the work are well understood by both the client-side and contracting-side of the industry. Such trades would not therefore fall under the definition of specialist.

2.2.3.1.3.2 Specialist work in context: typical values in relation to total construction cost

The following extract from the RICS Building Services Procurement Guide highlights the typical value of building services work within modern construction:-

Table 2.6: Building services work - elemental breakdown as a percentage of total construction cost

Group element	Highly-serviced factories	Air conditioned offices	General hospitals
1. Substructure	19	8	6
2. Superstructure	62	44	33
3. Finishes	4	11	8
4. Fittings	-	2	4
5. Services	15	35	49
Total	**100**	**100**	**100**

Source: RICS - Building Services Procurement - Guidance Note. 2000. RICS Business Services Ltd. p.6.

The value (ranging from 15% to 49%) therefore represents a significant proportion of today's construction cost. These percentages are further supported by Eccles (1992, p.3) & Bennett (1988, p.68) who state that building services can equate to as much as 40% of total cost. Berryman also recognises that the cost of services could easily equal or outweigh all the other work put together (1982, p.57). Specialist trades are therefore of significant importance in terms of overall construction cost.

2.2.3.1.3.3 Changes in the procurement of specialist trades

The procurement of specialist trades has gradually shifted from the more traditional methods where the design is completed by the client-side (Langford, Kennedy & Sommerville, 1992, p.65). Specialist trades typically play a more active role in the development of the design. The extent of this integration is seen to vary from design co-ordination through to full collaboration in the design process. Current advice within the industry (outside that of the Standard Method) recognises the changing role of the specialist (RICS, 2000 c, p.25).

Latham recommended (Executive Summary, point 8) that design responsibilities in building services engineering should be clearly defined and that particular care needs to be given to the integration of building services design. Latham also refers to grey areas existing between consultants and specialist engineering contractors (Latham, 1994, p. 23). In support of this, the RICS Procurement Guide recommends the need to have clearly defined roles and responsibilities for design co-ordination – particularly where the building services element is of significant value and complexity. If not, the guide predicts problems with installation time, installation cost, effect on other trades, co-operation between parties and standard of workmanship (RICS, 2000 c, p.14).

Both also propose the adoption of a checklist to allocate design responsibilities and suggest using the Building Services Research Information Association (BSRIA)

Allocation of Design Responsibilities for Building Engineering Services - technical note TN21/97 (RICS, 2000 c, p.9; Latham, 1994, p.30 & Atkinson, 2001, p.16)

They both also endorse using the building services contractor within the design process – a change in the traditional procurement route. The RICS Procurement Guide recognised the limited use of the contractor's expertise and potential to reduce cost if the building services contractor was able to propose alternative items of plant and equipment (RICS, 2000 c, p.24, 37 & 18; Latham, 1994, p.23 & Egan, 1998, p.30).

In fact, the RICS Mechanical and Electrical Panel further suggested the appointment of a building services contractor as the principal contractor if the building services element is very large provided they have the necessary management skills (RICS, 2000 c, p.26).

Research by Langford, Kennedy, & Sommerville (1992, p.66) identified frequent disputes between the main contractor and subcontractor and the greater fluidity of roles in construction. They too suggest that there is a strong case for the building services contractor becoming the main contractor and employing non-specialist trades contractors. They also drew distinctions between non-specialist contractors and specialists in terms of their ability to operate under Construction Management. Their research revealed that non-specialist trades contractors saw their roles as diminished and found co-operation more difficult whereas the specialist contractors were more positive and better able to handle democratic relationships. They argue that specialists are more responsive to change and skilled at working in a co-operative manner (1992, p.65 & 66).

Support for a change in the traditional procurement route and inclusion of the specialist in design development is seen to be widespread within the industry. The BSRIA report stated the logical use of the same contractor for both the original design and for construction (Latham, 1994, p.28).

> "Specialist contractors should form part of the design team assisting on buildability and programming........We need to draw on the talent and creativity of employees and not be restricted by strait-jacket of a bill.........Changes in

> technology, materials and prefabrication have been specialist and manufacture led." (Ardley, 1994, p.63)

Comments published in the lead up to the HVCA Summit (2001) provide further evidence of changing practice:-

> "Earlier involvement of specialists and a collaborative approach should benefit everyone, not just in terms of a better quality; better designed and a better constructed product, but better bank balances all round as well." (Atkinson, 2001, p.17)
>
> "Over the last three to four years we have actually been pursuing a policy whereby we are very selective on the projects we go for. The selection process is really about our becoming involved early on in the job and higher in the supply chain. That gives us better understanding of the job at an early stage so we can make a contribution." (Jim Faulkner, Director - Amec Building Services, p.16)
>
> "It (early involvement) is happening more and clients can see the benefits it brings.........regular construction clients are promoting it" (Alan McDougal - Shepherd's, p.16)
>
> "Involving the building services contractor early creates less friction between the parties and the project is better run." (Martyn Horton - Rosser & Russell's, p.16)

Despite the absence of any detailed procurement trends, a review of the literature would suggest that specialist trades are becoming more involved in the design process. This indicates a fall in the adoption of the traditional procurement method and thus diminished use of the Standard Method.

2.2.3.1.3.4 Changes in the state of design of specialist work

The procurement methods typically adopted are seen to affect the level of design completeness at the tender stage. The literature suggests that it is rare for the design of specialist work to be complete (or even near to completion) at the tender stage of construction (Rimmer, 1982, p.24; Bennet, 1983, p.84 & Wood, 1990, p.20).

> "…….history has dictated that the building services design is not far enough advanced within the procurement timetable to provide the quantity surveyor with sufficient information to produce bills." (RICS, 2000 c, p.37)

> "In general, the consulting engineer does the conceptual design….and the specialist contractor is responsible for much of the detail." (Latham, 1994, p.28)

> "The building services contractor generally has responsibility for detailed design work……….which limits the information available for billing." (RICS, 2000 c, p.37)

> "……….bidding documents are usually only in outline and the drawings are not usually diagrammatic." (Collier, 1987, p.126)

> "Services cannot be considered to be fully designed until say all electrical circuits have been routed, supporting steelwork, controls and instrumentation etc have been detailed or decided upon. All of this is rarely possible at the tender stage. One might question whether certain aspects of SMM7 might develop into a non-event when applied to engineering services in particular." (Berryman, 1982, p.57)

> "…………skill in detailed design is often by the contractor." (Swaffield & Pasquire, 1995, p.8)

A telling summary of current practice was also provided by James Nisbet (former President of the Quantity Surveyors' Division of the RICS):-

> "………..structural engineers expect the contractors to prepare the detailed connection details and services engineers expect the subcontractors to prepare all installation drawings. Architects usually require bills but services engineers

> resolutely require tenders to be based on drawings and specification." (Latham, 1994, p.24)

These results also correlate with the survey of quantity surveying graduates conducted by Swaffield (1994 b, p.2 & 14 – Section 2.2.2.25, p.62).

2.2.3.1.3.5 The ability of the quantity surveying profession to adequately measure specialist work

As specialist work now represents such high proportions of total construction cost it is important that the quantity surveying profession provides appropriate financial control and advice.

> "The quantity surveyor's fee should cover the total building, so it is not unreasonable for clients to expect competent advice and accurate cost estimates for M&E services." (Swaffield & Pasquire, 1995, p.1)

In order to underpin this, the literature cites the skill of *measurement* as being pivotal:-

> "............the whole structure of contemporary quantity surveying ....can be said to be firmly based on the twin pillars of technical construction knowledge and the techniques or skill of measurement." (McDonagh, 1992, p.3).

According to Fortune and Skitmore (1992, p.86), the ability to measure the work adequately relies on a number of characteristics. Fortune categorised these into three main areas in descending order of importance:-

1. *Educational soundness* - ability to think logically and quantify accurately relying on the overall ability to judge quality information and communicate effectively.
2. *Technical soundness* - relying on the knowledge of construction methods, materials and overall ability to sketch details.

3. *Personal soundness* - the ability to visualise.

Bannister & Fletcher (1931) also identified that knowledge of the customs of the trade were vitally important (Fortune & Skitmore, 1992, p.80). More specifically, Collier proposed that (p.80):-

> "M&E work requires a good knowledge of the design fundamentals before measurement can begin. The measurer has to be able to design the detailed requirements in their mind." (Collier, 1987, p.126)

Inevitably, if the traditional procurement route is not usually adopted and design is typically incomplete, this makes it very difficult for the quantity surveyor to measure the work in accordance with SMM7.

Further, it is suggested that two main factors impair the quantity surveyor's ability to measure specialist work:-

1. **The state of the design** (covered in Section 2.2.3.1.3.4, p.78).
2. **The availability of skills to measure specialist work** (covered in this section).

To summarise, despite recognising the importance of specialist work (in terms of total construction cost) and need for *measurement* to underpin this, the ability to measure specialist work is widely recognised as a shortfall in the ability of most quantity surveyors. The RICS have, themselves, generated a number of reports confirming this. The RICS Building Services Procurement Guide explains the background to this problem:-.

> "Building services contractors.....have traditionally had a closer relationship with building services engineers than the quantity surveyor. This relationship has developed because the building services engineer may rely on the expertise of the building services contractor or its suppliers to design some individual systems. This can result in areas of the design being described only in terms of its performance, i.e. the building services contractor will need to offer a design solution to meet the performance criteria established in the specification. This is

inappropriate information for quantity surveyors to prepare bills of quantities from." (RICS, 2000 c, p. 37)

The Procurement Guide also identified that only a small skill base existed within the quantity surveying profession to measure building services work (RICS, 2000 c, p.37). QS2000 (1991) identified the need for the quantity surveying profession to improve their expertise and education in this area. The report also recognised that the services industry is seen as somewhat separate from construction and that quantity surveyors have been slow to specialise to the extent needed to take a leading role and expressed their surprise given the high cost involved.

A further research paper published by the RICS (RICS, 1992) commented that the traditional quantity surveyor was not sufficiently prepared through their training to consider building services as part of their concern. Similarly, concerns have also been expressed from other areas of the industry:-

> "Main stream quantity surveyors are nonchalant about M&E services usually through fear or ignorance.....all too often they fail to use appropriate documentation. Even when they get a quantified schedule of rates they often lack the expertise to appraise the document produced by the M&E contractor. The vast majority do not possess the requisite understanding of M&E work to provide practical and professional advice. It reflects badly on our profession that we train just a handful of chartered professionals who can deal with an element of construction that may amount to 50% of the project cost." (Leighton, 1998, p.39).

> "Many quantity surveyors do not understand the technology of M&E services.........the complexity of services systems and the variety of alternative designs are partly responsible for the unsatisfactory cost control of services" (Swaffield & Pasquire, 1995, p.2).

Concerns have been raised within the industry about the detrimental effects of this trend away from traditional detailed measurement of specialist work by the client-side of the industry.

Coffey (1992, p.1 & 2) recognised that as mechanical and electrical contractors had increasingly generated their own design solutions they were also measuring their own work and the Standard Method of Measurement was not being used. This lack of measurement on the client-side had diminished any practical appreciation and ability to provide adequate financial control. According to Coffey, this resulted in:-

- Loss of detailed data – undermining the very reason to employ a quantity surveyor (1992, p.4).
- Reduced ability to provide interactive cost advice during design (1992, p.4).
- Reduced ability to provide post-contract cost control (1992, p.5).
- Loss of expertise (1992, p.6).
- Decline in relevance of the Standard Method – specialist contractors tending to use methods more akin to their manufacturing or material costs rather than installed work (1992, p.7).
- Reduced ability to undertake and negotiate other forms of tender not based on bills (1992, p.7).
- Reduced contribution to value engineering (1992, p.8)
- Difficulty in convincing the client of value for money (1992, p.8).

Coffey noted the inextricable link between detailed measurement, detailed cost data and accurate cost advice. This viewpoint is further supported by the QS2000 report commissioned by the RICS:-

> "The advantages of the quantity surveyor are built on a technical base of measurement and quantification...........with the decline in quantification comes, perhaps, a decline in the distinctiveness of quantity surveyors professional competence" QS2000 (1991).

As might be expected against this background of incomplete design information and low skill base, the quality of bills has suffered. The RICS Building Services Procurement Guide illustrates this point:-

> "Bills of quantities...........may not reflect how the work is priced – involving additional work for the contractor." (RICS, 2000 c, p.23)

> "It should be considered whether the building services contractor actually benefits from the production of bills." (RICS, 2000 c, p.37)

Perhaps of more concern are views expressed within the HVCA Estimating Guide only two years after the publication of SMM7. Despite being represented during the development of SMM7 (RICS, 1982, p.28) comments within the guide are critical of its effectiveness as a pricing document. The Guide devotes a chapter to bills of quantities but states that this does not imply that bills are the best method of estimating for heating and ventilating work, stating "usually they are not." (HVCA, 1990, p.64). Further:

> "It is a pity that bills have been claimed as the all-embracing answer, when they are patently nothing of the kind." (HVCA, 1990, p.66)

The Guide also cites cases where simplifications in the Standard Method actually make estimating more difficult (e.g. 'extra over' for pipework - HVCA, 1990, p.64) and "significant differences between his quantities (produced by the contractor for ordering) and those in the bills (produced by the client-side)." (HVCA, 1990, p.65)

Moreover, concerns about SMM7 have been consistently raised by the specialist sector:-

> "SMM7 complications (with regard to building services work) will, perhaps unjustly, do quantity surveyors no good at all." (Trounce, 1982, p.45)
>
> "Are the Development Unit taking into account changing practice – the role of specialist contractors?" (Rimmer, 1982, p.25).
>
> "There is a danger of bills becoming too much of a straight-jacket, inhibiting change and methods of building procurement and, in particular, in making use of the contractors' expertise in design development" (Sims, 1984 a, p.18).
>
> "Does SMM7 go far enough to re-establish the bill as the cornerstone of the profession (for specialist trades) – we think not. What is the point in developing a perfect Standard Method of Measurement if the bill of quantities is dying?" (Bucknall Austin, 1988, p.30).
>
> "Does the services industry require a Standard Method of Measurement for tendering purposes......in my view, the answer must be no......all the contractor needs to arrive at a competitive price is a set of drawings, a performance

> specification and an outline programme............he can add value by........measuring his own cost sensitive areas, adopting his own areas of competitive advantage, take short cuts on his own criteria and go straight to his own pricing conventions" (Ardley, 1994, p.61)

Ardley further states:-

> "Do bills give value for money?.......again, in my view the answer is no......bills produced using SMMs and prescriptive specifications have no value in today's specialist industry." (Ardley, 1994, p.61 & p.63)

Ultimately, such problems in the effectiveness of pricing documents surface in the form of contractual disputes. Davies (1992, p.59-61), representing the Federation of Associations of Specialists & Subcontractors (FASS), describes how, over time, knowledge has migrated from the client-side to the contracting-side of the industry. According to Davies, specialist contractors are increasingly taking on additional design responsibilities due to ever increasing complexities in building services. Davies further argues that "*severe training shortfalls*" from both the architectural side and quantity surveying and poor design information have had an adverse knock-on effect on bill production. Contractors are then encouraged to submit prices knowing full well that the bill will probably not resemble the work they will actually do and, as a result, face financial problems post-tender. Dodd & Langford (1990, p.385) also state that ambiguity in these new roles can itself be a source of conflict.

2.2.3.1.3.6 Summary

'*Specialist*' work, in the context of this research, refers to mechanical and electrical trades.

Methods of procuring specialist work have changed considerably over time. Knowledge has shifted away from the client-side (client and client design team) of the industry towards the contracting-side and, with it there has been a fall in the adoption of the traditional procurement route and bills of quantities. A significant gap in knowledge is now observed to exist between the client-side and contracting-side of the industry (in relation to design and methods of construction).

Further, current advice on the procurement and management of specialist trades would appear to be at odds with the traditional procurement route and adoption of bills of quantities as an effective pricing document. The RICS Guidance Note on Building Services Procurement suggests that SMM7 should only be used when a fully co-ordinated design and specification has been prepared – which it states, in reality, is very rare (RICS, 2000 c, p. 36 & 37). The Guide also recommends that the traditional method is usually most appropriate when the project is small and the building elements are not complex (RICS, 2000 c, p.25). In all other cases the Procurement Guide recommends the use of a pricing schedule instead of a bill of quantities and questions, in principal, how appropriate the bill is to the needs of the estimator (RICS, 2000 c, p.23 & 37). It further suggests that the contractor should have the opportunity to price alternatives (RICS, 2000 c, p. 13, 24 & 37). No such advice is evident within SMM7. The Guide, although non-mandatory, carries considerable weight as it states that it represents good practice and is likely to be used as a reference document to investigate allegations of negligence against the conduct of quantity surveyors (RICS, 2000 c, p.4). In support of this, Latham also favours a change in the traditional approach for these trades (Latham, 1994, p.28).

The views of the contractors themselves are of fundamental importance in any such review. Both the HVCA and ECA, representing the specialist contractors, were involved in the development of the Standard Method (RICS, 1982, p.28). However, their later views expressed in the HVCA Guide (1990, p. 64 & 66) and via the Latham Report (both representatives of the Specialist Engineering Contractor's Group - SEGC) are seen to question the usefulness of SMM7 as a method of preparing an effective pricing document (Latham, 1994, p. 115).

With diminished expertise to provide a detailed design for specialist work (and the benefits to do so), the client-side typically provides incomplete design information at the tender stage. This, coupled with a general shortfall in knowledge by the quantity surveyor, has reduced the adoption of SMM7. The extent of use of bills is unclear within the literature. However, reference to the provision of bills as "services not always required" within guidance on appointing a quantity surveyor (RICS, 1999, p.29) would suggest that their production is an exception rather than the norm.

It is also unclear which came first, whether the inability to provide effective pricing documentation led to the specialist becoming more involved in the design process or their increased involvement in design had a detrimental effect of the ability to prepare effective documentation. Irrespective of the root cause, the inability of the typical quantity surveyor to adequately measure specialist work causes concern in practice (Coffey, 1992, p.4). The skill of measurement is widely regarded as the foundation to successful financial management (McDonagh, 1992, p.3) – particularly important to an element of construction that can represent as much as 50% of total construction cost (Bennett, 1988, p.68). Concern about the quality of bills further questions their worth in the current market (Rabbets, 1992, p.18).

Overall, it would appear that the effectiveness of the Standard Method as a pricing document is questionable for specialist trades:-

- Bills do not appear to be widely adopted in practice and, when they are;
- It is unclear whether bills are actually used by these trades to generate a price.
- Current practice dictates that the design is not usually complete.

- The above factor makes it impossible for the quantity surveyor to measure the work (even if the requisite skills are possessed).

2.2.3.2 Changes in technology

Changes in technology may be viewed from two perspectives, firstly in terms of information technology and, secondly; building technology and prefabrication.

Significant advancements in computer technology have occurred since the Standard Method's first publication in 1922. Even within the life of SMM7, such potential for growth did not go unnoticed by the SMMDU:-

> "........within the life of SMM7, computer technology may transform bill production......paper bills may be replaced by a magnetic disc or tape that contractors would price directly." (RICS, 1982, p.3)

Development work has been focussed on two main areas: firstly, the automatic production of bills from drawn information and, secondly, estimating packages for contractors.

The former, the automatic transformation of drawn information into quantified work, has remained somewhat experimental (Selinger & Stamler, 1983, p.86 & 87; Kelly, 1991, p. 27).

In contrast, the use of computerised bills has developed considerably on the contracting side – particularly for main contractors where a number of computer packages are now available (Sullivan, 1997, p.54). Once the work is estimated these software packages allow a number of reports to be generated that are seen to encompass many of the ideas put forward by Pasquire (1991, p.219) e.g. split by resources, buying schedules and clarification of assumptions made. Furthermore, dimensions can be inserted (with annotations) and automatically calculated. Descriptions are then built-up by drawing down standard descriptions from a library (also containing the estimators' constants and norms). However, the bills have to be generated by each contractor for their own software package. This is particularly wasteful when, despite being produced by the client, the bills have to be re-inputted by the contractor. Recent developments have attempted to alleviate this problem by sending the client-produced bill electronically (Cole, 1998, p.13 & Coomber, 1989, p.71).

Despite the developments made in bill production it is recognised that measurement will remain necessary for the valuation of work at the post-tender stage (Davis, 1994, p.8). The fact that significant post-tender changes are usually encountered (Bennett, 1983, p.84 & Rimmer, 1982, p.24) and that the automatic production of bills from drawn information is not yet available (Selinger, 1983, p.75 & Kelly, 1991, p.27) means that the incidence of post-tender measurement will remain for the foreseeable future.

Finally, it is worth noting that significant changes in building technology and the level of prefabrication have occurred within the construction industry during the last twenty years (Gibb, 2001, p.308 & Egan, 1998, p.22 & 30). The extent of prefabrication and product development has also been largely responsible for the split in role of the specialist and non-specialist contractor (as defined by this research, p.72) and affected trends in their procurement. The increased level of prefabrication and specialist solutions has increased the extent of design and specification typically undertaken by the specialist contractor (Gibb, 2001, p.308). This in turn has encouraged the client to appoint specialist contractors earlier within the design process and take advantage of this shift in knowledge towards the contracting side of the industry (Davis, Langdon & Everest, 2002, p.67). In contrast, non-specialist trades have remained relatively unaffected by this trend and so too have their practices of procurement and specification.

As a consequence, the ability of the quantity surveyor to accurately describe and quantify specialist work has also diminished and pricing information now more usually stipulates the employers' performance requirements rather than detailed quantities (Swaffield & Pasquire, 1995, p.8; Latham, 1994, p.24 and RICS, 2000c, p.37). In contrast, the non-specialist work has remained virtually unaltered and quantity surveying profession still possesses the skills to readily quantify this work.

2.2.3.3 Current pressures surrounding the industry

Background pressures surrounding the building industry have influenced many of the aforementioned changes to traditional practice. It is not the intention of the literature review to cover these in detail but it is worth noting some of the major influences.

The advent of fee competition (Eccles, 1992, p.1; McDonagh, 1992, p.4 & Emmett, 1990, p.24), increased adoption of new methods of procurement (Eccles, 1992, p.1 & Emmet, 1990, p.24) and market forces (Eccles, 1992, p.1) have all played their part.

More recently, both Government and industry have carried out extensive reviews (Latham, 1994, Foreword). Latham (1994) and Egan (1998) suggested a number of ways to improve quality and efficiency within construction. Both have challenged existing practice and recognised the need for extensive change if the industry's aspirations are to be met.

Current thinking is directed at improving efficiency - referred to by Egan as *lean* production (Jones, 1998, p.20). Both Latham (1994, p.23) and Egan (1998, p.22 & 30) have recognised that, of fundamental importance in achieving this, is the integration of expertise at the design stage – when the project is formulated. As previously cited within the literature review this means a change in the traditional procurement approach and diminished use of bills of quantities – particularly for the specialist trades.

As a result of the above the quantity surveying profession has come under increasing pressure to take a wider view of the industry and the range of services if offers:-

> "During the last 15 years QS development has spanned an era of tremendous economic, political and technical change" (Symonds, 1995, p.17).
>
> "Does what has emerged (referring to SMM7) fulfil the requirements of the industry for the late 1980's and beyond.......I have serious doubts." (Ashworth, 1988, p.23)

> "QSs need to take a wider view" (Davis, 1994, p.7).
>
> "The QS profession is changing rapidly, becoming more consultancy based rather than technical." (Davis, 1994, p.9)

This trend was also recognised by Michael Rainbird (the 1992 Quantity Surveying Divisional President):-

> "We are.......moving away from measuring bills of quantity.....We need to give advice to clients.......in the broadest sense." (Bill, 1992, p.14).

2.2.4 Summary of findings from the literature review

2.2.4.1 Introduction

The literature review has so far provided a chronological appraisal categorised into three main areas:-

- Historical developments (section 2.2.1, p.23-30).
- Developments in pricing documentation from the early 20th Century to the present day (section 2.2.2, p.31-65).
- Changes to the background of the building industry (section 2.2.3, p.66-91).

The developments in pricing documentation (section 2.2.2) are seen to interrelate with one another in a relatively complex manner. In order to gain an appreciation of this a tabulated summary has been compiled (table 2.7, p.101). This table helps to conceptualise the main direction of each research activity.

In this, the summary of the literature review, efforts to improve the effectiveness of documentation are disseminated into the following areas:-

1. Historical developments.
2. Proposals to improve the effectiveness of documentation at the post-tender stage.
3. Proposals to improve the effectiveness of documentation at the tender stage.
4. Changes to the background of the building industry.

2.2.4.2 Historical developments

The practices of the middle-ages remained virtually unaltered up until the early 17th Century. Resources were employed and paid for directly by the client on a trade-by-trade basis.

Although the precise date is not determined within the literature it is probable that the Great Fire of London in 1666 changed the way in which the work was paid (Thompson, 1968, p.66). The client began to pay for the quantity of work completed based on pre-agreed rates but still continued to procure each trade separately. It was also the norm at this time to employ two sets of measurers per trade – one acting on behalf of the client and the other for the trade contractor. The wealth of literature on the subject pays credence to the relative importance of measurement.

As only the elite of the early 18th Century architects could find enough work to fund their highly fashionable profession many turned to the skill of measurement and became eminent architect-measurers. Competency and professionalism became increasingly important and were demonstrated by the need to belong to a Guild (relevant to each particular trade). Between 1770 and 1850 the specialisation of these measurers grew and progressed towards the measurement of buildings before they were constructed. This was most apparent within the larger cities, such as London, where much of the work was taking place.

The mid-eighteenth century saw a fundamental change in the way that buildings were procured - from a trade-by-trade basis to '*contracting in gross*' where the client employed a single contractor responsible for managing the entire works. This enabled the quantity surveyor to emerge as overall financial manager of the building process and act on behalf of both the client and contractor.

The two groups of surveyors in existence at this time, the Surveyors Institution and Quantity Surveyors Association recognised the importance of a *Standard* Method of

Measurement and the need to spread best practice. In 1912, a Joint Committee was established.

By the time of the publication of the first Standard Method of Measurement in 1922 the quantity surveyor had emerged from their trade and architect-measurer routes to overall financial managers of the construction process. Their measurement skills were grounded in detailed knowledge of individual trades that enabled them to progress from after-measurement to estimating the works prior to construction. The quantity surveyor had emerged as an impartial link between the client and contractor (Symonds, 1995, p.15).

2.2.4.3 Proposals to improve the effectiveness of documentation at the tender stage

Subsequent changes to the Standard Method of Measurement were made under the direction of the Standing Joint Committee. Between the years of 1922 and 1988 seven Standard Methods have been published within the UK building industry. Although the names of the parties involved have changed over time, each Standard Method has been produced with representation from both sides of the industry - quantity surveyors and building contractors. In the final edition these were represented by the RICS and BEC.

Revisions one to five were published in imperial and edition five reissued in 1968 as a conversion to metric. Revisions one to four dealt with measurement on a trade-by-trade basis with versions five and six simplified to reflect progress made with common measurement rules between each trade. Further developments in these generic rules enabled a Common Arrangement of Work Sections to be developed for SMM7 and the prose format to be published in tabular format. The seventh edition also embodied Co-ordinated Project Information conventions to allow commonality between drawings and specifications.

The adoption of the Standard Method is primarily aimed at the traditional method of procurement and relies on the design being substantially complete (Morledge & Sharif, 1995, p.41).

> "Bills of quantities shall fully describe and accurately represent the quantity and quality of the works to be carried out." (General Rule 1.1; RICS, 1988, p.11)

The Standard Method, based on limited field trials (Willis, 1988 a, p.26), was carried out over seventeen years ago (predominantly between 1982-84). Despite significant changes and problems encountered in practice, no review of its effectiveness is proposed. However, views from the industry would suggest the need to do so (Willis, 1988 a, p.28; Barnes, 1988, p.33; Powell, 1998, p.60; Wade, 1992, p.5; Rainbird, 1992, p.14).

These views are reinforced by criticisms of the Standard Method that are seen to fall into two categories – firstly, in principal and, secondly, in practice. In principal, the appropriateness of SMM7 would appear to be questionable for some trades (Swaffield, 1994 c, p.21). Specialist contractors have consistently raised concerns both during its development (Trounce, 1982, p.45; Rimmer, 1984, p.24; Sims, 1984 a, p.18) and since publication (Latham, 1994, p.28; HVCA, 1990, p.64 & 66). This suggests that the Standard Method may not be the most effective method of procuring prices for some trades. Secondly, in practice, a level of abuse is apparent but not clearly evaluated within the literature (Rabbets, 1992, p.18 & 22; Emmett, 1990, p.24). The value of work actually measured is also unclear as some trades appear to be frequently measured and others not.

In addition to revisions made under the direction of the Standing Joint Committee a number of proposals have been generated by the industry (table 7, p.101). Proposals for Elemental Bills (early 1950s), Sectionalised Trade Bills (early 1960s), Operational Bills (early 1960s), the BPF Schedule of Activities (1983), Pasquire's Builder's Quantities (1991) and Measurement Rules for Contractors Quantities (1996) all challenged the existence of the Standard Method. However, neither the BPF system nor Operational Bills were successfully implemented (Kodikara, 1990, p.20; Carr, 1965, p.550). Only

Pasquire's suggestions are found to be reflective of current practice - detailing resource splits, buying units and material schedules. However, these are only relevant for internal use by small/ medium main contractors.

Reference to table 7.1 (p.101) reveals that proposals to improve the effectiveness of tender documents have mainly emerged from the *client-side* of the industry i.e. the proposal has either been instigated by the *client-side* and/ or largely represents the client's perceptions of what improvements are required. Conversely there has been a dearth of proposals emerging from the *contracting-side* (only five out of a total of seventeen as tabulated – less than a third). This is quite surprising given that the end users of the information are contractor's estimators.

Comparatively few proposals (when compared to those at the post-tender stage) have challenged the Standard Method. However, the literature reveals a level of discontent within the industry – particularly for *specialist* trades. It is unclear from the literature to what extent this dissatisfaction relates to bills being inappropriate in principal, to poor practice or a mixture of both.

2.2.4.4 Proposals to improve the effectiveness of documentation at the post-tender stage

The literature has predominantly focussed on attempts to improve the post-tender use of bills – Elemental Bills (early 1950s), Sectionalised Trade Bills (early 1960s), Operational Bills (early 1960s), Banwell (1964), Higgins & Jessop (1965), Potts (1967), Operational Format – Activity Bills (1968), Nelson (1970), Skinner (1979), BPF Schedule of Activities (1983), Estimating Practices Committee (1983), Pasquire (1991), Kodikara (1990) and Measurement Rules for Contractors Quantities (1996).

These proposals have either recognised the potential or suggested ways to prolong the useful life of the bill post-tender. Most have exclusively focused on the internal needs of the main contractor.

Both the Elemental Bills (early 1950s) and Sectionalised Trade Bills (early 1950s) were not widely accepted by the industry and, for similar reasons, the Operational Format – Activity Bills (1968) met with a similar fate. Changes to standard phraseology (Fletcher & Moore, 1965) and CPI conventions were, however, successfully incorporated in procedural advice.

The suggestions by Kodikara (1990) and Pasquire (1991) are reflective of the way that main contractors internally manage their data and are evident within many of today's estimating software packages (Sullivan, 1997, p.54).

Reference to table 2.7 (p.101) reveals that the majority of *contractor-led* proposals have suggested presenting the measured work as separate resources – Operational Bill (Early 1960s), Banwell (1964), Skinner (1979), Pasquire (1991) and Kodikara (1990). Conversely, the *client-led* proposals have tended to suggest presenting the measured work as nett quantities of finished work – Elemental Bills (early 1950s), Sectionalised Trade Bills (early 1950s), Ferry & Holes (1964), Operational Format Activity Bills (1968) and Measurement Rules for Contractor's Quantities (1996).

However, suggestions to improve the post-tender use are limited by two factors. Firstly, there is the extent of change to the design during the post-tender stage (SMMDU, 1978, p.10; Bennett, 1983, p.84 & Rimmer, 1982, p.24). In practice, the tender information therefore becomes outdated. Secondly, according to Skitmore & Wilcock (1994, p.139), the proposals are further limited by estimating practice. They suggest that as much of the work (approximately 50%) is estimated on 'gut feeling' (rather than detailed calculation); the requisite detail required by these proposals would not be recorded.

2.2.4.5 Changes to the background of the building industry

The backdrop of the building industry has changed significantly within the last twenty years, both in terms of its structure and how the work is managed.

At the macro level, the volume of work now subcontracted by the main contractor has increased significantly (Skinner, 1979, p.29; 214; Pasquire, 1991, p.216; RICS, 2000 c, p.6; Shash, 1993, p.113). As a result, risk apportionment between the parties has altered and affected pricing practice - particularly for the main contractor (Abdel-Razeck & McCaffer, 1987, p.231). The main contractor now subcontracts high proportions of work that would have traditionally been kept in-house. These subcontracted trades were also found to be consistent in practice (Skinner, 1979, p.9; Pasquire, 1991, p.221).

The methods of procurement adopted have changed considerably. Traditional methods of procurement have fallen at the expense of fast-track methods with contractors increasingly embracing the design function. The RICS reported a halving in the value of bills of quantities used from 58.7% in 1984 to 28.4% in 1998 (RICS, 2000 b, p.5). It is suggested that these factors alter the effectiveness of existing pricing documentation.

Significant changes are also evident at the micro level in terms of how work is procured from *trades*. In particular, '*specialist*' trades (as defined) have changed their role within the industry. Technological advances, an increase in value of their work relative to total construction cost and recognition of their skills in design development have resulted in changes in the way that their work is procured and managed. The design is now usually undertaken entirely by the specialist trades or as a minimum – completed by them from a conceptual design. As a result, the effectiveness of the Standard Method as a method of preparing pricing documentation for these trades is questionable. The quantity surveyor is unable to prepare a bill from an incomplete design and, in practice, rarely possesses the requisite skill to do so. Current advice on the management of specialist trades is also seen to contradict the traditional approach and the application of detailed measurement rules (RICS, 2000 c, p.24, 37 & 18, Latham, 1994, p.23 & Egan, 1998, p.30).

Against a background of reduced adoption of the traditional procurement route, fall in use of bills of quantities and increasing level of design undertaken by the contractor, the effectiveness of traditional pricing documentation is questionable. Further questions therefore arise regarding, based on current practice, how effective pricing documentation should now be prepared.

2.2.4.6 Summary

The skills of the quantity surveyor were traditionally based on detailed knowledge of the practices of trade contractors (Symonds, 1995, p.20) and established methods of preparing pricing documentation based on the traditional procurement route.

Changes in the management of certain trades and shift away from traditional procurement methods have reduced the amount of measurement undertaken by the client's quantity surveyor. Bills of quantities now represent less than a third of current practice and their appropriateness in principal would appear to be in doubt for some trades. Furthermore, the actual extent and quality of work measured within bills is questionable.

The following bullet-points conclude the main findings of the literature review:-

- Bills of quantities, using the Standard Method of Measurement, are the traditional method of preparing pricing documentation within the UK.
- Changes in practice mean that bills are now produced in less than one-third of cases (by value).
- The quality and value of work measured in bills is questionable.
- Their appropriateness to certain trades would also appear to be in doubt in principal.
- Changes in management practice have reduced their relevance.
- The main contractor now subcontracts the majority of work.
- In practice, the method of procuring *specialist* work (as defined) rarely allows bills of quantities to be produced.

- The use of bills for *specialist* trades would not appear to be advantageous.
- Proposals have focused on attempting to prolong the post-tender life of bills.
- Attempts to prolong the post-tender use of bills have only taken into account the internal needs of the main contractor.
- Proposals to prolong the life of the bill post-tender are limited by estimating practice and the extent of post-tender change.
- Proposals have been predominantly '*client-led*'; only the more recent work has taken into account the needs of the *contracting-side* of the industry.
- The quantity surveying profession has come under increasing pressure to provide a wider range of services to the client and move away from traditional services such as bill production.
- The literature has failed to establish the appropriateness of bills to current practice.
- The needs of the subcontractor, now of significant importance, have been overlooked.
- The literature has also failed to understand the flow of data between contracting companies and instead focused on the internal transfer of data within main contracting organisations.
- Alternative methods of preparing effective pricing documentation have not been explored.

Table 2.7 serves to illustrate these points (p.101).

Table 2.7: Summary of previous research by category (excluding revisions of the Standard Method of Measurement)

Proposal	Element-al Bills	Sectionalis-ed Trade Bills	Operational Bills	Banwell	Ferry & Holes	Higgins & Jessop	Fletcher & Moore	Potts Report	Operational Format – Activity Bills	Nelson	Skinner	BPF System – Schedule of Activities	Estimating Practices Committee (EPC) of the CIOB	Pasquire	Kodikara	Measurement research – NTU	Measurement Rules for Contractor's Quantities
Date	Early 1950s	Early 1960s	Early 1960s	1964	1964	1965	1965	1967	1968	1970	1979	1983	1983	1991	1990	1992	1996
Proposed changes to the Standard Method of Measurement.			✔									✔		✔			✔
Proposed changes to the format of Bill of Quantities.	✔	✔	✔			✔			✔			✔		✔	✔		✔
Recognised room for improvement at the post-tender stage.	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔		✔
Recognised room for improvement at the tender stage.	✔	✔									✔	✔				✔	✔
Client-led proposal.	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔					✔
Contractor-led proposal.											✔		✔	✔	✔	✔	
Proposals attempted to take account of the Main Contractor's needs.											✔	✔	✔	✔	✔		✔
Proposal attempted to take account of the subcontractor's needs.											*1			*1		✔ *2	
View that measured work should be presented as nett quantities of finished work.	✔	✔			✔				✔								✔
View that measured work should be presented as separate resources			✔	✔							✔			✔	✔		
Suggested an improved way forward.	✔	✔	✔			✔						✔		✔	✔		✔

Footnote: *1 - Both recommended the need for further research to address the needs of subcontractors.
*2 – Based on 24 interviews.
☐ – Denotes major 'gaps' in previous research efforts.

2.3 Research problem

2.3.1 Introduction

This section of the literature review aims to expose a specific research problem left unexplored by previous efforts.

Gaps within previous achievements are detailed and their relative significance identified. An overall statement defining the research problem is developed which is underpinned by a number of bullet-point research questions (section 2.6, p.109).

2.3.2 Gaps in previous research

A review of previous research has been provided in section 2.2.4 (p.92) of the literature review.

Previous research has predominantly focussed on two main areas:-

1. Attempts to prolong the useful life of the bill at the post-tender stage of the construction process for the main contractor.

2. Revisions to the Standard Method based on the traditional procurement route.

As a result of changes in the management and structure of the industry, the use of established methods of preparing tender documentation has fallen significantly (RICS, 2000 b, p.5). A significant gap exists within the literature in terms of understanding the consequential effect on the end users of the pricing documentation (contractors' estimators) and the effectiveness of the documentation itself. Reference to table 2.7 (p.101) reinforces this point illustrating the lack of research directed at attempting to understand the needs of contractors' estimators at the tender stage – contractors' estimators being the primary users of the documentation.

Although the trend for the client-side to carry out measurement has reduced over time (RICS, 2000 b, p.5; Pasquire, 1992, p.11) it is argued that the burden of measurement has remained constant (Birchal, & Coffey, 1994, p.36; Eccles, 1992, p.7). According to Pasquire (1990, p.11) & Kodikara (1991, p.2) contractors still require quantified information whilst others would appear to find this problematic (SMMDU, 1978, p.28; HVCA, 1990, p.66; Davies, 1992, p.61; Ardley, 1992; RICS, 2000 c, p.37; Swaffield, 1994 c, p.22). By understanding the pricing process including who carries out the measurement, when, who retains the risk and what problems are experienced, this gap in the research may be addressed.

Table 2.7 (p.101) illustrates, in particular, that the needs of subcontractors have been overlooked. The failure of previous research to identify the needs of subcontractors is recognised as being a significant gap (Skinner, 1979, p.214; Pasquire, 1991, p.221). This is further exacerbated by current practice as the majority of the work is now consistently subcontracted (Skinner, 1979, p.9; Pasquire, 1991, p.221; Kodikara, 1990, p.94; Abdel-Razeck, & McCaffer, 1987, p.231).

Previous research has also failed to evaluate the overall condition of bills that are produced in practice. A more detailed analysis is required to determine the actual percentage, type of work typically measured in bills and their quality. The literature cites a number of isolated reports of abuse in practice (Rabbets, 1992, p.18 & 22 and Emmett, 1990, p.24) but gives no indication as to the extent of this abuse, what form this abuse takes or whether this may be grouped into various categories. This is important to determine in order to evaluate the benefits of any proposed improvements and understand the root cause of problems.

A further gap in previous research is seen as the lack of understanding of types of work *received* by contractors' estimators. A limited survey of types of work *let* by quantity surveyors fails to reveal the true workload of the contractor's estimator and thus appropriately judge the true worth of any proposals and effectiveness of current practice.

Furthermore, previous research has failed to gain sufficient understanding of the pricing process as a whole. At the micro level, Pasquire (1991, p.86) identified, by management task, which aspects of the documentation were critical for departments within the same contracting firm and therefore needed to be measured for them. No such exercise has been undertaken at the macro level to determine the current needs of main contractors and subcontractors throughout the pricing chain. This is expected to be a relatively complex chain of events, one that carries substantial risk (to the entire pricing chain) and could potentially change with background circumstances e.g. procurement method and type of contractor. A number of questions arise:-

- How are prices compiled in practice?
- Who takes the risk of the quantities being correct?
- How do subcontractors respond if they receive a number differing pricing documents from main contractors on the same project (Shakeshaft, 1994, p.46)?
- Do all subcontractors demand pricing information?
- What happens if pricing documentation is not supplied by the main contractor?
- Are there differences between trades?
- If there are differences between trades, what are the underlying reasons for this?
- Do *specialist* contractors (as defined) have any unique demands due to their position within the industry?
- Based on this knowledge, could the effectiveness of client prepared pricing documentation be improved?

For example, it may be established that main contractors need to quantify some trades in order to obtain prices from subcontractors. As a result, it may prove beneficial if the client carried out this measurement function in order to avoid duplication of effort – a return to the *traditional* method.

Overall, bills are used less frequently in practice, their quality is unknown and their appropriateness would appear to be questionable for some trades (Swaffield, 1994 c, p.22). The literature has failed to gain an understanding of how prices are currently procured within the industry – the processes involved, problems encountered and thus how they may be improved. The literature does not identify the underlying cause of isolated problems that are identified.

2.3.7 The research problem

In summary, problems are believed to exist during the process of tendering competitively let construction projects.

By understanding the processes and problems encountered during tendering, changes in the format of the pricing documentation may be proposed that will improve the accuracy of the pricing process and reduce the level of risk to which the contractor is exposed.

The overall problem that the research attempts to address is thus:-

> **How the effectiveness of documents used in competitive construction pricing can be improved for the contractors' estimator.**

The adoption of a *general* research problem is endorsed by Fellow & Liu (1997, p.98).

Finally, it would appear from the literature review that both the role of the quantity surveyor and the measurement debate has come full circle. It would appear that some contractors still require quantities to be produced by a single source – a task traditionally undertaken by the quantity surveyor. The industry is therefore in a similar predicament to that of the early eighteenth century at the time when the quantity surveyor first emerged.

2.4 Boundaries of the research problem

This section considers the explicit boundaries of the research project (Perry, 1995, p.15). The results of this research relate specifically to the:-

1. United Kingdom.
2. Building industry (as opposed to Civil Engineering or Heavy Engineering).
3. Tender stage of the construction process.
4. Contractor's viewpoint (as opposed to the views of the client or quantity surveyor).
5. The view of the representative bodies selected as samples of the above (i.e. the HVCA, ECA and NFB).

Further delimitations, in terms of sample size and questionnaire response rates, are addressed within the appropriate sections of the methodology chapter.

2.5 Parts of research problem studied previously

Very little of the previous research has attempted to improve the effectiveness of tendering documentation (table 2.7, p.101).

The Elemental Bills (early 1950s), Sectionalised Trade Bills (early 1960s), the BPF Schedule of Activities (1983) and Measurement Rules for Contractors Quantities (1996) were all based on the client's perception of how pricing information could be improved on behalf of the contractor. None of the proposals were based on detailed analysis of the contractor's needs and thus failed to gain widespread acceptance in practice (Skinner, 1979, p.11).

Skinner (1979, p.42) did however base his research findings on interviews with contractors' personnel. Despite recognising the potential to improve pricing documentation, Skinner did not recommend any proposals of how this could be achieved.

Work by the Standard Method of Measurement Development Unit (1971-88) and Swaffield (1994 c) are seen to most closely relate to the research problem, the former expending most effort in this direction.

The SMMDU based their SMM7 rules on the advice of a number of Advisory Panels. These were set-up to represent the interests of different trades within the industry. Despite direct liaison with the representative bodies the work is seen to have a number of limitations:-

- Their limited application in the current market due to a fall in adoption of the Standard Method.
- Reliance on the adoption of a traditional procurement route.
- Specialist contractors embracing the design function and thus reducing the appropriateness of the rules for these trades.

- Increased adoption of other methods of procurement (to which the measurement rules are not applicable).
- Changes in management practice.

Swaffield (1994 c, p.21) identified potential differences in trade practice between contractors. Although directly related to the research problem the findings were limited by the number of interviews conducted, were not tested and do not approach the problem in as much depth.

In summary, comparatively little of the previous research has addressed the identified research problem. The previous work has either been client-orientated, and therefore failed to be accepted by the contractors in practice, relevant to a limited set of criteria or based on limited research.

2.6 Research questions

A number of research questions are seen to underpin and more explicitly define the research problem (Section 2.3.7, p.105):-

1. What processes are commonly adopted in the preparation of pricing documentation?

2. How effective is current pricing documentation as indicated by those problems commonly encountered by constructors during the pricing of tender documentation?

3. What is the frequency and extent of each category of problem, its impact upon the relative accuracy of the pricing process and the extent of risk taken by the main contractor?

4. What is the impact upon the client of the exposure to risk of the constructor in terms of the current pricing documentation?

5. Can solutions be formulated to reduce the frequency and extent of the problems identified?

6. Can revisions to the processes commonly adopted in the preparation of pricing documentation be proposed and evaluated?

7. Can revisions to the pricing methods commonly adopted (in light of the above) be proposed and evaluated?

These form the objectives of the research project and, as they are listed in a chronological order, also form key milestones within the research programme.

2.7 Summary of findings

The overall aim of the literature review chapter is to critically appraise the existing literature and identify a gap in previous efforts that is worthy of investigation.

The introduction (section 2.1, p.19-22) provided a conceptual overview of the chapters contents and overall structure. A review of the literature was then provided in section 2.2 (p.23-101). This covered developments from the early 17th Century to the present day.

This was followed by a review of existing achievements which enabled the research problem to be defined (section, 2.3 p.102–105), to investigate:-

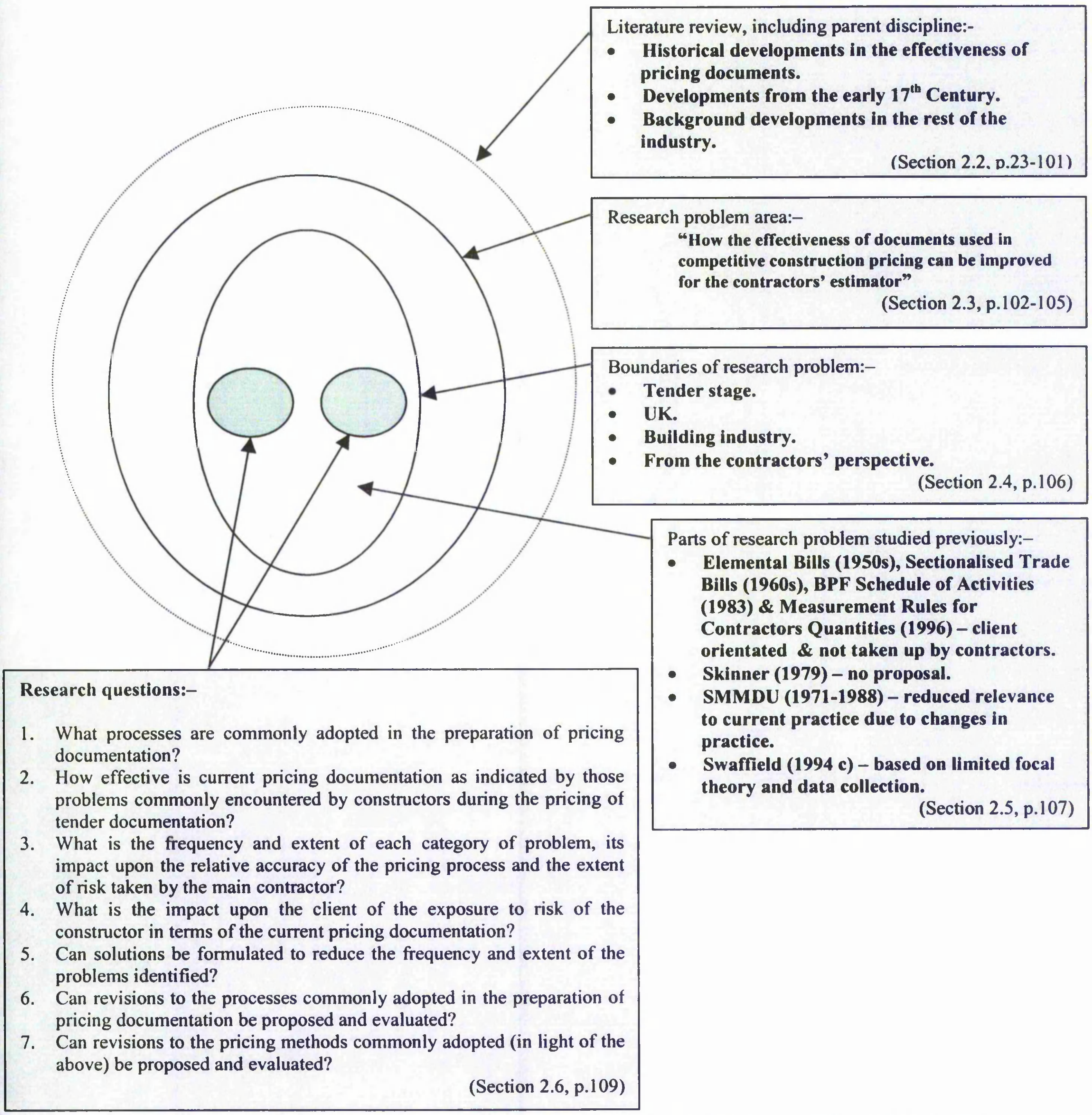
> **How the effectiveness of documents used in competitive construction pricing can be improved for the contractors' estimator.**

Based on the review of literature, problems are believed to exist during the process of tendering competitively let construction projects. A lack of understanding of current processes has been identified as a significant gap in previous research. It is proposed that, by identifying the processes and problems encountered, proposals may be generated to improve the format of pricing documents. These proposals should enable the accuracy of the pricing process to be improved and also to reduce the level of risk to which the contractor is exposed. It is also expected that perceptions of current practice within the literature will differ from what happens in reality.

The boundaries of the research are defined within section 2.4 (p.106) and parts of the research problem previously undertaken evaluated in section 2.5 (p.107). The individual research questions set the objectives of the project and, as they are in chronological order, also act as milestones to the overall programme (section 2.6, p.109).

Finally, the initial conceptual illustration (p.21) is repeated (figure 2.4, p.111) and relevant details populated. This serves to summarise the entire literature review chapter.

Figure 2.4: Relationship between the research problem and research questions



Source: Adapted from - Perry, C. (1995). "A structured approach to presenting PhD theses: notes for candidates and their supervisors." p. 17.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The purpose of this chapter is to explain the methodology adopted in seeking to achieve the aims and objectives of the research.

To recap, the research focuses on the UK building industry with the principal aim of:

1. Establishing the current effectiveness of pricing documentation from the perspective of the contractors' estimator – the end user of pricing information.
2. Proposing changes in the format of pricing documentation to improve its effectiveness to the contractors' estimator.

The research methodology aims to provide sufficient data to address the research problem and find which methods will generate data of sufficient quality and quantity to most appropriately test the thesis (Nachmias & Nachmias, 1992, p.14). The success of the methodology in achieving this provides the *standard of proof* of the overall outcome.

In essence, the methodology provides a record of the research techniques adopted, how they relate to the problem under investigation and rationale behind key decisions made (Perry, 1995, p.25)

3.1.1 Structure of the chapter

The structure of this chapter reflects the chronological order in which the research has been carried out.

The chapter explains the overall methodology adopted and how this enables the research problem to be addressed – illustrated in figure 3.1 (p.116). An explanation of the overall research programme is provided (figure 3.2, p.117) and, in more detail, the individual stages of the research plan that underpin this (table 3.1, p.118). Each of these stages are seen to employ a main research theme, namely:-

Stage 1 - Interviews,

Stage 2 - Industry survey (questionnaire survey 1), and;

Stage 3 - Empirical testing (questionnaire survey 2).

An explanation of the common objectives between these three stages illustrates how they are inter-linked (figure 3.3, p.119). It also demonstrates inherent triangulation within the methodology (Sapsford & Jupp, 1996, p.91; Fellows & Liu, 1997, p.95).

Having described the overall methodology, the justification of such an approach is provided on two fronts, firstly, in terms of meeting the desired methodological criteria for the given problem and, secondly; in the context of previous research (section 3.1.3, p.121).

The chapter is then subdivided into each of the three research stages. Detailed explanations of the key decisions made and their rationale are provided in each of these sections.

Consideration is also given to ethical issues before summarising the overall contents of the chapter.

3.1.2 Overview of the research methodology

3.1.2.1 Overall approach

The research focuses on an area of practice that remains largely unexplored by previous research – *whether the effectiveness of pricing documents adopted in competitive construction tendering can be improved for the contractors' estimator.* The research is initiated without any preconceived views on how the effectiveness of pricing documentation may be improved.

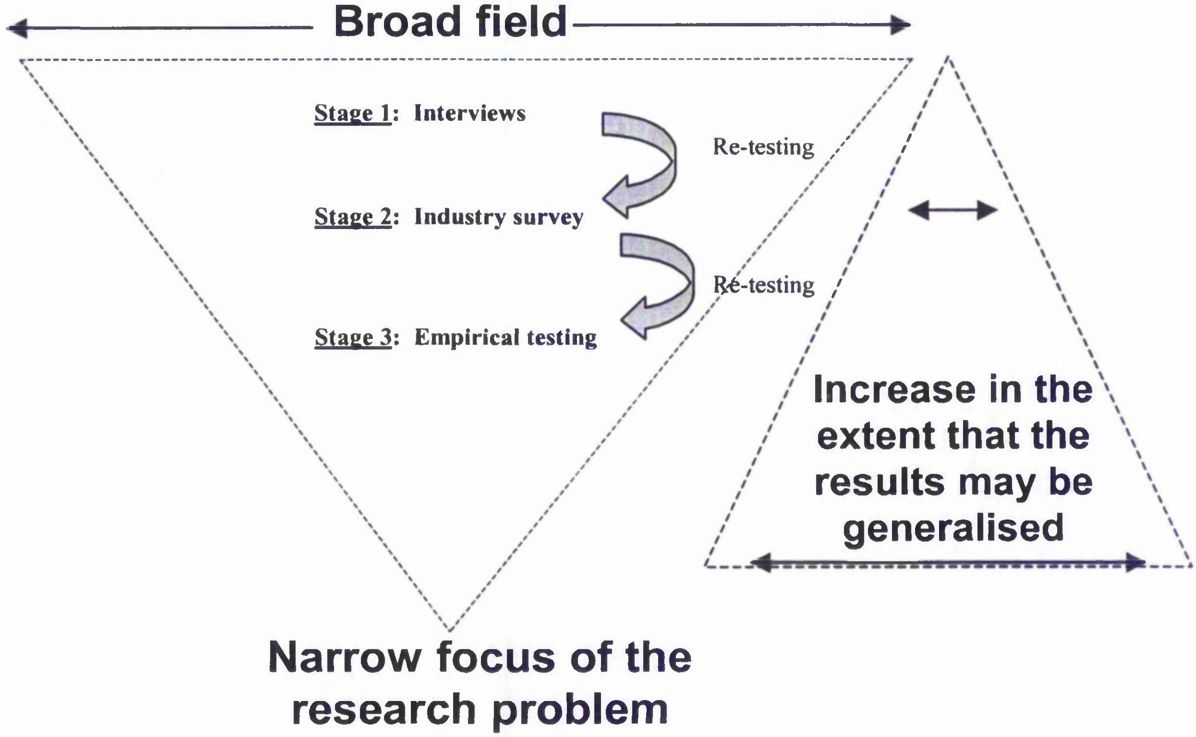
All that is understood at the initiation of the research programme is a general appreciation of the area under investigation and objectives that the research is required to achieve. Theory must therefore be developed on an empirical basis – from the process of carrying out the research itself.

The overall characteristics of the methodology are critical in achieving this aim, namely, a gradual testing of the results on more representative samples, re-testing of previous findings and inherent triangulation (Sarantakos, 1993, p.56). An in depth understanding of the research problem is initially obtained during the interview phase. These findings are then re-tested during subsequent stages in order to develop the theory gained and test the views on a more representative audience (Denzin & Lincoln, 1994, p.224).

> "....the nature of the subject to be researched....may not be possible to isolate to a particular defined topic to study....In such cases, the aims and objectives are likely to be framed loosely and be quite 'open-ended'....qualitative...methodologies get beneath the manifestations of problems and issues...and thereby...facilitate appreciation and understanding of basic causes and principles, notably, behaviours." (Fellows & Liu, 1997, p.79 & 80)

This iterative learning process, of discovering the underlying issues and re-testing, is continued until a robust understanding of the research problem is obtained. Once obtained, proposed solutions are then tested-out to establish whether they hold true. This gradual narrowing of the area under investigation is illustrated in figure 3.1 (p.116).

Figure 3.1: Overall narrowing of the research problem and commensurate increase in the extent to which the results can be generalised



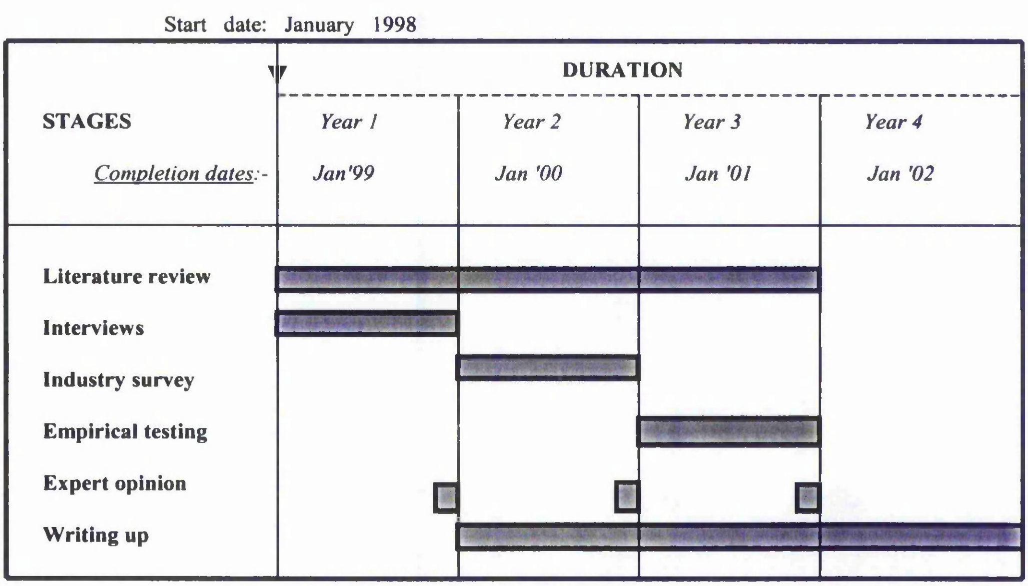
Source: (of left-hand illustration) Perry, C. 1995. A Structured approach to presenting PhD theses: Notes for candidates and their supervisors. p.10.

The right-hand-side of the illustration shows how, in parallel to a narrowing of the research problem (on the left-hand-side), the extent to which the results can be generalised gradually increases i.e. how widely the results may be applied (Concise Oxford Dictionary, p.564). The research instruments become progressively more structured as the focal theory is developed and as confidence is gained about the robustness of the findings. An in depth understanding of the research problem is initially obtained during the interview phase. These findings are then re-tested during subsequent stages in order to develop the theory gained and test the views on a more representative audience (Marshall & Rossman, 1995, p.144). These techniques progress from interviews, to semi-structured questionnaires and finally develop into structured questionnaires. The results are also tested out on increasingly wider and more representative audiences.

3.1.2.2 Programme

The research was carried out over a particular period of time during which current practice was established and examined. The programme was established at the commencement of the research project and is illustrated below. The overall programme was adhered to. However, in reality the research process was much more fluid than the programme would suggest and stages were seen to overlapped with one another - an experience also cited by Pasquire (1991, p.12 & 13).

Figure 3.2: Overall programme of work



3.1.2.3 Linked objectives between stages

A fundamental principle inherent within the design of this methodology is the extent of overlap between the objectives of each stage. This design feature enables the same data and theory to be tested-out using different methods of data collection and analysis. Table 3.1 demonstrates how the individual objectives of each stage interrelate with one another.

Table 3.1: Objectives of each stage with illustrated links

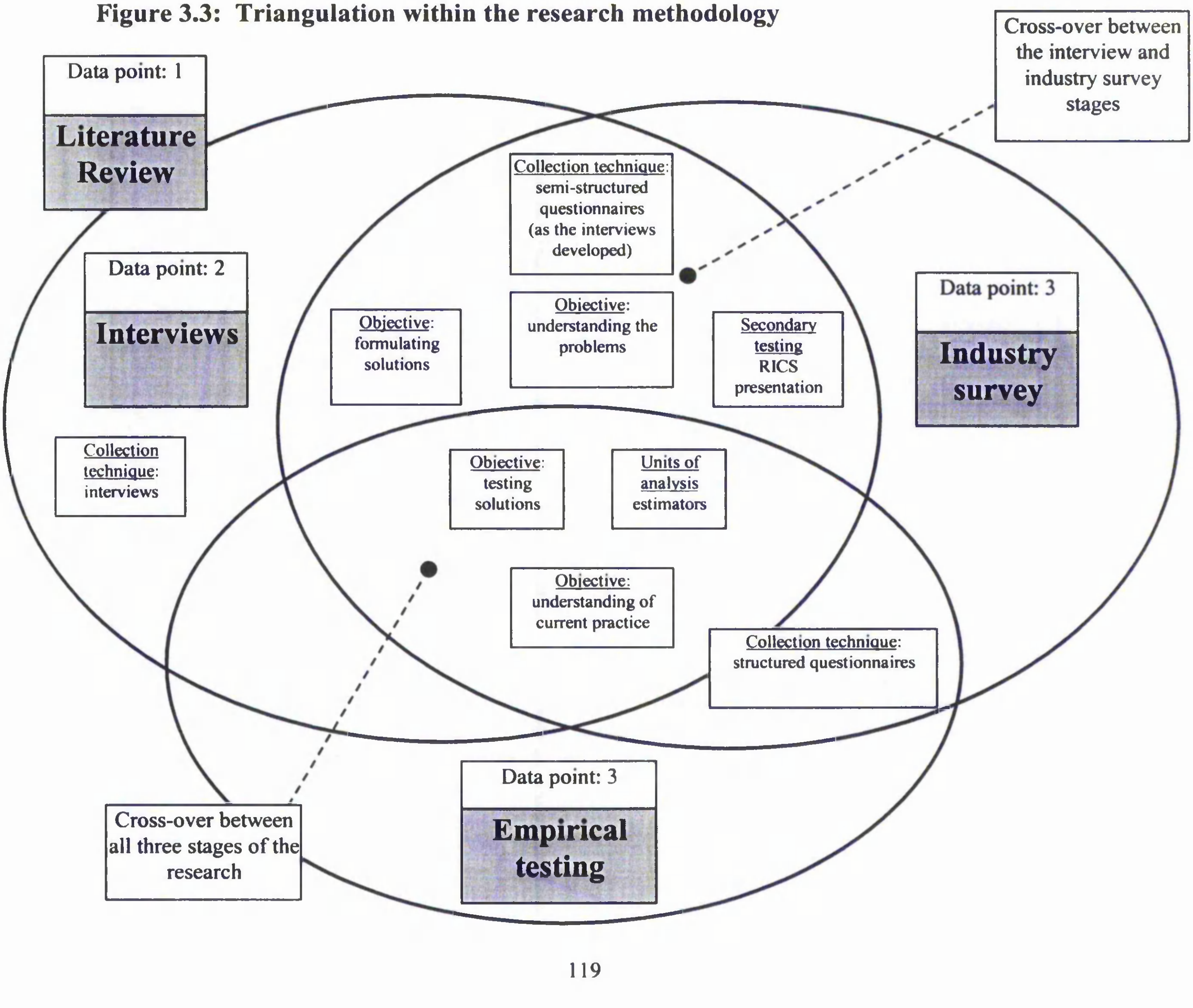
Ref	General Research Methods	Main theme/ objective of each stage*	Links	Sub-objectives of each stage**	Research techniques	Output(s)
1	**Interviews.**	Understanding the problems.		Understanding the problems. Formulating solutions. Testing solutions.	• Interviewing key participants from a cross-section of practice.	• Identify the processes commonly adopted in the preparation of pricing documentation. • Establish what problems are encountered and the effectiveness of current pricing documentation. • Establish the frequency and extent of each category of problem, its impact upon the relative accuracy of the pricing process and the extent of risk taken by the main contractor. • Identify the impact upon the client. • Develop tentative solutions to reduce the frequency and extent of the problems identified. • Suggest revisions to the processes commonly adopted. (i.e. research questions 1-7).
2	**Industry Survey.**	Formulating solutions.		Understanding the problems. Formulating solutions. Testing solutions.	• Collecting data via questionnaire surveys. • Presenting findings to expert panels.	• Quantify the qualitative findings from the above stage. • Refinement of the above theory. • Final production of proposals. (i.e. research questions 1-7).
3	**Empirical testing.**	Testing solutions.		Testing solutions.	• Re-testing formulated solutions from the above stage via questionnaire surveys.	• Validated proposals. (i.e. research question 7).

Each of the three stages contains an overall objective* as a theme; i.e.:-

	<u>**Stage**</u>		<u>**Overall objective**</u>
1.	Interviews	–	to gain an understanding of the problems.
2.	Industry survey	–	to formulate solutions.
3.	Empirical testing	–	to test the solutions.

Sub-objectives** are also seen to form a common thread between the main stages of the research, these are illustrated within the *'links'* column (table 3.1, p.118). In so doing, the data and theory are tested using different methods of data collection and analysis. Triangulation occurs when the same objectives are common to more than one stage - the same phenomena are therefore viewed from different perspectives (Miles & Huberman, 1994, p.435). For example, *'understanding the problems'* and *'formulating solutions'* appear in both the interview objectives and those of the industry survey. *'Testing solutions'* appears in all three. The results and theory emanating from one stage form the data to be tested in the next and so on. This triangulation of the methodology is relatively complex and is illustrated further in figure 3.3:-

Figure 3.3: Triangulation within the research methodology



Triangulation may therefore be seen to act in two ways:-

1. Using different methods of data *collection* on the same phenomena, and;
2. Using different methods of data *analysis* on the same phenomena.

> "Looking at multiple actors in multiple settings enhances generalisibility" (Miles & Huberman, 1994, p.435)

The data itself emanates from four main areas, the literature review (covered in the last chapter), interviews, the industry survey and empirical testing. It is intended that the above research methodology will act as a basis to continually question and refine any findings derived and also to instill rigor and objectivity into the research programme.

> "Triangulation forces the researcher to consider situations from a variety of standpoints, it is an excellent medium for stimulating and focusing thought." (Lenard et al, 1997, p.23)

As mentioned at the beginning of this section the overall research methodology is defined as qualitative in nature (Lenard et al, 1997, p.21). However, the techniques employed within this overall umbrella are seen to become progressively more structured as the methodology develops.

> "It is important, within any research methods that the most appropriate techniques are applied at any one stage rather than either a qualitative or quantitative method." (Sarantakos, 1993, p.56)

In addition to the above, a further design feature is apparent within the methodology - the development of theory throughout the course of the research rather than this being specific to any one stage. By way of example, the "*understanding of problems*" is developed during the interview and industry survey stages and "*testing solutions*" shared by all three. A smooth transition of theory is therefore evident throughout the course of the research rather than a cut-off point being enforced when a stage completes.

In more general terms, the research may be defined as:-

- *Non-causal* – as it does not attempt to establish the true cause and effect (it merely correlates the views of estimators).
- Involving *minimal researcher interference* (as the researcher purely observes and collates data from the subjects under investigation).
- Being undertaken within the *natural environment* (the subjects are not subjected to a false or contrived setting).
- Conducted over a *cross-sectional time horizon* (a 'snap-shot' in time).

3.1.3 Justification of the overall research methodology

Having explained the overall design of the research methodology this section seeks to justify the approach adopted. Substantiation is provided on two fronts, firstly, in relation to the type of problem under investigation and, secondly; how this relates to previous research. Justification is also required to demonstrate what other potential techniques have been rejected during the decision-making process and why. This section merely reviews the *overall* decisions that have been introduced to date, that is, the higher-level methodological decisions. More detailed explanations are contained within the respective sections later within this chapter.

3.1.3.1 Justification of the methodology in relation to the phenomenon under study

The selection of both an appropriate research methodology and style of questioning need to give due credence to the kind of problem under investigation. The 'phenomenon under investigation' is defined as the setting or environment in which the research will take place and the 'type of questioning' - an appropriate route of enquiry (Marshall & Rossman, 1995, p.42).

The research seeks the opinion of contractors' estimators to establish their views on the effectiveness of pricing documentation. The opinion of contractors' estimators is sought as they are the primary users of pricing documentation. An in depth understanding of current practice will need to be obtained and proposed solutions generated. The research therefore needs to pass through an initial exploratory phase in order that the requisite depth of study is gained from which these proposals may be generated (Yin, 1989, p.35). Both the *depth of study* and necessity that proposals are *developed* are key drivers in deciding upon the overall methodological approach.

Methodologies adopted within research may be broadly divided into two categories – qualitative and quantitative (Fellows & Liu 1997, p.19). Quantitative techniques, as a prerequisite, require that a basic understanding of the subject area has already been obtained and that, from this, research instruments may be applied to test-out existing assertions. Particularly in the initial stages of this research it was considered inappropriate to adopt a pre-defined research instrument. Assertions could have been made from a combination of sources - knowledge gained from the literature, personal experience and from previous research, however; as this data did not directly relate to the focal theory of the research the assertions could well have been incorrect. Quite simply, if the wrong questions were being asked then there was a risk that the wrong conclusions could be drawn. It was therefore considered inappropriate to assume what the underlying issues were. The adoption of a quantitative methodology was therefore discounted.

The qualitative approach, in principle, suited both the type of issues that were being investigated and the route of enquiry necessary to meet the objectives (Marshall & Rossman, 1995, p.40). Having decided upon the overall qualitative approach careful consideration was then given to the specific techniques that would be applied within this overall umbrella. It was recognised that an in depth study of the views and experiences of estimators would be initially required. Although it was anticipated that a wealth of in depth knowledge would be gained, this would probably be specific to a small sub-set of the total population and therefore be inappropriate to generalise from. A second, intermediary stage, was recognised as being vital before any direct conclusions could be drawn. This would enable the results to be tested on a wider audience and the assertions to be developed and refined. The final testing stage would then ensure that the results from the latter stage had been interpreted correctly and that these held true in practice (Nachmias & Nachmias, 1992, p.22).

From this high level approach the three stages referred to in the previous section were borne – each reflecting the theory developed at any one point in time. A singular research technique (i.e. just interviews) was rejected in favour of adopting the most appropriate techniques for each stage. To rely solely on a single method of data collection or analysis exposes the reliability and validity of the results to inherent weaknesses (Nachmias & Nachmias, 1992, p.128).

To recap, the objective of stage one was to unearth how estimators priced their work, the problems they faced and potential solutions to overcome these. Questionnaires were considered at this stage but, as little understanding had been gained, they would need to be too open ended to be of real use. Also, without some prior knowledge the nature of the questions would be difficult to ascertain and there was concern that, in light of this, more fundamental issues may be overlooked. Face-to-face consultations were considered to be the most appropriate means of obtaining this in depth understanding and afforded the researcher the added advantage of probing into particularly relevant areas as an when they arose (Sekaran, 1992, p.20). Theory would be developed by comparing and contrasting the findings of each interview – a technique known as 'cross-case analysis' (Yin, 1989, p.57).

> "If we typify qualitative casework, we see data....continuously interpreted, on first sighting and again and again. Records and tabulations are perused not only for classification and pattern recognition but for "criss-crossed" reflection." (Stake, 1994, p.242)

The true meaning of a response could be explored and underlying reasons unearthed. Interviews afforded this flexibility (Yin, 1989, p.13). Additionally, copies of actual pricing documentation could be obtained first hand. This would help in the assessment of current practice.

The objective of stage two was to test the results emanating from the interviews. Questionnaires were seen as the best vehicle to do this as they allowed the views of a minority to be tested out on a larger audience with relative ease (Strauss & Corbin, 1990, p.57). Interviews were initially considered but discarded due to the sheer number of people required to be involved and it was considered that the unstructured format of the notes would also make analysis problematic. A completely structured questionnaire was considered to be too rigid a research instrument as the respondents may wish to express views outside the scope of the questions. This approach also presupposes that all the issues have been recognised. Conversely it was recognised that if the questionnaires were completely unstructured the process of disseminating and interpreting this data would prove troublesome and possibly run the risk of misinterpretation. For these reasons semi-structured questionnaires were considered to be the most appropriate means of meeting the objectives. This allowed testing to be undertaken in a structured manner (one that could be readily analysed) and gave the respondents freedom to express their own opinion (Cohen & Manion, 1989, p.109-117). In practice, some questions were left open-ended and others structured dependant upon the quality of data derived from the interview stage.

Appropriate techniques for the empirical testing stage, stage three, proved to be too problematic to define at the outset. Although the objective was clear the means of achieving this was difficult to forecast. It was difficult to predict what kind of data would be available for testing, the level of confidence in this data and what the proposed methods of improving the effectiveness of pricing documentation would be. In light of this it was considered prudent to leave stage three purely as a principle and decide upon the most appropriate technique at a later stage.

> "The design should preserve the flexibility that is a hallmark of qualitative methods." (Marshall & Rossman, 1995, p.38)

3.1.3.2 Justification of the methodology in relation to previous research

The second area in which the context of the research requires justifying is in relation to previous research efforts.

The *qualitative* and *triangulated* approaches adopted are in line with all previous research efforts within this field – Skinner (1979, p.1), Pasquire (1991, p.7) and Kodikara (1990, p.5). Similarly, previous research efforts have begun with an outline research problem then sought to examine this in more detail as their research was underway. Skinner (1979, p.3) anticipated that bills could better serve the contractors' needs post-tender and sought to establish where the greatest potential existed. Both Pasquire (1991, p.218) and Kodikara (1993 a, p.263) proposed that the post-tender use of bills could be improved if compensating work/ re-work could be reduced and generated proposals during the course of their research. Similarities are also evident in terms of the overall design and individual research techniques applied. Table 3.2 highlights this further (p.126).

Table 3.2: Comparison of research stages and techniques in relation to previous research

Commonality	Skinner (1979)	Pasquire (1991)	Kodikara (1990)	Kings (2002)
Understanding the underlying issues.	(termed the) "Principal study" – interviews within a single contracting firm to gain in depth understanding.	Interviews with 3 contracting firms to derive draft measurement rules.	Interviews with 10 contracting firms to understand the underlying issues.	Interviews to gain an understanding of current practice, processes and problems.
Formulating solutions.	n/a	Testing the above findings on 5 contracting firms to refine the rules.	Each of the above 10 contracting firms was re-visited to probe underlying problems and help generate proposals.	Semi-structured questionnaire survey to refine the above views and test-out proposals.
Testing the solutions.	Testing views out on a wider audience by questionnaire survey, one sample of contractors' quantity surveyors and two of a cross-section of estimators, planners, buyers, agents and contracts managers.	Final testing of results with contractors' estimators and experts within the industry (based on eight interviews).	Tested on two 'live projects', interviews with estimators from the original 10 contracting firms and a professional acceptance survey with 33 external candidates.	Structured questionnaire survey to test the proposals.

Similar interviewing techniques have also been applied by other researchers within the field (Swaffield, 1994 c, p.10; Skitmore & Wilcock, 1994, p.141; Fortune & Skitmore, 1992, p.80).

The final similarity is seen as Skinner's use of representative bodies within his questionnaire survey that participated within the development of the Standard Method i.e. the NFBTE (Skinner, 1979, p.152). As detailed later within the methodology chapter, the current research seeks the views of the ECA and HVCA during the questionnaire surveys (who formed part of the Plumbing and Mechanical Engineering Installations Advisory Panel for SMM7). This is an important feature as it affords the original contributors to the Standard Method the opportunity to comment on its actual effectiveness. The Standing Joint Committee themselves admitted that this had not been sufficiently addressed within the development of the Standard Method (Willis, 1988 a, p.26).

3.1.4 Stages within the research methodology

An overall introduction to the methodology has been provided. The *qualitative* methodology is seen to incorporate three main stages, interviews, an industry survey and empirical testing stage. This enables the results to *triangulated*. Justification of this approach has been provided on two fronts – firstly, in terms of the phenomenon under study and, secondly, in relation to previous research.

The following sections provide a more detailed explanation of the three key stages. A précis of the literature review is initially given.

3.2 Literature review

Although covered in the previous chapter, the literature review effectively forms the initial stage of the research.

Provisional thoughts, prior to carrying out the literature review, tentatively focussed on improving the effectiveness of measured data. However, It was unclear whether this should be directed at the tender stage, post-tender stage and for whom. The literature review began by obtaining directly related articles. By obtaining documents cited within the bibliography of these papers and expanding the scope of the review, an understanding of the current state of measurement research was established. Over time, a considerable amount of relevant literature was acquired. This enabled the main contributors to be identified. A wider review, taking into account the changing background of the building industry, enabled their relative success and relevance to current practice to be evaluated.

As a result, the effectiveness of documentation at the *tender* stage of construction was identified as a relative gap within previous research (bearing in mind the changes in organisational structure and current practice). The literature review established that the opinion of the *end-users* (the contractors' estimator) had not been sufficiently addressed - subcontractors in particular. The literature review therefore identified a specific research problem, around which, the research methodology would need to be directed. It also established a number of research questions, the successful achievement of such, would also need be incorporated within the methodology. The nature of the problem under investigation therefore directed the methodological approach i.e. who was approached, how, what questions should be asked and how any opinions formed should be tested.

To ensure the originality of the proposal, key researchers and representative bodies were then contacted (from November 1997 to February 1998 e.g. Swaffield and Pasquire). This confirmed that no such similar work was under way. It also provided further contacts and, by explaining the overall direction of the research to them, confirmed that the research proposal was worthwhile. Contacts were obtained from the above review and supplemented by a database of construction researchers available on the internet (CNBR – Co-operative Network for Building Research). In particular, the views of the RICS were helpful. A number of personnel were contacted within the RICS and all confirmed that the only proposed changes to the Standard Method were to take account of UNICLASS. They also recognised the desire for change within practice and the diminishing use of SMM7 (Joe Martin – BCIS, Building Cost Information Service; Stephen Brown - Research Officer; T Paton - Construction Planning and Procurement Practice Panel). In particular, Chris Powell (QS Divisional President at that time) suggested that the RICS should, but were not, looking at a further amendment to the Standard Method in line with current practice and confirmed that the proposal was valid. Christopher Willis was also contacted - a member of the Standing Joint Committee and key participant to previous changes in the Standard Method (letter dated 31st December 1997). Mr Willis gave the opinion that no such changes were required to SMM7 and considered that it would continue to be used for evermore. A certain amount of disparity was therefore evident within the RICS.

The literature has been analysed firstly, in chronological order and, secondly, by area of work undertaken. This has enabled a robust understanding of the literature to be obtained and relative impact of consequential events to be understood. A tabular summary of this analysis (p.101) then serves to highlight the relative gap in previous work. The relative significance of these gaps has then been valued by analysing the changing background of the construction industry (e.g. value of work now subcontracted). This analysis enabled a specific research problem to be identified (based on published works). A further review of key researchers and representative bodies within the industry ensured that no similar research, to that proposed, was in progress and that the proposal was both valid and original. At this stage, a methodology was designed (section 3.1.2, p.115). Having completed the overall design a more detailed design of the interviews was therefore appropriate. This is outlined within the next section (3.3, p.130).

3.3 Interviews

3.3.1 Introduction

This section of the methodology provides a detailed explanation of the interview decision-making process. It begins with an overall explanation of why interviews were adopted in favour of other potential techniques. It then continues to describe the rationale behind key decisions made, namely; the initial pilot studies, main interviews, methods of selection, data collection and data analysis.

3.3.2 Aims and objectives

The overall aim of the interviews is to allow an in depth understanding of the subject area to be developed. The dearth of relevant data means that an in depth investigation is required prior to adopting a more structured research instrument. By going through a number of question-and-answer cycles it is possible to gain an in depth understanding, theorise from this, re-test and (if appropriate) generalise (Strauss & Corbin, 1990, p.19; Denzin & Lincoln, 1994, p.431). It allows the researcher to gain a detailed understanding of the subject area first-hand and, by using 'probing' techniques, unearth the main issues that are perhaps not recognised within the existing literature. This understanding gradually develops and allows theory to be generated (Denzin & Lincoln, 1994, p.278).

Previous work within the subject area discovered that, unless such techniques were employed, then candidates would just tend to provide a response in keeping with the perceptions contained within the literature. Skitmore & Wilcock (1994, p.151) revealed that, as estimators were familiar with the prescriptive literature they tended to rationalise their response in this manner. Delving deeper Skitmore & Wilcock found that estimating practice differed to the literature and to the estimators' initial response (1994, p.139).
However, as interviews focus on a small sub-set of the total population and home in on

specific issues, the results are often too specific to make generalisations from (Stake, 1994, p.237). Hence the need to adopt further research techniques later on within the overall methodology (Sarantakos, 1993, p.78).

The objectives of the interviews are summarised as follows:-

Processes

- Identify the processes commonly adopted by constructors to prepare the tender (the contractors' estimator being the target end users).

Problems

- Establish the problems encountered by constructors during pricing.
- Establish the frequency and extent of each category of problem.

Consequences

- Establish how the problems effect the accuracy of pricing.
- The extent of risk taken by the constructor.
- The clients' exposure to risk as a result of the above.

Proposals

- Produce proposals aimed at reducing the frequency and extent of problems identified.

3.3.3 Sampling decision making process

As will become apparent, many of the practical details such as sample size and selection criteria were made as the research was being conducted. This maximised the potential of a truly qualitative approach and meant previous decisions were not too restrictive (Strauss & Corbin, 1990, p.23).

3.3.3.1 Sample size

The issue of sample size was broached early within the decision-making process. However, after much deliberation it was considered inappropriate to enforce a sample size i.e. a prescribed number of interviews that had to be undertaken. In theory, the total number of cases investigated should be sufficient to allow 'saturation' of the results to occur - a certain level of confidence that a reliable and valid understanding of the issues has been obtained (Stake, 1994, p.243). At this point the results would become predictable. In practice, this is recognised when the theory emanating from previous interviews is able to predict the responses from further cases that are sampled (Yin, 1989, p.54).

It was decided that a pre-defined sample size was inappropriate and that sampling should continue until it was considered that the point of saturation had been reached (Yin, 1989, p.57).

3.3.3.2 Selection criteria

The method adopted to select the cases was recognised as being fundamental to the overall methodology as unrepresentative sampling could potentially bias the results. Questions such as who should be approached, what characteristics they should possess and how many of each type were deliberated over for some time.

It was recognised that a complex array of types of contractor exists within the building industry and that their characteristics would probably differ in terms of turnover levels, type of work undertaken, experience, types of clients they predominantly work for, location and usual position within the supply chain etc. However, it was considered that, within this, generic groups of contractors would probably exist particularly in terms of the research objectives i.e. the type of problems they encounter when pricing their work and potential solutions to overcome these. To elaborate, it was postulated that there may be differences in the problems encountered between main contractors and subcontractors and also between different types of subcontractor.

Initially, attempts were made to presuppose what these groupings could be. The assumption being, that if they proved successful and were confirmed by carrying out the interviews then theory could be generated immediately. It was originally assumed that the problems encountered and potential solutions were related to different types of work undertaken i.e. the trades themselves. If correct, an exhaustive list of all trades would therefore be required in order that groups of contractor could firstly be established. The Common Arrangement of Work Sections within SMM7 was regarded as a reasonable basis from which to start (containing 316 in total). Each trade was systematically grouped into a higher-level grouping, this higher level grouping was then further grouped to yet a higher level until a total of six groups remained (Appendix A, p.405 and B, p.410 provide details of this and their definitions). The six types of contractor were defined as:-

1. Demolition contractors.
2. Groundworkers.
3. Assembly contractors.
4. Constructors.
5. Prefabricators, and;
6. Specialists.

However, having completed the exercise it was recognised that by pre-defining the types of contractor that should be selected certain assumptions were being made about their response and, in so doing, this could potentially introduce bias. Questions also arose about the number of samples that should be taken from each category.

Having followed this train of thought for some time this was now considered to be inappropriate and discarded. Instead of presupposing groups of contractors that should be selected, it was considered that a cross-section of contractors should be sampled to ensure that a reasonably representative sample was obtained. This 'cross-section' would include a mixture of main and subcontractors, types of trades, turnover levels, the number of employees, time in business and location etc. Again, a pre-defined cross-section was considered in line with Kodikara's research (1990, p.86) but later rejected in favour of an undefined cross-section. Bias could be introduced by assuming that characteristics such as turnover level number of employees effected their problems encountered in pricing (Yin, 1989, p.65). It was decided that the most appropriate method was to select a cross-section of contractors (in no pre-defined quotas), record their characteristics and theorise later if appropriate. This was considered to be more in keeping with the qualitative nature of the research - to allow theory to emerge naturally as opposed to trying to predict.

> "Selection by sampling of attributes should not be the highest priority.....balance and variety are important, opportunity to learn is of primary importance."
> (Stake, 1994, p.244).

3.3.3.3 Data collection

Methods of collecting the data, interview protocols and means of analysis were then considered. It was recognised that each interview should follow a similar protocol. This should ensure that the data was collected consistently, avoid potential bias and ensure reliability within the results (Yin, 1989, p.45). A table of pre-defined areas of questioning was developed. This table was divided into the following six sections that are in line with the research objectives:-

1. **Circumstances** (i.e. characteristics of the contractor, type of work undertaken, number of employees, turnover levels).
2. **Processes** (how they price the work for different methods of procurement).
3. **Problems** (problems they encounter in line with the above).
4. **Consequences** (the impact of the problems).
5. **Proposals** (proposed methods of overcoming the stated problems).
6. **Comments/ Other/ General** (any other comments that did not neatly fall into any of the above).

By recording the results in this manner it was envisaged that analysis of the results would be made simpler (Stake, 1994, p.243). A similar approach was adopted by Kodikara (1990, p.83) and Pasquire (1991, p.15). Information from the literature review was inserted within each of the categories to direct the questioning and serve as a basis to test the literature review findings. It was recognised from the outset that the questioning should in no way be restricted by these categories and that by adopting a 'probing' technique the responses could be explored in more detail (Nachmias & Nachmias, 1992, p.230). The '*comments/ other/ general*' section acted as a 'catch-all' for responses outside the other five areas (example contained in Appendix C, p.412).

3.3.3.4 Pilot studies

Before embarking on the interviews it was considered prudent to test the assumptions made on a number of pilot studies particularly with regard to the method of data collection.

In all, six contractors were interviewed – four subcontractors and two main contractors from a cross-section of backgrounds. This was considered sufficient to test-out the interview techniques and methods of data collection. The contractors were selected from the Yellow Pages directory within the Hull area. Upon completion of the pilot studies a review was carried out to assess how well the assumptions had been tested-out and their appropriateness.

On reflection, it was considered that the approach was valid and that sufficient preparation had been made to commence the rest of the interviews. The tabular questioning format proved particularly useful. In addition, attempts to define the sample size and method of selection were confirmed as inappropriate.

3.3.3.5 Selection

Contractors continued to be selected from local Yellow Pages directories. This was broadened to take in contractors from the Leeds and York areas. It was recognised that, selecting contractors within a limited geographic spread may introduce bias (Nachmias & Nachmias, 1992, p.175). Contractors outside these areas may not hold the same opinion. However, this issue is addressed later within the research methodology when the assertions made from the interviews are tested on contractors from varying locations. Obtaining the requisite depth of study was considered more important – the extent that the results could be generalised was not a prime concern at this stage.

3.3.4 Interview protocol

To ensure the reliability of the methodology, it was recognised that a stringent protocol should be followed particularly the way in which the research was introduced and manner in which the questions were asked. Yin (1989, p.45) supports this approach. Once a potential contracting firm had been selected from the Yellow Pages directory they were telephoned and the estimator within the firm located. The background of the research was then explained and request of an interview made at their convenience.

The interviews were carried out in person and lasted for a minimum of an hour (approximately one and a half hours on average). Each interview began with an introduction to the research and outline of what the interview would cover. Ethics were also addressed and assurance given that neither the candidates' name or company details would be referred to in the published works.

This introduction was followed by a number of opening questions covering the type of work carried out, time in business, turnover and number of employees. The questions then opened into broader areas of discussion in line with the broad sections detailed in section 3.3.3.3 (p.135). Preconceived questions were not drafted, the researcher merely focused questioning around the key areas under investigation. This provided an excellent opportunity to probe and follow more in depth lines of enquiry.

The data collection sheets provided the right balance between directing the interview towards the objectives of the research and being able to generate open discussion.

At the end of each of interview the notes were read back to the candidates to ensure they had been correctly interpreted. Any theories or generalisations emanating from the research were also proposed to the interviewees and feedback obtained.

3.3.5 Interviews undertaken

In total, forty-seven contractors were interviewed. Details of their characteristics and results are contained within the results chapter (p.181).

When approximately forty of the interviews had been completed it was felt that the results were becoming predictable, different types of contractors could be forecast to respond in a certain manner. The findings from previous interviews were also being tested out and found to hold true. It was considered at this point that 'saturation' had been achieved (Stake, 1994, p.243).

To test whether saturation had truly occurred a further seven contractors were interviewed. This allowed the findings that were specific to different types of contractor to be tested out further. As predicted, the researcher continued to be able to predict the responses that were made. At this point it was recognised that the interview stage of the research had become exhaustive and was now complete.

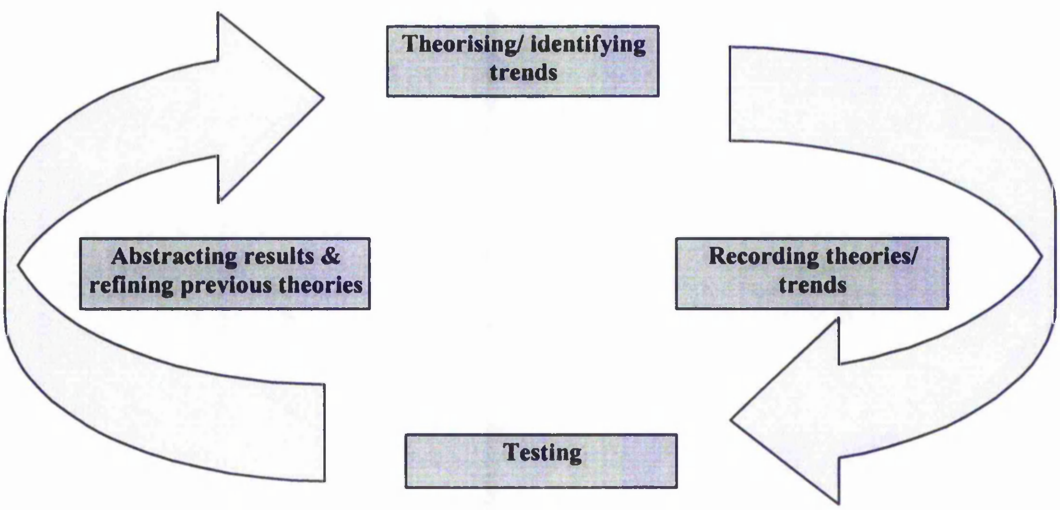
3.3.6 Analysis

Analysis of the interviews was made on an iterative basis. After each interview the notes were typed-up and any generalisations or trends noted. By abstracting the results in this manner some form of analysis was already being undertaken. It soon became apparent that a number of trends were emerging. The data collection pro-forma was then updated with a record of these emerging trends to enable re-testing and a more in depth investigation during the preceding interviews.

Pasquire also analysed data in this manner and referred to the process as analysis by tabulation (1991, p.15).

These question-and-answer cycles allowed theory to be developed from the data (Strauss & Corbin, 1990, p.19; Denzin & Lincoln, 1994, p.431). Analysis was therefore being undertaken as the research was being carried out. Glaser & Strauss refer to this as "constant comparative analysis" (Glaser & Strauss, 1967, p.7). This approach also served to triangulate the data collated from the literature review. The illustration below helps to explain this simultaneous development - the testing and refinement of theory.

Figure 3.4: The iterative loop



Source: Adopted from Fellows & Liu , 1997, p.10 (Aristotle's inductive-deductive method).

As a result of this iterative process the questioning gradually became more focused.

Although the results of the research are explained in detail within the results chapter, for the purposes of continuity, it is worth mentioning here what the key findings were. This helps explain the route of the methodology subsequent to this stage. Two groups of contracting organisation were identified – *specialists* and *non-specialists*. The dividing factor being their behavioural response when presented with quantified pricing information. It was found that the specialist trades (as defined within the literature review, p.73) did not want pricing information to be quantified for them (as traditionally expected) but instead preferred to quantify the work themselves. Conversely, non-specialists trades preferred the work to be quantified for them. Non-specialists were found to be satisfied when the established principles were adhered to.

3.3.7 Expert validation

Upon completion of the interviews it was considered worthwhile testing the results on an expert panel. This would enable important feedback to be gained and gauge the level of agreement or otherwise with the findings so far. The RICS was selected as an appropriate body as its members are directly involved in producing much of the industry's pricing information. A presentation was arranged for the 23rd March 1999 and carried out at the Nottingham and Derbyshire Quantity Surveying Branch. An outline of the overall research aims was presented followed by a summary of the results obtained so far.

This served as an excellent opportunity to present, based on the interview findings, what was considered to be current practice and how this compared to common perceptions held within the industry. It was also possible to give first-hand examples of the quality of pricing documentation received by estimators and present their view on the usefulness of this pricing information.

3.3.8 Summary

This section has provided a summary of the interview methodology. The key decisions have been detailed and their rationale explained.

In essence, the approach sought to maintain a careful balance between the requisite amount of structure to ensure reliability and, at the same time, the flexibility to adapt the overall methodology to the exploratory nature of the research.

The section concludes with details of a presentation to the RICS that helped gain invaluable feedback once the interview stage had been completed.

3.4 Industry survey: questionnaire survey 1

3.4.1 Introduction

Having gained an understanding of the focal theory, stage two seeks to test the extent to which the identified problems and solutions can be generalised and to develop the latter. The industry survey aims to achieve this by testing the interview findings both on a wider audience and in a more structured manner.

This section of the methodology explains the rationale behind the key decisions made, how the data were collated, analysis techniques employed and additional means of verifying the results. It also considers limitations within the methodology.

3.4.2 Aims and objectives

The previous section described how two quite separate groups of contractor had been identified by the interviews. These had been categorised as specialist and non-specialist contractors. The overall aim of this section is to build-up a profile of these two groups of contractor and to test their behavioural differences against a number of criteria. The objectives of this stage are detailed below:-

1. **Gain an understanding of the overall background of the two groups of contractor, including:**
   1.1. The characteristics that typify specialist and non-specialist organisations.
   1.2. Current practice in terms of the type of work they receive.

2. **Obtain their views on the:**
   2.1. Quality of pricing information produced by quantity surveying firms.
   2.2. Abilities of quantity surveying firms to produce useful pricing information.

2.3. Problems that contractors estimators' encounter with bills of quantities.

2.4. Root causes of the problems they encounter with bills of quantities.

2.5. Quality of pricing information they produce themselves.

3. Identify the contractors suggested solutions in terms of their:

3.1. Preferred level of input during the tendering process, and;

3.2. Suggested solutions to overcome the stated problems.

3.4.3 Sampling decision making process

The aim of the sampling process is to gain as representative a sample of the two different groups of contractor in order that behavioural differences may be tested-out in line with the above objectives.

The following section details the key decisions made in seeking to achieve this. It is worth noting that these decisions were not made in isolation from one another. Due consideration was given to the demands of the project itself and the requisite standards of academic research. In reality, all of the key decisions were firstly made in isolation then reviewed in respect of one another. In this manner the full spectrum of issues was assessed prior to commencing the survey.

3.4.3.1 Sampling frame

In seeking to achieve the stated objectives it is vital that appropriate sampling frames are obtained.

Despite an abundance of potential sampling frames within the building industry, no single sampling frame identifies the total population of all contractors' estimators, as the primary user group for pricing documentation, in existence within the UK. Nor, as would be expected, does a single sampling frame identify the total population of specialists or the total population of non-specialists. Samples are therefore required to be drawn from individual sampling frames that partly represent the total population i.e. subsets of the total population.

Prior to selecting these individual sampling frames due credence was given to the potential for bias. It was recognised that a single sample of specialists and a single sample of non-specialists (i.e. two samples in total) may not be truly representative of the type of contractor they were assumed to represent. That is, a sample of specialist views may not concur with those of a secondary sample of specialist views. Without some form of assessment of this factor the extent to which the results could be generalised would be limited.

In light of the above it was considered prudent to obtain a further sample from the same category of contractor i.e. a second sample of either a specialist or non-specialist. By correlating the results of two like samples this would allow assumptions to be made about to what extent the results could be generalised and the potential for bias assessed. For example, a high correlation between two non-specialist samples would allow assumptions to be made about how representative these views were of other non-specialist subgroups. Ideally a secondary sample should be taken of each classification of contractor - four in total. However, within the constraints of the research, this was considered to be unachievable. In light of this, a secondary sample of just one classification of contractor was decided upon i.e. three in total. This was not considered to be a problem as findings about the extent to which the results could be generalised from one classification of contractor to the other would be transferable - both will have been selected using identical methodologies. By carrying out a secondary sample of one classification of contractor the results are triangulated. Triangulation techniques are therefore employed both within the overall methodology (at the macro level) and within the individual stages (at the micro level). The methodological approach is strengthened in this respect.

A number of potential sampling frames are in existence within the building industry each containing their own inherent advantages and disadvantages. Each potential sampling frame was firstly identified followed by a more detailed assessment of how relevant this may be for the purposes of the research. The comments and decisions are summarised in table 3.3 (p.146).

Table 3.3: Industry survey: assessment of potential sampling frames

Sampling Frame	Representing?	Comments	Decision
1. CMI (Construction Market Intelligence – a division of the DETR (Department of the Environment Transport and Regions).	Specialists & Non-Specialists.	This body represents over 160,000 contractors. Data is collated from mandatory surveys. However, the data is protected and cannot be disclosed for research purposes. In addition, the body does not neatly match one or other of the two classifications of contractor.	Rejected
2. Construction on Line.	Specialists & Non-Specialists.	Represents over 8,000 firms - a mixture of contractors and consultants. However, the data is protected and cannot be disclosed for research purposes. In addition, the body does not neatly match one or other of the two classifications of contractor.	Rejected
3. BEB (Building Economics Bureau).	Specialists & Non-Specialists.	This body consists of a database of 2,000 plus contractors. However, it does not differentiate between specialists and non-specialists. There is also a £100 fee to obtain the database. Originally considered as a potential but subsequently rejected in lieu of a more appropriate sampling frame.	Rejected
4. CIBSE (Chartered Institute of Building Services Engineers).	Specialists.	Due to internal organisational changes the body were unable to give time in assisting with the research. This was considered, at the time, to be a potentially important sampling frame. However, in light of further relevant sampling frames this was not considered to be a problem.	Rejected
5. Members of the CIOB (Chartered Institute of Building).	Specialists, Non-Specialists & others.	This database represented more than 34,000 members. However, the body does not exclusively represent contractors' estimators. In addition a number of these may belong to the same company and therefore distort the results if prior checks are not undertaken. The data is also protected and cannot be used for research purposes.	Rejected
6. CBC's (Chartered Building Companies) a database within the CIOB (Chartered Institute of Building).	Specialists & Non-Specialists.	As the database only consisted of approximately 300 member companies this was considered too small for the required sample size. In addition, the body does not neatly match one or other of the two classifications of contractor.	Rejected
7. ECA (Electrical Contractors Association).	Specialists.	This consisted of contractors that typified the category of *specialists* (as defined). It also represented some 2,000 specialists from a wide cross section of the industry. The body was considered to contain sufficient members to draw samples from and to be representative of specialists.	**Accepted**

Table 3.4: Industry survey: assessment of potential sampling frames (continued)

Sampling Frame	Representing?	Comments	Decision
8. HVCA (Heating and Ventilating Contractors Association).	Specialists.	This consisted of contractors that typified the category of specialists (as defined). It also represented some 1,320 specialists from a wide cross section of the industry (80% of the total workload in terms of turnover). The body was considered to contain sufficient members to draw samples from and to be representative of specialists.	**Accepted**
9. MCG (Main Contractors Group).	Non-Specialists.	A division of the Construction Confederation that contains the largest database of construction companies within the UK – representing over 5,000 companies and over 75% of the UK workload. This database only represented the 23 top contractors within the UK (in terms of turnover) and therefore would not be representative of all non-specialists.	Rejected
10. FBSC (Federation of Building Specialist Contractors) a division of the Construction Confederation.	Specialists & Non-Specialists.	Despite the title this body contained a mixture of specialists and non-specialists (as defined by the research) and was subsequently rejected in lieu of more appropriate sampling frames.	Rejected
11. CECA (Civil Engineering Contractors Association).	Neither.	A division of the Construction Confederation. This contained Civil Engineering contractors and was therefore not relevant to the research that focused on the more traditional building side of the industry.	Rejected
12. HBF (House Builders Federation) a division of the Construction Confederation.	Specialists & Non-Specialists.	These represented management contractors who 'developed' rather than had to price work themselves on a competitive basis. This did not therefore comply with the focal theory of the research.	Rejected
13. BWF (British Woodworking Federation) a division of the Construction Confederation.	Specialists.	This division of the Construction Confederation included manufacturers as opposed to purely constructors and was therefore discarded.	Rejected
14. SBEF (Scottish Building Employers Federation) a division of the Construction Confederation.	Specialists & Non-Specialists.	By its very nature this represented members from a restricted geographic location and was therefore discarded in lieu of more appropriate sampling frames.	Rejected
15. NFB (National Federation of Builders) a division of the Construction Confederation.	Non-Specialists.	This consisted of members that typified the category of non-specialists (as defined). It also represented a substantial number of non-specialist contractors (over 3,200). The body was considered to contain sufficient members to draw samples from and to be representative of non-specialists.	**Accepted**
16. NCF (National Contractors Federation) a division of the Construction Confederation.	Non-Specialists.	This only represented 25 contractors and was therefore discarded in lieu of more appropriate sampling frames.	Rejected

Based on the quality of the available sampling frames it was decided that two specialist bodies would be selected - the ECA and HVCA and one non-specialist body – the NFB. This complied with the overall desire to obtain two separate samples of one type of contractor and a single sample from the other. The flexibility in deciding this after the sampling frames had been analysed allowed the most appropriate choice to be made.

The three bodies selected also exclusively represented the types of contractor under investigation (i.e. no filtering of the sampling frame was required). In addition, contractors within these sampling frames were expected to strongly typify the characteristics of the contractors as defined by the interviews. The selected samples also typically represent contractors involved in bidding for work within the main stream building industry i.e. not sole practitioners involved just in private work. The results are therefore relevant and may be generalised to all contractors involved within the building industry involved in similar work (e.g. the CMI and MCG – items 1 and 9, table 3.4).

Based on the same rationale as the interviews, estimators were selected as the target audience - individual contracting organisations being the units of analysis.

3.4.3.2 Overall sampling technique

Sampling techniques may be broadly divided into two groups (Fellows & Liu, 1997, p.120):-

a) *Probability techniques* - affording each and every member of the sampling frame an equal opportunity of being chosen i.e. random sampling.

b) *Non-probability techniques* – selective methods of choosing the subjects. Their method of selection being made on a non-random basis.

By process of elimination the non-probability technique is defined as the most appropriate and is further defined within this section after a number of key decisions are made.

3.4.3.3 Sample size

The size of the individual samples required calculating. To avoid small number statistics it was recognised that a minimum of thirty-two responses would be required for each sample (Cohen & Manion, 1989, p.104). The calculation in Appendix D (p.413) summarises how this number was derived and key assumptions made. Basically, thirty-two was taken as the minimum number of responses. It was initially assumed that a response rate of around thirty percent would be achieved. This is consistent with previous research within this field (Swaffield, 1994 b, p.1; Lenard et al, 1997, p.27).

Additional factors that may effect the response rate were then considered. Time constraints of the estimators were considered to have a major adverse effect on the response rate. However, factors increasing the response rate were considered as follows:-

1. Their specific interest in trying to improve current practice.
2. Making personal contact with each respondent prior to sending the questionnaire.
3. As the questionnaire had been well piloted (details below) this would also perhaps encourage a higher response rate.

In taking these factors into account a response rate of 18% was assumed which equated to a sample of 182 per sample frame (546 in total). This was considered to be a conservative assessment of the final response rate.

Effectively a *quota* had been established for each of the three sampling frames. Once this quota of 182 was obtained then the sampling process would become exhaustive. The selected sampling technique may therefore be further defined as a *non-proportional quota* sampling technique. Inevitably, it is crucial how this quota is selected from the total population within the sampling frame. This point is covered within the selection process (3.4.6, p.153).

3.4.4 Questionnaire design

Considerable effort was devoted to the development of the questionnaire. In order to ensure that the objectives stated at the beginning of this section were met each question was tied back to an individual objective. Appendix E (p.415) provides an illustration of this.

The style of each question was directly related to how far the underlying theory had been developed. The interviews unearthed a number of issues each seen to be at differing stages of understanding. A mixed questionnaire style was therefore appropriate (Nachmias & Nachmias, 1992, p.246-268 & Oppenheim, 1992, p.7). Some questions were styled in a 'tick-box' format with pre-defined response categories. These questions did not enable the respondent to express an opinion outside the pre-defined response categories. Examples include the level of turnover, number of employees, format of pricing information and views on the quality of pricing information. These issues had been sufficiently understood to enable the questions to be clearly worded and for the response categories to be defined. It was also recognised that, in areas where theory was less developed, the respondent should be afforded the opportunity to express their own unhindered opinion. To address this, the last three questions were designed to allow the respondents complete freedom in expressing their views. These questions related to three main issues:-

1. Problems encountered in pricing bills.
2. Their perception of the root causes of these problems.
3. Suggested solutions to overcome these problems.

3.4.5 Pilot studies

3.4.5.1 Initial pilot study

Having defined the individual focus and style of each question (tied back to the original objectives), their wording was recognised as being fundamental to the validity of the responses.

In seeking to address this issue a pilot was undertaken to obtain feedback on the style and format of the questionnaire. The initial pilot was sent to six specialist contractors and six non-specialists (twelve in total). Of the six within each subset, three candidates had already been interviewed and three had not - these effectively acted as a blind sample. This blind sample served as an important check that the original responses were not biased. It was recognised that the in depth knowledge interview candidates gained during the interviews may well affect their response. Sending the questionnaire to those that had already been interviewed also served to check that the questionnaire responses were in line with those anticipated.

The samples were selected from the local Yellow pages within the Hull area. Each candidate was firstly telephoned and a protocol followed to introduce the background of the research before requesting that they take part in the pilot study. A covering letter enclosed the questionnaire that reaffirmed the aims of the research and gave assurances that the response would be treated confidentially. Three of the six specialist questionnaires were returned, two from the interviews and one blind. Four of *the* non-specialists pilots were also returned, three from the interviews and one from the blind sample.

No significant differences were identified between the blind samples and those already approached via the interviews. The majority of responses were also in line with those anticipated (based on the behavioural differences identified) and were considered to meet the overall objectives of the survey. However, some of the responses fell outside the parameters expected and other questions were filled out incorrectly. For example, the estimators were asked to fill out the format in which they received the pricing information and express this as a percentage (e.g. Plan & Spec - 40%, Design & Build - 30% and Bills of Quantities - 30%). The sum of these percentages should have equated to one hundred percent but, in a number of cases, did not. It was considered that some of the questions may be poorly worded. These respondents were then telephoned so that their understanding of the question could be assessed. This proved most fruitful as their interpretation varied somewhat from the original intentions of the question. As this misinterpretation was consistent it was evident that further work was required to improve the wording of these questions. The opportunity was also taken to check questions that had been answered in line with the anticipated response. It was confirmed that these had been correctly understood and therefore did not require further refinement.

3.4.5.2 Secondary pilot study

In light of these problems a number of questions were redrafted. These were initially discussed and presented to a supervisory meeting at Nottingham Trent University. Examples of the poorly answered questions were provided so that an informed view of the amendments could be made. The revised questions were accepted as being appropriate, however, it was considered prudent to re-test these via a secondary pilot study. This would serve to check that the refinements had been sufficiently addressed.

In a similar fashion to the initial pilot study, six questionnaires were sent out to each of the contractor groups (twelve in total). Three of the six were sent to original respondents and three to a further blind sample. Exactly the same protocol was followed as the initial pilot when contacting potential candidates. Of the specialists three interview respondents replied and three blind respondents (six in total). Of the non-specialists one interview respondent replied and three blind respondents (four in total). There was not considered to be any bias in those that did not respond nor between the original and blind responses. The response was most favourable and now proved, in light of refinement that the questions were consistent with anticipated behaviours identified within the interviews. Examples of the completed questionnaires were presented at a supervisory meeting and after discussion it was agreed that no more pilots were required. The questionnaire was now considered to be sufficiently robust to distribute to a wider audience.

A copy of the completed questionnaire is contained in Appendix F (p.416).

3.4.6 Selection process

A contact was initially identified from each of the representative bodies. This comprised a Technical Director from the NFB, The Head of the Commercial Contracts & Legal Department from the HVCA and Head of the Communications and Public Affairs Department of the ECA. The overall aims of the research were firstly explained followed by the reasons for selecting their particular representative body. Assurance was given that the results would not refer directly to specific individuals or firms and that disruption to their members would be kept to a minimum.

Each of the three representative bodies supplied a complete listing of its members. All followed a similar theme but were structured slightly differently. Members were listed by company name and by location. Addresses and telephone numbers were also supplied. Each membership listing provided a detailed analysis of each firms' characteristics such as turnover levels, type of work undertaken and any further specialist sub-group they belonged to within that particular body. This allowed a broad cross-section of contractors to be selected. The researcher attempted to gain as much of a balance between turnover levels and type of work undertaken as possible. The specialist sub-groups to which some of these contractors belonged (i.e. Ductwork group of the ECA) were not differentiated between as, in accordance with the aims of the industry survey, the only relevance was the overall body.

Having identified the individual contracting firms each company was personally telephoned and a standard introductory protocol followed. The overall aims of the research were explained and assurance given that the results would be completely confidential. Once agreement had been reached a covering letter was sent enclosing the questionnaire and stamped addressed envelope included. A footnote in the bottom corner of each questionnaire displayed a unique number that was cross-referenced to a central database containing the company details. This enabled the questionnaire to be recognised upon its return.

The overall response was better than originally anticipated and is summarised in table 3.4 below:-

Table 3.4: Industry survey questionnaire responses

		Actual returned		Comparison	
Representative Body	**No. of surveys sent out**	**No.**	**%**	**No.**	**%**
1. NFB	182	76	42	-106	-58
2. HVCA	182	59	32	-123	-68
3. ECA	182	37	20	-145	-80
Totals	**546**	**172**	**32**	**-374**	**-68**

3.4.7 Analysis

The analysis stage was broken down in to two phases. Phase one consisted of an initial review of the results using descriptive statistics. This allowed a 'feel' for the data to be obtained and an evaluation of the best method of secondary analysis to be made. It was recognised that the second phase would need to statistically evaluate differences between the specialists and non-specialists (to test the anticipated heterogeneity) and to also test the correlation between the two specialist samples (to test the anticipated homogeneity). SPSS was chosen as the most appropriate means of achieving this. SPSS is particularly appropriate when qualitative data are analysed and, once the data are inputted, offers the flexibility of numerous analysis techniques (Nachmias & Nachmias, 1992, p.469). In particular, the Mann Whitney U test was applied to measure how the response from different representative bodies compared. The decision-making process developed by Foster was adopted (1998, p.19). Further statistical analysis of key research questions was also carried out using the sign test (Fellows & Liu, 1997, p.148 & Kodikara, 1990, p.255).

Prior to being input into SPSS the questionnaire responses required coding (Nachmias & Nachmias, 1992, p.470). The structured tick box responses were easily coded as they were already pre-defined. The free text responses required a more detailed assessment. This involved reading through each of the responses a number of times and from this conceptualising the underlying issues. These issues were then checked by going back through the free text responses to make sure each point had been covered. Unique codes were then generated for each of these issues and responses coded accordingly.

Although a good response to the survey was obtained consideration was also given to those that had not responded. It was considered that no underlying trend in their characteristics existed and that it was unlikely that their views would differ considerably (Bell, 1996, p.86).

3.4.8 Expert verification

Having completed the industry survey it was considered important to test the generated theory on a panel of experts. After much consideration the RICS Mechanical and Electrical Services Panel were selected. The M&E Services Panel represented practitioners at the forefront of their discipline, interested in improving procedural advice and attaining a greater level of understanding of current issues within the industry. As the focal theory of the research had emerged, the results were now directly relevant to this panel.

The presentation took place on the 3rd August 2000 at Parliament Square, London. An open invitation was sent to all members of the Panel. Attendees included John Sparkes (the Chairman), David Nicholl (a practitioner) and Joe Martin (Executive Director of the Building Cost Information Service). The presentation covered the overall objectives, the research undertaken at that time (interviews and the industry survey) and focused on the results of the latter. The research was well received and useful commentary written by Joe Martin on behalf of the Panel. A copy of the response to this is contained in Appendix G (p.425).

3.4.9 Limitations within the methodology

It is important to consider any potential limitations within the methodology and their affect on the reliability and validity of the results.

The low attendance of members from the Mechanical and Electrical Services Panel may draw into question how representative their feedback was. However, the attendees were well versed with the views of other panel members. The research methodology did not rely heavily on the results of the presentation - it was merely seen as an additional check measure.

3.4.10 Summary

This section has detailed the methodology adopted in carrying out the industry survey. The aims and objectives of the stage and key sampling decisions have been identified. The design of the questionnaire was then explained including piloting techniques adopted to ensure its appropriateness. Reference has been made to analysis techniques.

3.5 Empirical testing: Questionnaire survey 2

3.5.1 Introduction

The following section describes the third and final stage within the triangulated research methodology. Having gained an understanding of the focal theory and tested the potential solutions in a more structured manner, the empirical testing stage homes in on the focal theory of the thesis and finally tests out the proposed solutions. This is achieved by carrying out a secondary industry wide survey.

This section will cover the key decisions made, how the data were collated and analysis techniques employed. It will also give consideration to limitations within the methodology.

3.5.2 Aims and objectives

The previous section described how the behavioural characteristics of identified groups of contractor, specialists and non-specialists, were tested via an industry survey. The overall aim of the empirical testing stage is to test out two specific issues:-

1. The frequency by which quantity surveying firms accurately quantify the work in practice for:-

    1.1 Specialist contractors.

    1.2 Non-specialist contractors.

2. Based on the above, the preferred source of quantified information:-

    2.1 Whether the estimators prefer to quantify the work themselves, or;

    2.2 Whether the estimators prefer to have it produced for them.

3.5.3 Sampling decision making process

The aim of the sampling process is therefore to gain as representative a sample of the two different groups of contractor (specialists and non-specialists as defined) to test their views on the above objectives.

The key decision making process in seeking to achieve this is detailed below.

3.5.3.1 Sampling frame

Of fundamental importance is the target audience at which the questionnaires are directed. Based on exactly the same rationale as the other two stages the target audience was identified as the contractors' estimator. The contracting companies themselves thus forming the units of analysis.

It was decided, in the first instance, that the solutions derived from the industry survey should be re-tested on the original respondents. This would help to ensure that a correct interpretation had been made – particularly with respect to theory generated from the open-ended questions. All those that responded to the original questionnaire would therefore be sent a copy of the final questionnaire. Further samples were also taken of the three representative bodies in order to ensure an adequate response level.

It was also considered of interest to obtain the views of other members from within the industry. The views of other contracting organisations (not necessarily members of the above sampling frames) and the views of the quantity surveying firms were sought. Although the potential solutions were focused on improving the effectiveness of pricing documentation for estimators it was considered worthwhile taking in the views of other interested parties from within the industry. As the quantity surveying firms were known to frequently produce bills of quantities this would enable the proposed solutions to be tested from a different perspective. If both views correlated then this would add weight to the overall thesis.

In summary, it was decided that five samples would be drawn in total:-

1) NFB.
2) HVCA.
3) ECA.
4) Other contractors.
5) Quantity surveying Firms.

Appropriate sampling frames for the first three groups of contractor had already been identified within the previous section of the research (section 3.4.3.1, p.144). The last two samplings frames (for the quantity surveying firms and 'other contractors') were compiled from lists of personnel within these firms. The companies were selected from around the UK to ensure that the respondents were not limited geographically.

3.5.3.2 Sample size

Having defined the appropriate sampling frames the required sample size from each of these was then considered.

As the respondents to the industry survey would all be sent a copy of the final questionnaire their sample size was already defined - seventy-six for the NFB, fifty-nine for the HVCA and thirty-seven for the HVCA (table 3.4, p.154).

The total number of samples required was then derived based on the original response rate (above) and the requirement to attain a minimum response of 32 (to avoid small number statistics). The size of the total samples therefore equated to one hundred and fifty-three for the NFB, one hundred and fifty-eight for the HVCA and one hundred and ninety-four for the ECA. The higher total samples obviously reflecting a lower original response rate.

The list of quantity surveying firms and 'other contractors' equated to fifteen and sixteen respectively. Thus, the total number of samples for the validation survey was five hundred and thirty-six (this is summarised in Appendix I, p.433).

As detailed within the previous section the sampling technique (p.149) was that of a *non-proportional quota* sample (Nachmias & Nachmias, 1992, p.167). Samples were continually taken from the sampling frame until the required number of samples (i.e. the quota) had been achieved.

3.5.4 Questionnaire design

The overall objectives of the empirical testing stage were defined at the beginning of this chapter and questions were worded to conform to these.

As specific issues were now being tested the questionnaires could be designed with prescribed tick-box response categories (Oppenheim, 1992, p.12). They no longer required any free text sections. Both types of contractor were expected to vary in opinion, the final stage sought to test-out whether these held true - to validate these assertions in a structured manner.

The questionnaire was also visibly shorter, four questions in total, reflecting the narrow focal theory of the research (as illustrated at the beginning of this chapter within figure 3.1, p.116).

3.5.5 Pilot study

Having defined the individual focus of each question it was considered important to validate these by carrying out a pilot study. This would enable the wording of the question to be checked and also that the respondents correctly understood what was being asked of them. The aim of the pilot was to obtain feedback on the questionnaire style and format.

The pilot was sent to ten specialist contractors and ten non-specialists (twenty in total). As all previous respondents were to be approached for the questionnaire itself it was not possible to approach these for the pilot study. Therefore ten additional samples of each category were drawn from the sampling frames.

Each candidate was firstly telephoned and background of the research explained, before requesting that they take part in the pilot. Once agreement had been reached the questionnaires were sent with a covering letter and stamped addressed envelope.

An overall response rate of seventy percent was achieved (fourteen responses in total). Eight were returned by the non-specialists and six from the specialists. It was considered that a sufficient number had been received from each interest group to allow an appropriate analysis of the results to be undertaken.

Only two responses varied from that anticipated. One specialist response gave an unexpected view on non-specialist work and a non-specialist on their own work. Although some disparity is only to be expected the researcher wanted to discover the reason for these anomalies, for example, a poorly worded question or whether it had been an oversight on the respondents behalf. Each of the two respondents were telephoned and questioned about the responses made. To allow an informed discussion to take place the filled out questionnaire was faxed back to the respondents and discussed in detail. The researcher considered that it was inappropriate to focus on the individual question as the respondent may well just state the opposite response (the anticipated response) to please the researcher. Instead, it was not suggested that any of the questions were incorrect only that the researcher wanted to check that the questions had been fully understood (in line with previous discussions about the pilot). Each of the questions was addressed in turn and most appropriate response category discussed (effectively blind). In both cases the respondent recognised their initial error without prompting from the researcher. Having re-read the question respondents changed their view of what the most appropriate response should be. When asked about the wording of these questions the respondents had a clear understanding of what was being asked of them. However, it was felt that the questions could be more clearly worded and minor refinements were made.

The piloted questionnaire was presented at a supervisory meeting at Nottingham Trent University. Examples of the completed questionnaires from the pilot study were distributed and the aims and objectives of each question discussed. It was considered that the questionnaire was sufficiently robust and clear to allow distribution to a wider audience. A copy of the completed questionnaire is contained within Appendix H (p.430).

3.5.6 Selection process

The same protocol was followed as for the initial industry survey. The original respondents were sent a copy of the questionnaire and an explanatory covering letter. All of the new samples were individually selected from the three membership listings. This allowed a broad cross section of contractors to be selected based on their characteristics. The researcher attempted to gain as much of a balance between these characteristics as possible. Contact was also made with the quantity surveying firms and 'other contractors'.

Once the firms had been selected each company was personally called and the estimator located. The overall aims of the research were explained and anonymity assured before the request to fill out the questionnaire was made. Once agreement had been reached a covering letter was sent enclosing the questionnaire and stamped addressed envelope. To enable the questionnaire to be recognised upon its return the questionnaires were tagged before being sent out. A footnote in the bottom corner of each questionnaire displayed a unique number that corresponded with the members database.

It was envisaged that by telephoning the respondents and enclosing a freepost envelope the response rate would be increased.

The overall response was better than originally anticipated and is summarised thus:-

Table 3.5: Empirical testing questionnaire responses

		Actual returned		Comparison	
Representative Body	**No. of surveys sent out**	**No.**	**%**	**No.**	**%**
1. NFB (76 + 77)	153	98	64	-55	-36
2. HVCA (59 + 99)	158	92	58	-66	-42
3. ECA (37 + 157)	194	96	49	-98	-51
4. QS Firms	15	11	73	-4	-27
5. Contractors	16	12	75	-4	-25
Totals	**536**	**309**	**58**	**-227**	**-42**

3.5.7 Analysis

Analysis of the results was broken down in to two distinct stages. An initial review of the results was made using descriptive statistics. This allowed a 'feel' for the data to be gained and an evaluation of the best method of secondary analysis to be made (Fellows & Liu, 1997, p.145). It was recognised, in a similar vein to the industry survey, that the secondary analysis would need to give due credence to statistical measures. An evaluation would need to be made of the amount of correlation between the two specialist results and degree of variance between the specialists and non-specialists. In addition, analysis would need to be undertaken of the response from quantity surveying firms and the 'other contractors'.

SPSS was chosen as the most appropriate means of statistically analysing the data (refer to section 3.4.7, p.154 for the decision-making process).

The response categories in each question were firstly given a unique code and data collated in this format. The end product being a list of coded responses alongside each unique contractor within the database.

Although a good response to the survey was obtained consideration was given to those that had not responded. It was considered that no underlying trend in their characteristics existed and that it was unlikely that their views would differ considerably from those already obtained (Bell, 1996, p.86).

3.5.8 Limitations within the research methodology

The number of samples drawn from the two new groups (quantity surveying firms and 'other contractors') was very low. As a result any inferences made from these results need to be made with extreme caution. Certainly the views from quantity surveying firms cannot be held as a generalisation of the total population. The results of these two additional samples therefore provide no real evidence either in support or against the thesis.

3.5.9 Summary

This section has covered the overall methodology adopted in undertaking the empirical testing stage of the research - the final stage.

An overall introduction to the empirical testing stage including its aims and objectives was outlined and the decision-making process in seeking to obtain a representative test of these objectives explained. This included an assessment of the sampling frames from which the samples should be drawn, the size of the samples, questionnaire design, piloting, selection process and final analysis techniques. Due consideration was then given to any limitations within the methodology. It was concluded that generalisations should not be drawn from the results of quantity surveying firms or 'other contractors'.

3.6 Evaluation of the research methodology

Three individual techniques have been applied within the overall qualitative methodology.

The interviews were aimed purely at identifying the underlying issues about how contractors price their work, the kind of problems they face and potential solutions. They also provided an invaluable update of current practice. By theorising from the interviews it was evident that a number of trends were occurring that typified certain types of contractor.

> "Starting with a topical concern, researchers pose foreshadowed problems, concentrate on issue-related observations and interpret patterns of data that re-form the issues as assertions." (Stake, 1994, p.239)

Although, it was considered that a degree of saturation had been experienced, that is, the results were becoming predictable; the results could not be generalised to a larger audience.

The findings therefore required testing on a larger and more representative audience hence the adoption of a more structured research instrument. However, prior to carrying out the industry survey, it was considered important that a balance was maintained between obtaining structured responses to pre-defined questions and allowing a certain degree of freedom within the response. It could not necessarily be assumed that the interviews had unearthed all of the underlying issues.

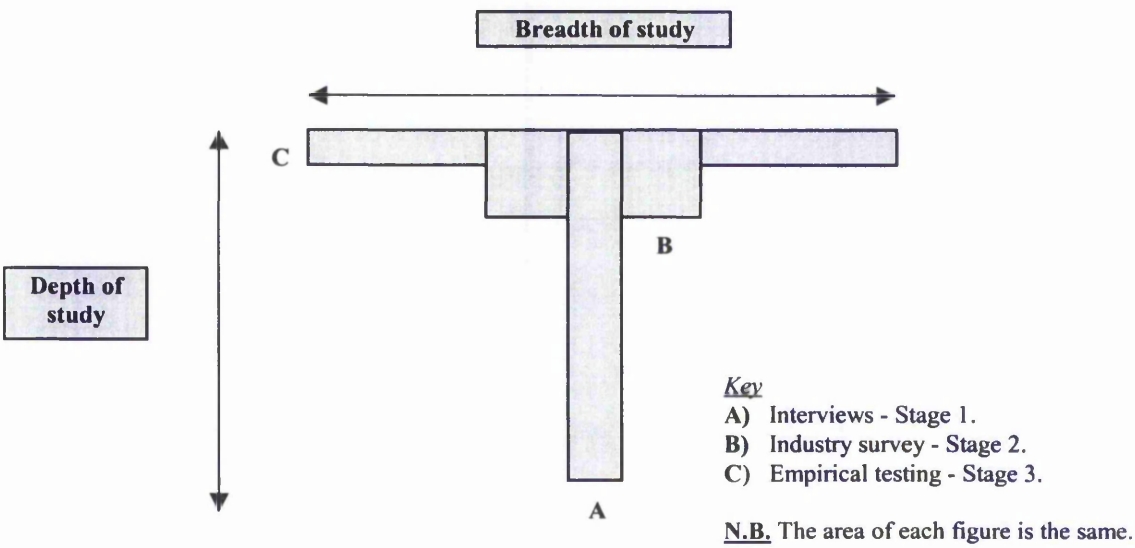
At each of the above stages check measures were implemented to test-out the findings with experts. This proved beneficial in two respects:-

1) To crystallise thoughts and findings, and;
2) To gain invaluable feedback.

The final stage tested out the developed theory in a purely structured manner. This reinforces how the theory has been developed throughout the course of the research by conceptualising, testing and re-testing the results.

The following illustration shows how the techniques have enabled theory to be gradually developed from an in depth understanding to generalisable solutions tested on a representative audience.

Figure 3.5: Breadth v. depth in 'question based studies'



Source: Fellows & Liu, 1997, p.90.

In addition, each of the three stages employed piloting techniques which, in themselves, helped to focus the attention of the study and question the focal theory of the research.

The overall methodology prudently allowed each stage of the research to be undertaken with a degree flexibility. The manner in which their individual objectives were achieved was developed as the research progressed.

In each of the three stages great care was taken to obtain both as representative a sample of candidates as possible and to follow strict protocols to ensure reliability.

3.7 Reliability and validity

It is considered that the adopted methodology has enabled both reliable and valid results to be obtained.

The initial in depth nature of the research allowed key issues and problems to be identified and thus direct the rest of the research around this. A number of 'tactics' (Miles & Humberman, 1994, p.432) have also been employed to test-out the findings of the research and ensure their validity (e.g. noting patterns and themes, clustering and making comparisons).

> "Validity means the ability to produce findings that are in agreement with theoretical or conceptual values; in other words to produce accurate results and to measure what is supposed to be measured." (Sarantakos, 1993, p.74)

The results of the research have also been continuously tested out in subsequent stages and, during this substantive testing, found to hold true.

> "Validity is claimed if the findings....are supported by empirical evidence." (Sarantakos, 1993, p.74)

The methodology has been documented in sufficient detailed (supported by the appendices) to enable the research to be replicated – effectively providing a "chain of evidence" (Yin, 1989, p.102). Protocols were also strictly adhered to and subjects approached in a consistent manner throughout.

3.8 Ethical considerations

Due regard has been given to ethical issues relevant to the research project.

Appropriate personnel from membership bodies were initially contacted and approval obtained prior to contacting the members direct. The overall objectives of the research were explained to each candidate and anonymity of the results assured.

Disruption to the candidates was also kept to a minimum. Freepost envelopes were enclosed with each questionnaire and contact made at appropriate times.

Gratitude was always extended to those that devoted time to the research.

3.9 Summary

This chapter has outlined the methodology adopted in seeking to achieve the aims and objectives of the overall research project.

The chapter describes the processes undertaken by the researcher throughout the course of the research. The three main stages within the methodology are seen to complement one another and to provide continuity in their objectives. By adopting a triangulated approach the research has developed an understanding of current practice within the industry, the problems encountered by estimators and proposed solutions to overcome them.

The research also allows the area under investigation to be tested in a number of different ways. This means that the results do not remain exposed to inherent weaknesses within any one technique (Fellows & Liu, 1997, p.95). The adopted techniques provided a degree of flexibility to enable them to be tailored as required. As the focal theory of the research is relatively unexplored this is a vital quality inherent within the design of the methodology. As theory is developed it is continually re-tested until confidence is gained.

Within each of the three stages of the methodology details are provided of the key decisions made and their rationale. Due consideration is given to the sampling techniques, potential for bias and the research instruments used for data collection.

Despite a critical analysis within each of these stages it is considered that the overall objectives of the research methodology have been attained. However, although not critical to the overall results, samples from two groups (quantity surveying firms and 'other contractors') are not considered worthy of including within the results. Their views are not considered to be representative of their member groups and thus unreliable to draw any conclusions from.

CHAPTER FOUR

RESULTS

4.1 Introduction

The aim of the results chapter is to present and analyse the findings of the research against the overall research problem and individual research questions.

No attempt is made to draw any conclusions about the results at this stage. Although a number of general trends are noted within the commentary, their interpretation, comparison with other researchers and implications for theory and practice are addressed within chapter five - *discussion of findings*.

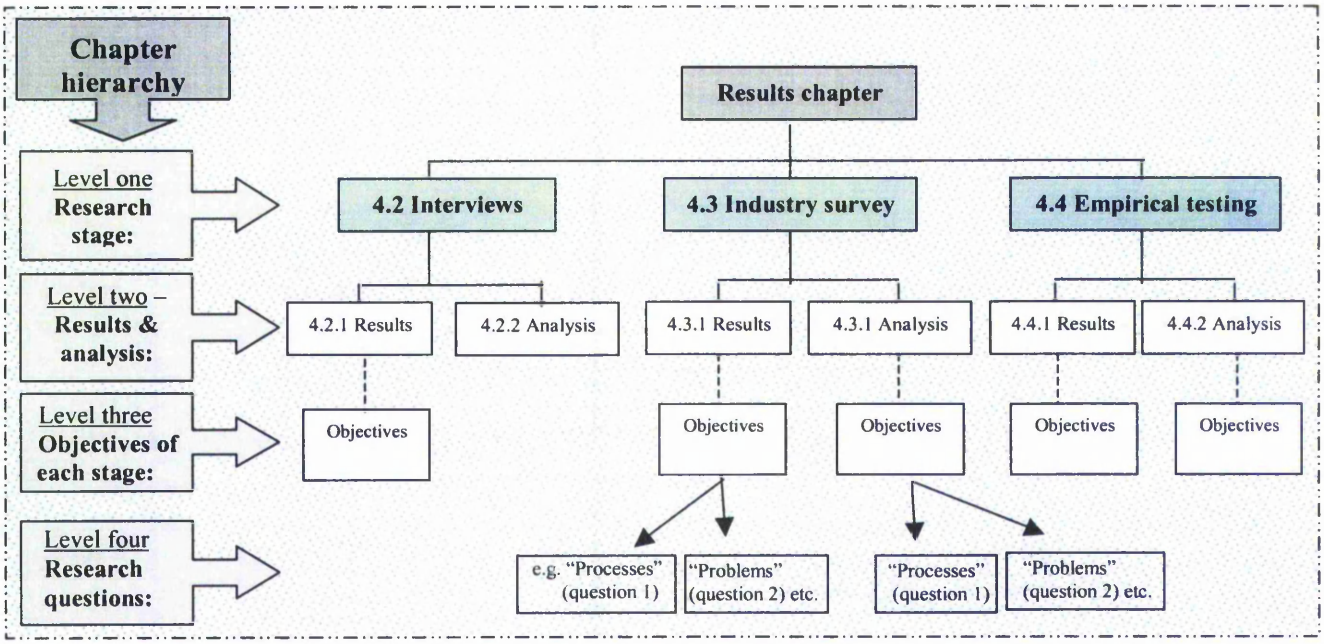
The results chapter also unites the previous two chapters. Findings are recorded against each of the research questions established during the literature review and represent the outcome of techniques selected within the methodology chapter.

An initial introduction to the structure of the chapter is provided before explaining the style of presentation that has been adopted. A summary of the key findings is contained at the end of the chapter.

4.1.1 Structure of the chapter

The results chapter is by far the largest chapter within the thesis. The presentation of such a substantial amount of data requires a logical and structured approach to be adopted. Figure 4.1 serves to illustrate the overall structure of the chapter and consistent approach that has been applied to each stage:-

Figure 4.1: Overall structure of the results chapter



Basically, the chapter is broken down into four main levels - referred to as the *chapter hierarchy* within the illustration. Level one of the chapter hierarchy reflects the main stages of the research project that were previously established during the methodology chapter i.e.:-

4.2 Interviews.
4.3 Industry survey.
4.4 Empirical testing.

Each of these stages is then further subdivided into a *results* and *analysis* section (referred to as level two). For example, the industry survey is broken down as follows:-

4.3 Industry survey

→ **4.3.1 Industry survey *results***

→ **4.3.2 Industry survey *analysis***

The *results* and *analysis* sections are then further broken down by *research objective* (level three) and, finally; into each of the individual *research questions* that underpin these objectives (level four).

The interview section is the only exception to this structure. As stated within the methodology chapter (section 3.3.6, p.138), analysis of the interview findings was carried out on an iterative basis as the data was collated. A separate analysis section is therefore not necessary.

Structuring the chapter in this manner helps maintain continuity throughout the entire thesis. It also enables a single research question to be tracked from its inception, at the literature review stage; through to the selected methodology, results, analysis and final conclusions.

4.1.2 Presentation of the results

The style of presentation has been tailored to the type of data and individual objectives of each stage. A presentation of the participants involved is initially provided at the beginning of each section. The results are then presented against each of the research questions relevant to each stage. Commentary is provided at this level. Their collective findings are then reviewed at research objective level then, more globally, in the context of the stage itself. In this respect, the results are disseminated by research question and the theory re-constructed in order to address the objectives of the research.

Flow charts are used extensively within the interview results to best illustrate the complex flow of information and interfaces between the each party. Tables are also provided at regular intervals and help to reinforce the findings made.

The industry survey contains the largest proportion of data within this chapter. Histograms have the added benefit of allowing each of the varying styles of questioning to be presented in a consistent format. This is an important feature given the volume of results involved. Each response is expressed in percentage terms and compares the cumulative view of each of the three representative bodies. To aid understanding, a consistent colour has been used throughout (yellow for the NFB, blue for the HVCA and green for the ECA).

In order to maintain a conceptual overview of the industry survey findings and comprehend their relationship to one another, a summary table is contained at the end of the industry survey section (table 4.7, p.261). A further colour coding is contained within this table and serves to categorise the results according to whether the two defined groups of contractor are in agreement with one another or whether their views differ considerably. This provides a powerful summary of the industry survey section.

Analysis of the industry survey is itself split according to its two main objectives:–

1) To test the statistical significance of each representative body by research question.
2) To compare statistically the views of each representative body i.e. their level of agreement with one another.

The results of the analysis are summarised in exactly the same order as they are recorded within the chapter – by research objective then by research question (table 4.9, p.456 – table 4.36, p.475). These tables help maintain a conceptual overview of the results and enable the individual findings to be reviewed in context with one another.

The final empirical testing stage is set out in exactly the same manner as the industry survey above. The results are initially presented in the form of histograms. A tabulated summary of the results is also provided (table 4.37, p.286). This is followed by a summary of the analysis (table 4.38, p.291 – table 4.42, p.293).

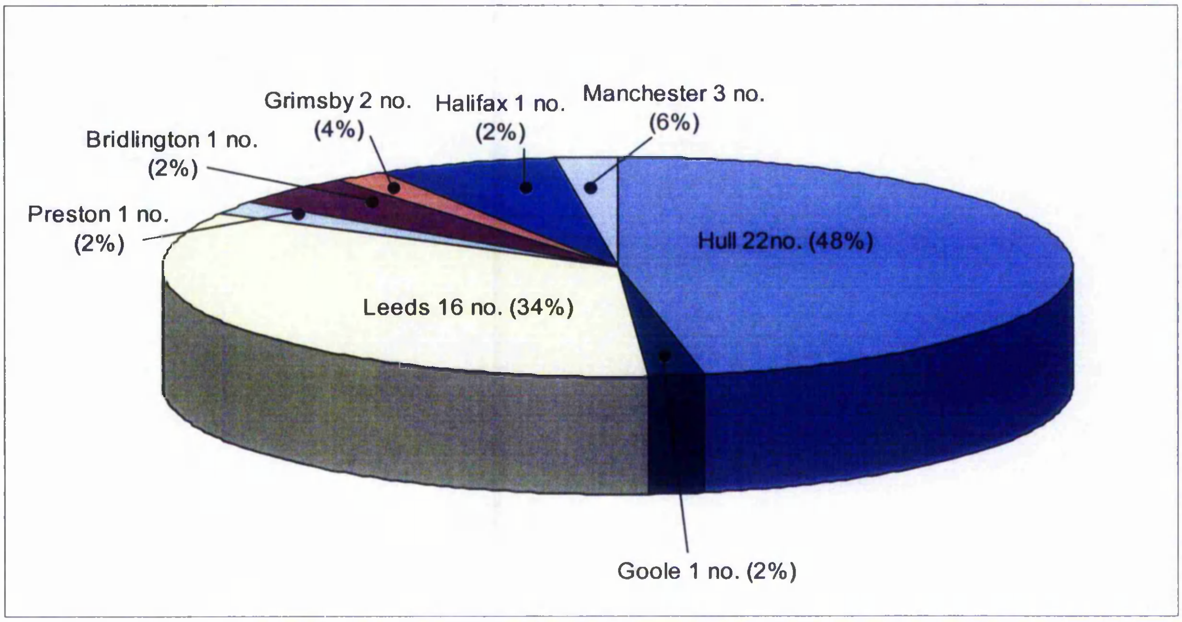
4.2 Interviews

The background of the 47 contractors involved in the interviews is initially presented.

4.2.1 Profile of participating firms

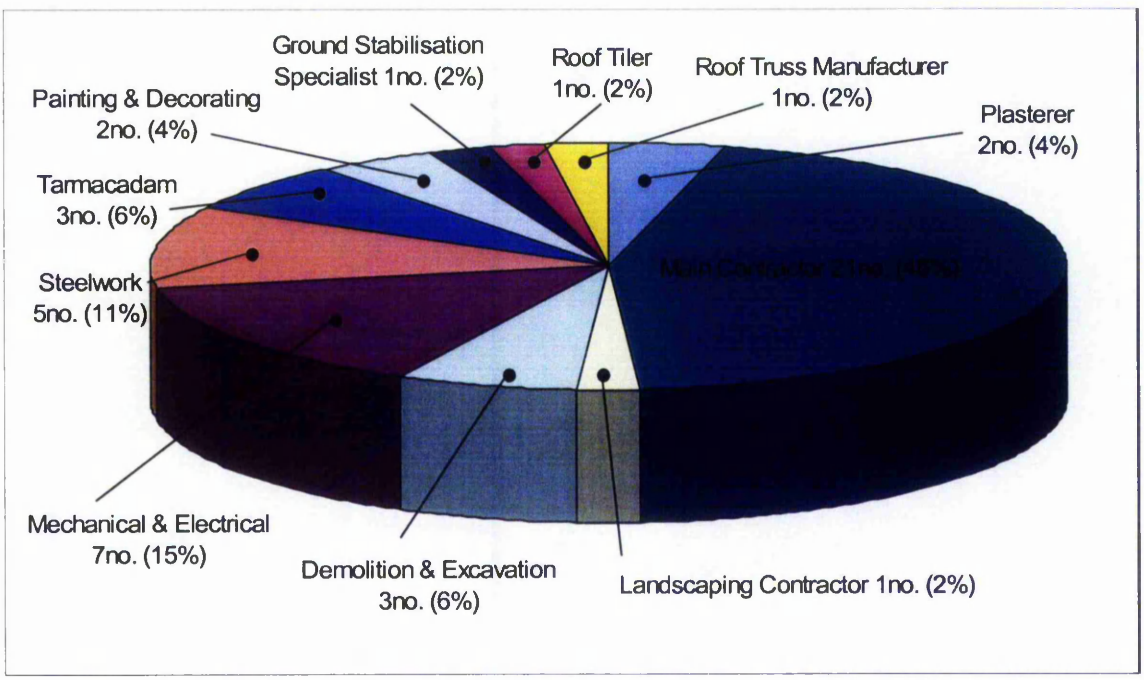
As chart 4.1 illustrates below, interviews were predominantly carried out within the Yorkshire region. The majority took place in Hull (22 no, representing 48%) followed by Leeds (16 no, 34%). A further 10 interviews (18%) were also conducted in the outlying areas of Manchester, Halifax, Grimsby, Bridlington, Preston and Goole.

Chart 4.1: Locations of interviewed contractors



The type of work undertaken by each contractor is illustrated below. A cross-section of contracting organisations participated in the interviews. Out of a total of 47, 21 (46%) of the firms were main contractors and 26 (54%), subcontractors. The subcontractors were represented by a mixture of types of contractor - landscaping (1no, 2%), demolition and excavation (3no, 6%), mechanical and electrical (7 no, 15%), steelwork (5no, 11%), tarmacadam (3no, 6%), painting and decorating (2no, 4%), ground stabilisation (1no, 2%), roof tiling (1no, 2%) a roof truss manufacturer (1no 2%) and 2 plasterers (4%).

Chart 4.2: Type of contractor



4.2.2 Interview results

The results of the interviews are reported against the two main objectives of this stage - *understanding the problems* and *formulating proposed solutions*.

4.2.2.1 Understanding the problems: objective 1

The results initially focus on the processes involved in tender preparation and flow of information therein. The problems encountered are then categorised and their consequential affects evaluated based on presented frequency levels.

What processes are commonly adopted in the preparation of pricing documentation?
(research question 1)

The processes involved in preparing a price were found to be relatively complex. However, by splitting the process down by participant/ interface, three distinct stages are evident:-

Table 4.1: The three main stages to the pricing process

Stage	Parties involved	Level	Description	Interface between
1	Client/ Main contractor.	**Macro level.**	Covers the overall format of pricing documentation as presented by the client.	Client and main contractor.
2	Main contractor.	**Macro level.**	Covers the main contractors management of the pricing documentation.	N/A – covers main contractors internal options/ decisions.
3	Main contractor/ subcontractor.	**Micro level.**	Covers the overall format of pricing documentation as presented by the main contractor to the subcontractor.	Main contractor and subcontractor.

Both the client/ main contractor interface and the main contractors own decision-making process are viewed as being at the macro level (stages 1 and 2 in table 4.1, p.183). As the flow of information is tracked down to subcontractor level it is also evident that a micro level of tender preparation exists (i.e. stage 3).

Separating the pricing process into three clearly defined stages serves to highlight the main parties involved, their decision making processes and effect of the format of the tender documentation on their ability to price the work effectively. Each have fundamental choices to make during the pricing process which in turn have consequential effects on one another.

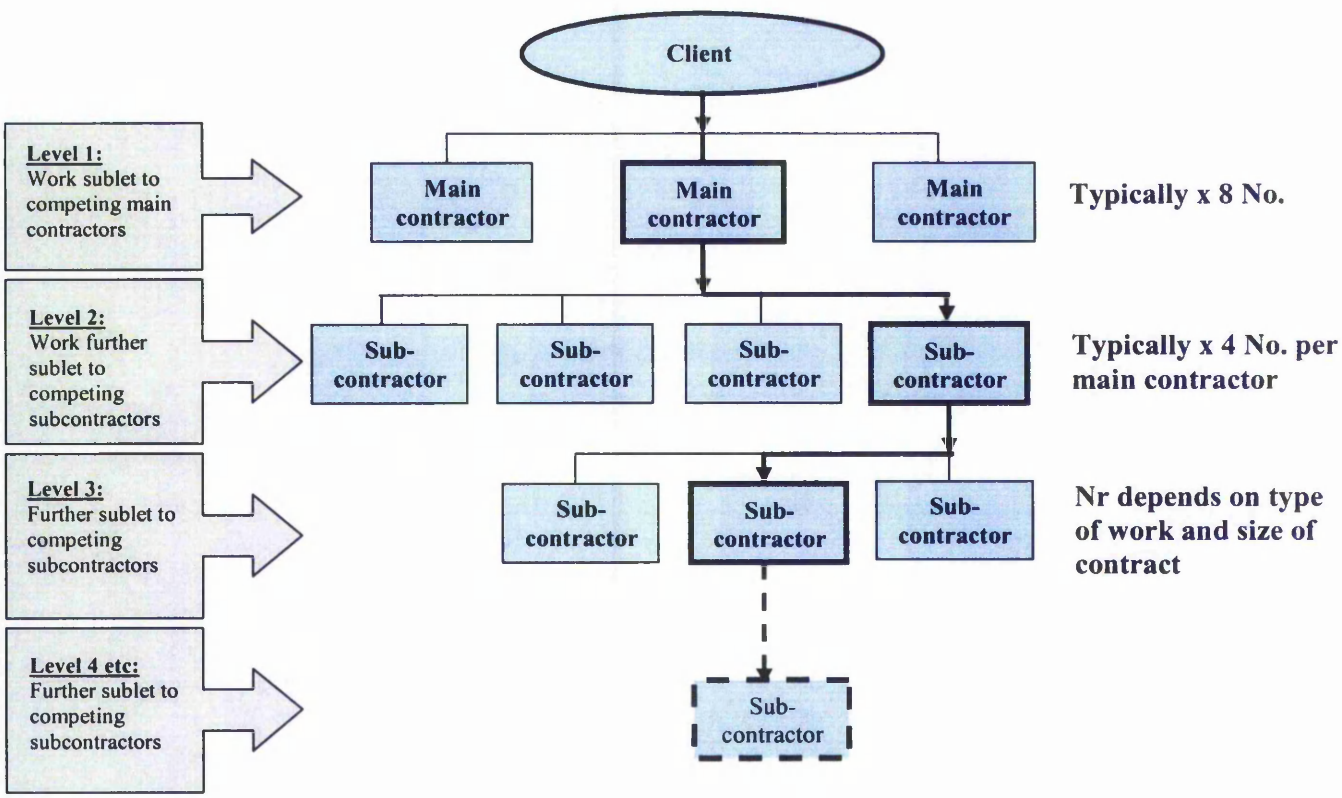
Stage 1: Interface between client and main contractor (macro level)

The initial interface between client and main contractor effectively forms the start of the pricing process i.e. the point where the pricing process is initiated by the client. The format of the tender documentation from the client was found to have a significant affect on the entire pricing process.

The interviews questioned, in practice, how many contractors were typically involved within the pricing chain and their respective level within the hierarchy. Figure 4.2 (p.185) serves to highlight the typical contractual arrangements and number of parties involved within the pricing chain. As will become evident later within this section, it is important to establish the typical contractual hierarchy and number of contractors involved as this enables the frequency of the problems encountered to be evaluated.

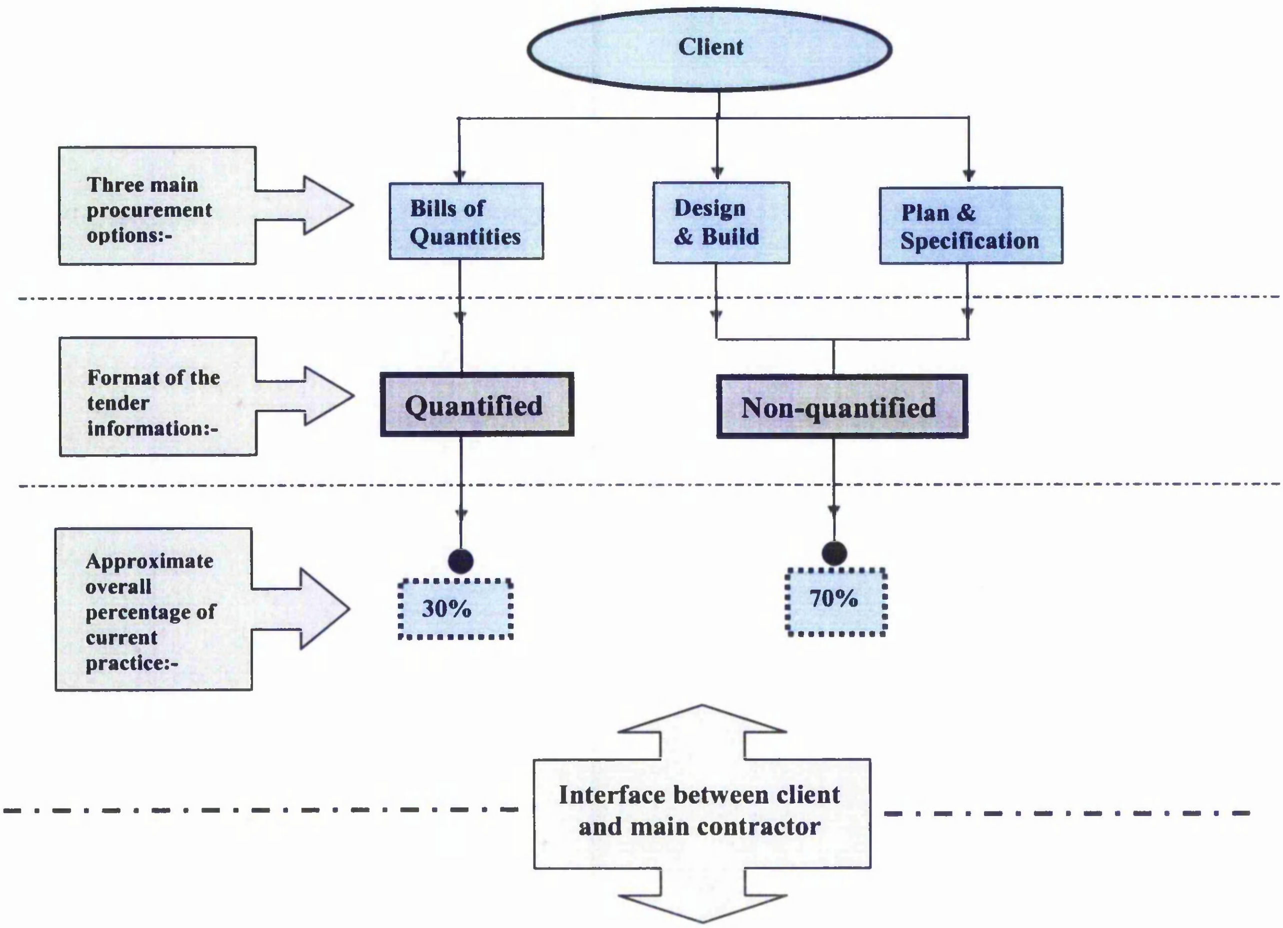
The interviewed estimators reported that approximately 8 main contractors would be asked to price on a typical contract (referred to as *level one*). At *level two*, subcontractor level, approximately 4 contractors would typically be asked to price. Therefore, if every main contractor used a different subcontractor this would equate to 32 subcontractors per trade. However, in reality, the same subcontractors would be used by competing main contractors. Somewhere between 4 and 32 subcontractors would therefore typically be involved in the pricing process. The potential to use different subcontractors was repeated at the next level down – *level three*. Again, level two subcontractors would also use common level 3 subcontractors. It is worth noting that both the number of levels in the contractual hierarchy and number of contractors involved was directly affected by the value and complexity of the particular contract. Both the number of levels and number of contractors involved tended to increase as the projects rose in terms of their complexity and cost. However, the illustration does serve to provide a level of understanding as to the typical arrangements in practice.

Figure 4.2: Typical contractual hierarchy and number of contractor involved (stage 1)



Having evaluated the overall procedural framework a more detailed review of the methods of procurement was undertaken. Interviews served to confirm the existence of three basic methods of procuring construction work, namely, Design and Build, Plan and Specification and Bills of Quantities. The frequency of use of each method of procurement was also recorded and is illustrated below:-.

Figure 4.3: Typical format of the pricing documentation (stage 1)



The initial results revealed that the traditional method of preparing pricing documentation was used infrequently in practice - perhaps accounting for as little as 30% of the total workload. More probing questions also revealed that, as a generalisation, about a third of this was not measured in accordance with the Standard Method. Therefore, only about 20% of the all contractors' workload was actually measured. The results identified a level of disparity between initial questioning and more probing analysis of the value of work actually measured. Only a superficial level of understanding had been obtained by previous literature (RICS, 2000 b, p.5).

The fact that only about two-thirds of the stated frequency of work in bills of quantities format was actually measured led to a number of more probing questions. The research, through more in depth investigation, revealed which trades were typically measured and those that were not. This led to an important discovery.

The actual percentage of work that was measured consistently differed between different types of trades. At first, a discernable trend was not evident; however, as the number of interviews increased an overall trend in current practice was identified. The main contractors and more traditional subcontractors (defined as the likes of plasterers, roof tilers and flooring etc) reported a higher incidence of work being measured for them than the more specialist trades (defined as mechanical and electrical trades).

This was an important discovery in the context of the research project. An underlying trend in terms of whether the work was measured was therefore found to relate to the characteristics of the trade itself.

The interviews then sought to investigate why this trend occurred in practice. Again, a more in depth and focused line of enquiry was undertaken. The interviews then started to question, based on variances in practice in terms of the information *supplied*, how each contractor would prefer to *receive* the tender documentation to best prepare a price for the works. An open view was maintained as it was not necessarily presumed that all work was preferred to be measured as indicated by the literature.

This revealed that all contractors, both the main contractors and both types of subcontractor (the more traditional and those that carried out specialist work), reported a basic need for their work to be quantified before they could determine a price.

Essentially, the design needed to be separated into understandable elements of work in order that the amount of work involved could be quantified and the requisite resources priced. However, despite all contractors stating their basic need for the work to be quantified, the preferred *source* of this information was found to differ between types of contractor (i.e. *who* they preferred to quantify the work).

It was revealed that, the main contractors and more traditional subcontractors preferred their work to be quantified for them. Examples included trades such as groundwork, brickwork, roof tiling, plastering, painting, cladding, concreting and floor finishings. The type of work that was subcontracted by main contractors was also found to be consistent in practice.

In direct contrast, it was discovered that the specialist subcontract trades preferred to quantify the work themselves. They stated a desire for their work not to be quantified for them as required by SMM7.

This important observation was made at an early stage within the interview stage and so enabled the findings to be re-tested on subsequent cases. It was subsequently confirmed that the main contractors and more traditional subcontracts preferred the work to be quantified for them whereas the more specialist trades preferred to quantify the work themselves. The rationale behind each approach was also found to be based upon similar core issues – accuracy of the price, ease of pricing, speed in preparing a price and overall cost.

Discovery of specialist and non-specialist contractors:

Re-testing of these findings on subsequent interviews confirmed the original observations. An important discovery of two, quite separate, groups of contracting organisation had been established.

One category of contracting organisation, typified by the more specialist trades such as mechanical and electrical work, was found to share a number of typical characteristics:-

- The design for this work was rarely at a state of completion that allowed direct pricing.
- As a result, they would carry out a significant proportion of the design work themselves.
- A number of in-house assumptions would be made during this process.
- These in-house assumptions would often be unique to each competing contractor – each would develop their own design solution.
- Their perception of the quantity surveying profession, in terms of their ability to quantify their work, was poor. They firstly did not perceive that the design had typically progressed to a state that allowed quantification by an external party. Secondly, they considered that the profession did not typically possess adequate understanding of their work to allow them to produce accurate quantities.
- These trades preferred to quantify the work themselves – they found this quicker, cheaper, more reflective of actual cost and that they retained less risk when they did so.

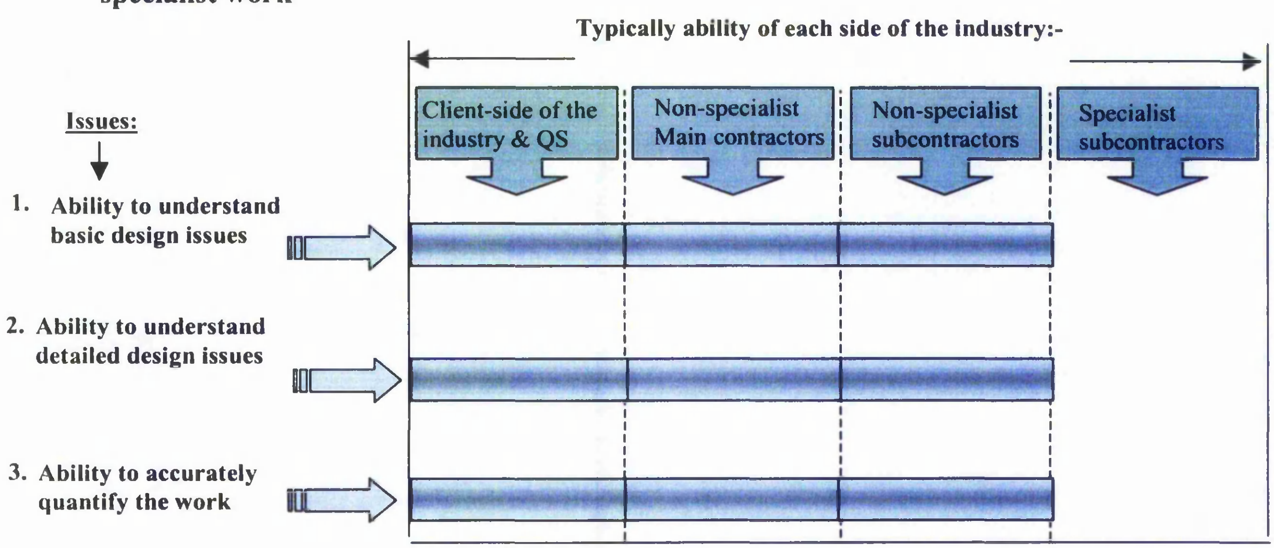
The other category of contracting organisation, typified by the more traditional work such as brickwork, plastering, roof tiling, flooring; was also found to share a number of common characteristics. These were represented by both main contractors and the more traditional subcontracted work. This group of contracting organisation was found to be typically the opposite of the former:-

- The design for this work was substantially complete.
- Very little, if any, design work was required to be completed by the competing contractor.
- A relatively minor element of in-house pricing assumptions needed to be undertaken. Differences in overall price therefore related to the contractors overall efficiency or desire to obtain the work rather than innovative design solutions.

- Their perception of the quantity surveying profession, in terms of their ability to quantify their, work was good. Firstly they did in fact perceive that the design had typically progressed to a state that allowed quantification by an external party. Secondly, they considered that the profession also did typically possess adequate understanding of their work to allow them to produce accurate quantities
- These trades preferred to have the work quantified for them – they found this quicker, cheaper, to be more reflective of actual cost. They also stated that they retained less risk when the work was quantified for them.

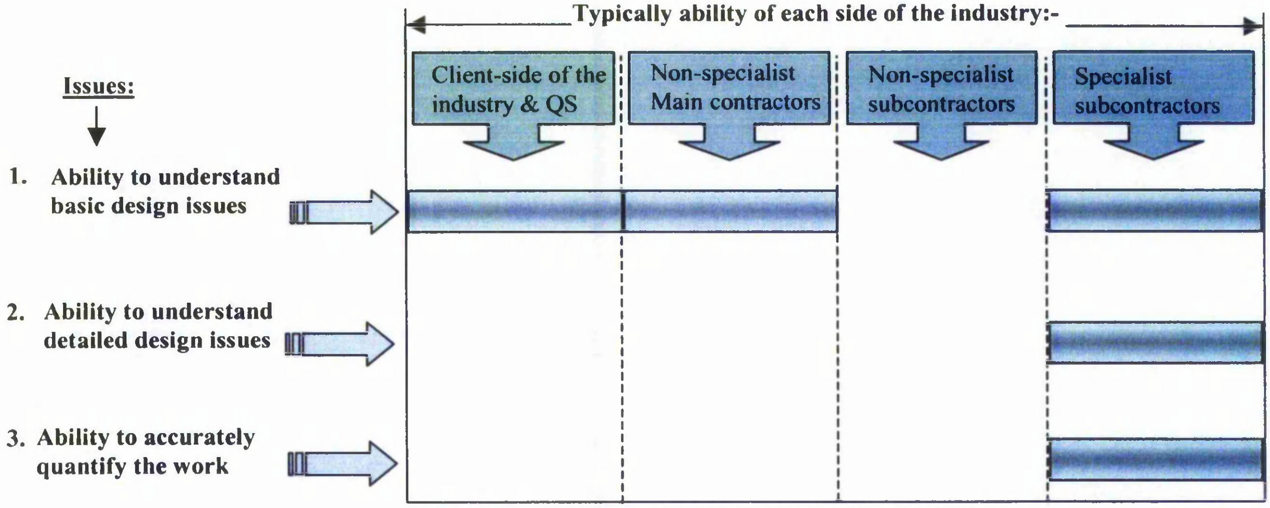
In light of the above typical characteristics, the former group was classified and defined as '*specialist*' and the latter, '*non-specialist*' (which encompassed both the main contractor and relevant subcontractors). It is also important to note that these two definitions cover the full spectrum of contracting organisation within the industry; that is, a separate type of contractor is not left outside these two definitions. The following two illustrations serve to reinforce these classifications and highlight where the 'knowledge' base of each type of work most typically resides - whether this resides solely with the contractor or is also shared with members of the industry that are external to the contracting organisation. The first illustration focuses on the non-specialist group of contractors:-

Figure 4.4: Where the 'knowledge' base resides within the industry for non-specialist work



The client-side of the industry, quantity surveying profession, main contractor and non-specialist contractors are all therefore able to understand basic design issues for non-specialist work. As would be expected, specialist contractors are unable to achieve any of the *issues* (as detailed on the right-hand side of the diagram) as they do not in practice receive this type of work for pricing. The client-side of the industry, main contractor and non-specialist subcontractor are all able to understand detailed design issues and also to quantify the work accurately.

Figure 4.5: Where the 'knowledge' base resides within the industry for specialist work



In a similar fashion, the above illustration highlights the knowledge of specialist work from within the industry. The non-specialist subcontractors' lack of knowledge can be explained by the fact that, as the specialist contractors in the previous illustration, they would not actually receive this information in practice. The client-side, quantity surveying profession and non-specialist main contractors are not typically able to understand detailed design issues nor are they able to accurately quantify the works.

The specialist trades therefore possess unique knowledge of their own area of work that is not possessed by either the main contractor (from whom the pricing documentation is received), the quantity surveying profession or the client (the initiator of the pricing process).

The following table summarises the typical characteristics of the two, quite separate, types of contracting organisation that are found in practice:-

Table 4.2: Typical characteristics of "specialist" & "non-specialist" trades

Type	Examples	Characteristics				
		1. Complexity	2. Level of design undertaken by contractor	3. State of design	4. QS understanding	5. Preferred source
Non-Specialist	Plastering, brickwork, drainage, tiling, flooring, excavation.	Low.	Minimal.	Usually substantially complete.	High. - (part of) core training.	"proper" BQ's (i.e. SMM7) - quick - simple
Specialist	M&E.	High. - unique knowledge & solutions.	Substantial.	Usually incomplete.	Low. - little training.	To measure the work themselves (i.e. move away from SMM7)

Characteristics 1-3 (complexity of work type, level of design undertaken by the contractor and the state of the design) were also found to affect characteristic 4 (understanding of the quantity surveyor). This, in turn, affected characteristic 5 (the contractors' preferred source of quantified information).

The discovery and classification of the *specialist* and *non-specialist* trades is an important milestone within the research. As will become evident, when coupled with the typical pricing practices of the industry, an understanding the types of contractor within the industry and their preferences for quantified information enables the root cause of the problems to be identified.

Finally, it is important to note that none of the interviewed contractors reported the use of nomination as a procurement route. All work was therefore procured via the main contractor.

Stage 2: Management of the pricing documentation at the main contractor level – the main contractors' decision making process (macro level)

Stage two of the pricing process focuses on the main contractors' management of pricing documentation i.e. the main contractors' decision-making process and their rationale behind this. Figure 4.6 (p.194), overleaf, provides an illustration of this stage.

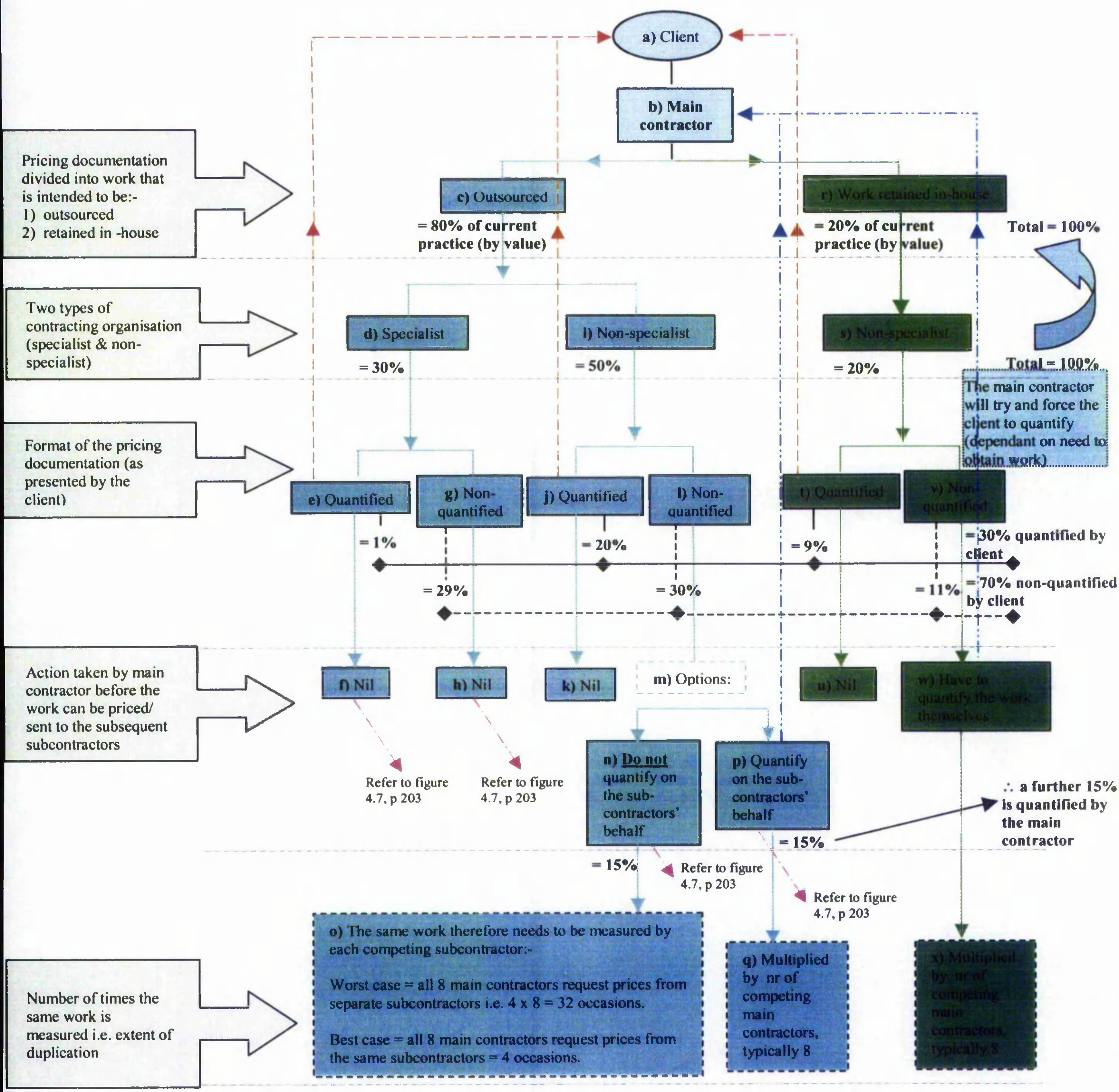
The illustration begins with the original request to price being received by the main contractor from the client (item b). A critical stage in the pricing process then occurs; the main contractor splits the work into two main areas:-

1) Work that is outsourced.
2) Work that is retained in-house.

The narrative on the left hand side of the presentation explains how the main contractor manages the information after this point. Annotations at key stages also serve to highlight the proportion of practice they typically represent.

This record of the overall flow of information is reinforced by table 4.3 (p.195) which summarises the milestones involved. The table also provides a more detailed explanation of each stage.

Figure 4.6: Illustration of the main contractors typical management of the pricing process



Key:-

Quantification risk retained by client.

Quantification risk retained by main contractor.

Quantification risk retained by subcontractor.

The following table serves to explain each of the referenced stages as illustrated above.

Table 4.3: The main contractors typical management of the pricing process

Ref	Title	Description	Total % of current practice (by value)
a	Client.	The illustration begins with the client – the initiator of the whole process. Tender documentation is initially transferred from the client (or representative) to the main contractor.	100%
b	Main contractor.	Upon receipt, the main contractor then subdivides the documentation into two main classifications:- • Outsourced work. • Work retained in house .	-
c	Outsourced (by main contractor).	The majority of work in outsourced by the main contractor.	80%
d	Outsourced by main contractor to specialist subcontractor.	Less than half of this is typically sublet to specialist contractors.	30%
e	If the work is already quantified for the specialist contractor (by the client).	In reality, only approximately 1% of the total value of specialist work is actually measured.	1%
f	Action taken by main contractor before the work can be priced/ sent to subsequent subcontractors.	If the specialist work is measured by the client, the main contractor will pass this onto the subcontractor as the priced document is likely to be requested in the same format. No direct action is therefore required.	-
g	If work is not already quantified for the specialist contractor (by the client).	If the work is not quantified, which is usually the case, the main contractor will procure a subcontract price on a non-quantified basis.	29%
h	Action taken by main contractor before the work can be priced/ sent to the subsequent subcontractors.	No action is required of the main contractor.	-
i	Outsourced by main contractor to non-specialist subcontractor.	Approximately half of the total value of work is priced by non-specialist subcontractors. Again, in theory, the format of the tender documentation may be in one of two formats:- • Quantified, or; • Non-quantified.	50%
j	If work is already quantified for the non-specialist contractor (by the client)	This represents approximately one fifth of the total value of work.	20%
k	Action taken by the main contractor before the work can be priced/ sent to the subsequent subcontractors.	No action is required of the main contractor.	-
l	If work is not already quantified for the non-specialist contractor (by the client).	Approximately 30% of the total industry workload is subcontracted to non-specialist contractors in a non-quantified format.	30%
m	Options available to the main contractor for non-specialist subcontracted work that is not already quantified by the client.	Two main option exist for the main contractor.	-
n	**Option 1**: The main contractor does not quantify the work on behalf of the non-specialist subcontractor.	Quantifying the work on behalf of the subcontractor increases both the workload of the main contractor and the level of risk. If at all possible, the main contractor will try and avoid quantifying subcontract work.	15%

Table 4.3: The main contractors typical management of the pricing process (continued)

Ref	Title	Description	Total % of current practice (by value)
o	Number of times that the same work is quantified i.e. extent of duplication within the industry.	If the work is not quantified on the contractors behalf, the non-specialist subcontractor will be faced with two options:- • To reject the non-quantified pricing information and insist that the work is quantified by the main contractor (in reality, this depends on their need to obtain work). • To quantify the work themselves (if they are in need of the work). The latter scenario results in significant levels of duplication within the industry. Assuming the 'worst case' (as described) this causes 15% of the total workload to be measured on 32 occasions (all 8 contractors employing 4 separate subcontractors). Assuming the 'best case' (as described) this causes 15% of the total workload to be measured on 4 occasions.	-
p	<u>Option 2</u>: The main contractor does quantify the work on behalf of the non-specialist subcontractor.	Bearing the above responses in mind, the main contractor will balance their own on-costs with their need to obtain competitive prices. By quantifying the work on behalf of the subcontractor a greater return rate will be expected and thus overall competitiveness of the main contractors quote.	15%
q	Number of times that the same work is quantified i.e. extent of duplication within the industry.	Although the above scenario reduces the total amount of duplication (when compared with "o") a substantial amount of duplication is still experienced within the industry. Again, assuming 8 main contractors, the same work is duplicated 8 times. Thus, 15% of the total workload will be measured on 8 occasions.	-
r	Retained in-house (by main contractor).	Only a small proportion of the work is retained in-house by the main contractor.	20%
s	Type of work retained in-house by the main contractor.	Non-specialist work is typically retained in-house by the main contractor.	-
t	If the work is already quantified by the client.	Approximately half of this is quantified by the client.	9%
u	Action taken by the main contractor (to enable pricing) if the work is already quantified.	No further action is required by the main contractor.	-
v	If the work is not already quantified by the main contractor	Approximately 11% of the industry's pricing documentation is non-quantified for the main contractor.	11%
w	Action taken by the main contractor (to enable pricing) if the work is not already quantified.	If the work is not quantified the main contractor has little choice but to quantify the work themselves. If the need for work is low then the main contractor may refuse to quantify the work and reject to tender for the work at all. This is more likely if they are also obliged to quantify subcontract work in order to obtain competitive quotations (refer to "o" above).	-
x	Number of times that the same work is quantified i.e. extent of duplication within the industry	Assuming 8 main contractors, this results in 11% of the work being measured 8 times over.	-

The illustration also highlights which parties retain the risk. This, coupled with the knowledge of frequency of practice provides some indication of the total amount of risk endured. It also provides an understanding of the extent of duplication that typically occurs in practice – a point that is further reinforced in the table below:-

Table 4.4: Total value of quantified work and extent of duplication between the client, main contractor and subcontractor

Pricing route	Category of contractor	Source of quantified pricing documentation			Cross check with figure 4.6, p.194 (items c & r)
		Client	Main contractor	Subcontractor	
Out-sourced by main contractor	*Specialist*	1%	-	29%	*30%*
	Non-specialist	20%	15%	15%	*50% (total = 80%)*
	Sub-total	**21%**	**15%**	**44%**	
Retained in-house by main contractor	*Non-specialist*	9%	11%	-	*20%*
	Total	**30%**	**26%**	**44%**	
Extent of duplication:	**Multiplied by duplication factor**	-	x 8 no. subcontractors	Typically between 4 and 32 occasions	
	Total duplication % (by value)/ number of times the same work is measured	-	Equivalent of the entire workload being measured **2.08** times (i.e. 26% x 8).	Equivalent of the entire workload being measured between **0.60** and **4.80** times (i.e. 15% x 4 and 15% x 32).	

The initial column in table 4.4 outlines the two main options available to the contractor in order to generate a price – whether to outsource the pricing function or to retain this in-house. Work that is out-sourced is then further subdivided into two categories (column two), that of the specialist contractor and that of the non-specialist. The adjacent three columns then serve to split the source of the quantified pricing documentation.

The client therefore quantifies approximately 30% of the industry workload in total – 1% of specialist work and 29% of non-specialist work (20% of which is outsourced by the main contractor and 9% which is retained in-house).

The main contractor does not quantify any specialist work, has to quantify approximately 15% of out-sourced non-specialist work (in order to obtain sufficient response and remain competitive) and quantify approximately 11% of their own workload. Approximately 26% of the total industry's workload is therefore quantified by the main contractor.

Finally the specialist subcontractors quantify approximately 29% of the total industry's workload (their preferred source of quantified information) and non-specialist contractors have to quantify approximately 15% of the total industry workload. The total value of work measured by subcontractors thus equates to 44%.

A cross check in the final column confirms the overall workload undertaken by each category of contractor – 30% by the specialist contractor, 50% by the non-specialist subcontractor and the balance of 20% by the main contractor (totaling 100%).

Of notable interest is the extent of unnecessary duplication endured by each of the three categories of contractor. The 29% of measurement undertaken by each competing specialist contractor is unavoidable as each typically applies their own unique design solution to the construction problem posed. As a consequence, each contractor's quantities will be different and need to be prepared by the individual contractor concerned. The duplication endured by the non-specialist trades is avoidable however. Approximately 26% of this duplication is undertaken by the main contractor, multiplied by a typical number of 8 competing contractors this is the equivalent of project being quantified twice (2.08 times). However, the 44% of subcontract work that is duplicated is typically multiplied by an increased number of competing contractors further down the pricing chain. This equates to the entire works being quantified between 2.68 and 6.88 times (depending on the number of different competing contractors).

Duplication of the quantification task was therefore found to be significant – particularly at lower levels of the pricing chain. Overall this equates to the entire workload being typically measured between 2.68 and 6.88 times (2.08 + 0.60 = 2.68 and 2.08 + 4.80 = 6.88).

Finally, approximately one third of the interviewed contractors stated that they often found work to be deliberately over-measured by the quantity surveyor to cover for inadequacy within the design.

Stage 3: Management of the pricing documentation at the subcontractor level (micro level)

The third and final level of managing the pricing process is concerned with the subcontractor – at the micro level of the pricing chain. Again, the subcontractors have been categorised as either being of specialist (typically representing 30% of the total workload) or of non-specialist origin (typically representing 50% of the total workload).

Figure 4.7 (p.203) illustrates the subcontractors' management process and begins at the point when the tender documentation is received by each type of subcontractor. In terms of format, approximately 1% of the specialist workload is quantified compared with 35% of the non-specialist workload; these figures are annotated on the diagram. The respective balance is inevitably non-quantified – 29% for the specialists and 15% for the non-specialists.

Point (c) reinforces the findings presented previously with respect to the preferred source of quantified information i.e. non-quantified for the specialists and quantified for the non-specialists. Box (d) simply confirms this point.

The subcontractors natural response to the pricing documentation is then recorded (e) i.e. how they would react in a competitive tendering environment. The natural response from the specialist contractor is to ignore the externally quantified pricing information and produce their own quantities. Conversely, the non-specialists would prefer to reject the non-quantified information and insist that the main contractor carries out the measurement exercise on their behalf. However, in reality the subcontractor may not have the ability to force the work to be quantified on their behalf by the main contractor. Further investigation revealed that the dependent variable affecting this response was that of the need to obtain work. Inevitably, if the non-specialist subcontractor is pricing sufficient work that is in a quantified format then the subcontractor is more likely to reject non-quantified information. Similarly, the specialist subcontractor is less likely to be forced into pricing quantified information if their own workload is sufficient.

Assuming the need to obtain work is prevalent in both cases, the specialist is forced into pricing the quantified work and the non-specialist, into producing their own quantities (f). This is referred to as the 'enforced' response as both sets of contractor are forced into an area that is against their own volition.

However, forcing the contractor into a position they would naturally avoid has a number of consequences (g):-

Specialist contractors:

Specialist contractors find that externally supplied quantities are too inaccurate as a basis for pricing. The level of design completeness means that the majority of the measured work becomes superseded by the contractor's own decision making. They also find the items that are measured do not tie in with the contractors own methods. Although a similar pricing methodology is followed by each contractor (e.g. price resource costs initially to derive unit rates) no industry wide standard is evident. In reality, if forced to price the measured work the specialist contractor will group together the bill items and submit a lump sum price – usually against each page of the bill of quantities. This in turn provides the client side with little understanding of the cost base, how to value interim payments or how to evaluate variations post-tender. With this in mind, the specialist contractor qualifies the quotation heavily. Such problems increase the likelihood of post-tender dispute. If the client further enforces the request to have each item quantified then the problems of valuation become more exacerbated - the split of the contractors' price becomes even more arbitrary. The measurement task is therefore unnecessarily undertaken by the client-side.

Non-specialist contractors:

Again forcing the subcontractor into an unnatural situation causes significant problems. Having to quantify the work themselves results in excessive duplication – the cost of which is either directly included within the tender or indirectly incurred by the industry as a whole. The subcontractor has to make their own subjective assumptions about which items to quantify particularly where responsibility for measuring the work may fall between a number of trades or where tender information is unclear. Prices are therefore heavily qualified and the client is less able to value payments and post-tender changes. This results in an increased likelihood of post-tender dispute. The interviewed contractors stated that additional allowance would often be included within their tenders to account for potential post-tender conflict. Both the subcontractors and main contractors also stated that, if responsible for the accuracy of quantities, they would allow additional money within their tender to compensate for their own inaccuracy

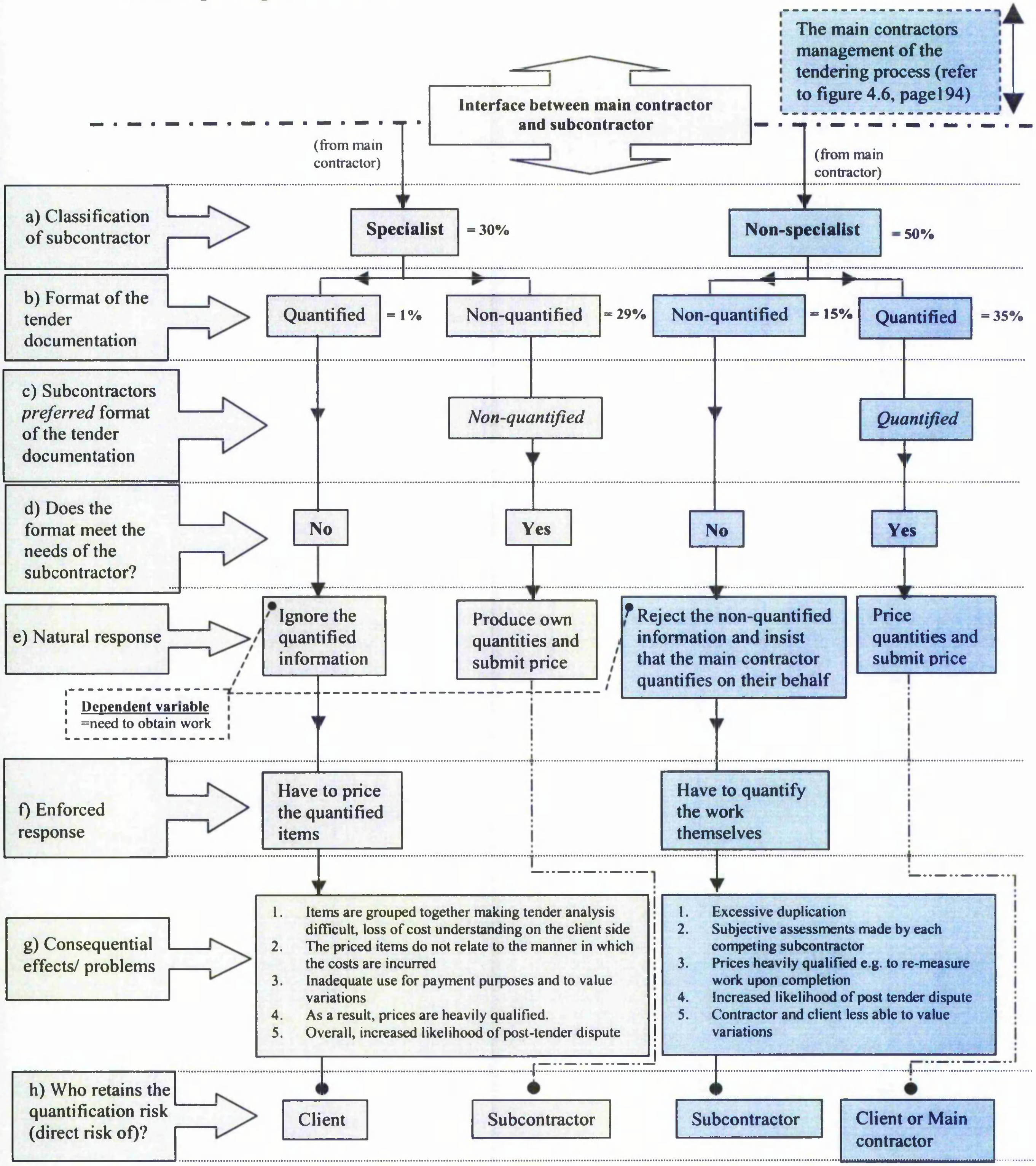
Finally, it is worth noting which party retains the *direct* and *indirect* risk of quantification. In this context, direct risk is borne by the initial recipient. Indirect risk is the knock-on-effect to another party of this risk being endured.

The specialist will naturally take on the direct risk of their own quantification with no indirect risk to any other party. However, if forced to price externally measured work they will take on the direct risk but heavily qualify their quotation. Resultant problems are therefore passed back to the main contractor. The main contractor/ client therefore retains indirect risk. In the case of the non-specialists, forcing them to quantify the work will also result in a heavily qualified quotation. Substantial indirect risk will also be borne by the main contractor/ client through qualification. In practice the extent of this risk is significant. Non-specialist subcontractors will usually submit a price 'subject to re-measure' or just on a rates basis.

Therefore, the total amount of risk endured within the pricing process in increased by:-

1) An external party quantifying specialist work (i.e. client or main contractor).
2) An external party not quantifying non-specialist subcontract work (i.e. client or main contractor).

Figure 4.7: Illustration of the subcontractors' behavioural response to different forms of pricing documentation



How effective is current pricing documentation as indicated by those problems commonly encountered by constructors during the pricing of tender documentation? (research question 2)

The question of effectiveness is evaluated from the perspective of the end users of the pricing documentation i.e. the contractors estimators. Problems are seen to arise when the contractors' preferred source of quantified information is not met.

The *specialists* ignore quantified information that is produced for them and instead base their price on their own quantities. A review of the characteristics of these firms helps to explain their rationale. As sp*ecialist* contractors are frequently required to design the work themselves only they have the foresight as to the likely scope of work and consequently take responsibility for measurement. In practice, work measured by the client's quantity surveyor is found to be inaccurate. If a bill is provided for the *specialists* they typically bracket the bill items together and return a lump sum price. Without exception, the interviewed main contractors state that they would not prepare quantities for these trades. This reinforces the view that current pricing documentation, as per the Standard Method, is not effective. An important discovery within the interviews was that non-quantified specialist work was prepared in an *inconsistent* format. Therefore, despite complying with the specialists' principal needs, the pricing documentation was still not effective (due to such inconsistency).

Conversely, *non-specialist* contractors encountered significant problems when their work was not quantified for them. Unnecessary duplication was experienced as each of the competing main contractors would have to quantify the same work themselves. Further problems were encountered with *non-specialist* subcontractors. Their need to obtain work was found to dictate their behavioural response to pricing information passed on by the main contractor. If they were in great need of work they would have little choice but to quantify the work themselves. However, this would again result in further duplication of measurement. In practice, their returned price would be qualified to avoid responsibility for the accuracy of the quantities and, in the event of any such inaccuracies, they would seek reimbursement for additional cost. In the majority of cases the main contractor would have to bear the cost and responsibility of quantity production and, effectively, provide a service to the subcontractor – one traditionally fulfilled by the client's quantity surveyor. If not, the main contractor would be less competitive (relying on fewer quotes). In both scenarios, excessive duplication was apparent and the main contractor would take on the risk of quantification for *non-specialist* subcontractors. The Standard Method of Measurement is therefore an effective means of procuring prices from these trades, however, in practice it is not used as comprehensively as the non-specialists would like. Approximately 41% of current practice is therefore not effective (11% measured by the main contractor for their own use, 15% on behalf of subcontractors and 15% quantified by the subcontractors). When taking account of the multiplier affect of numerous trades competing on the same contract this represents a significant proportion of practice that is not effective.

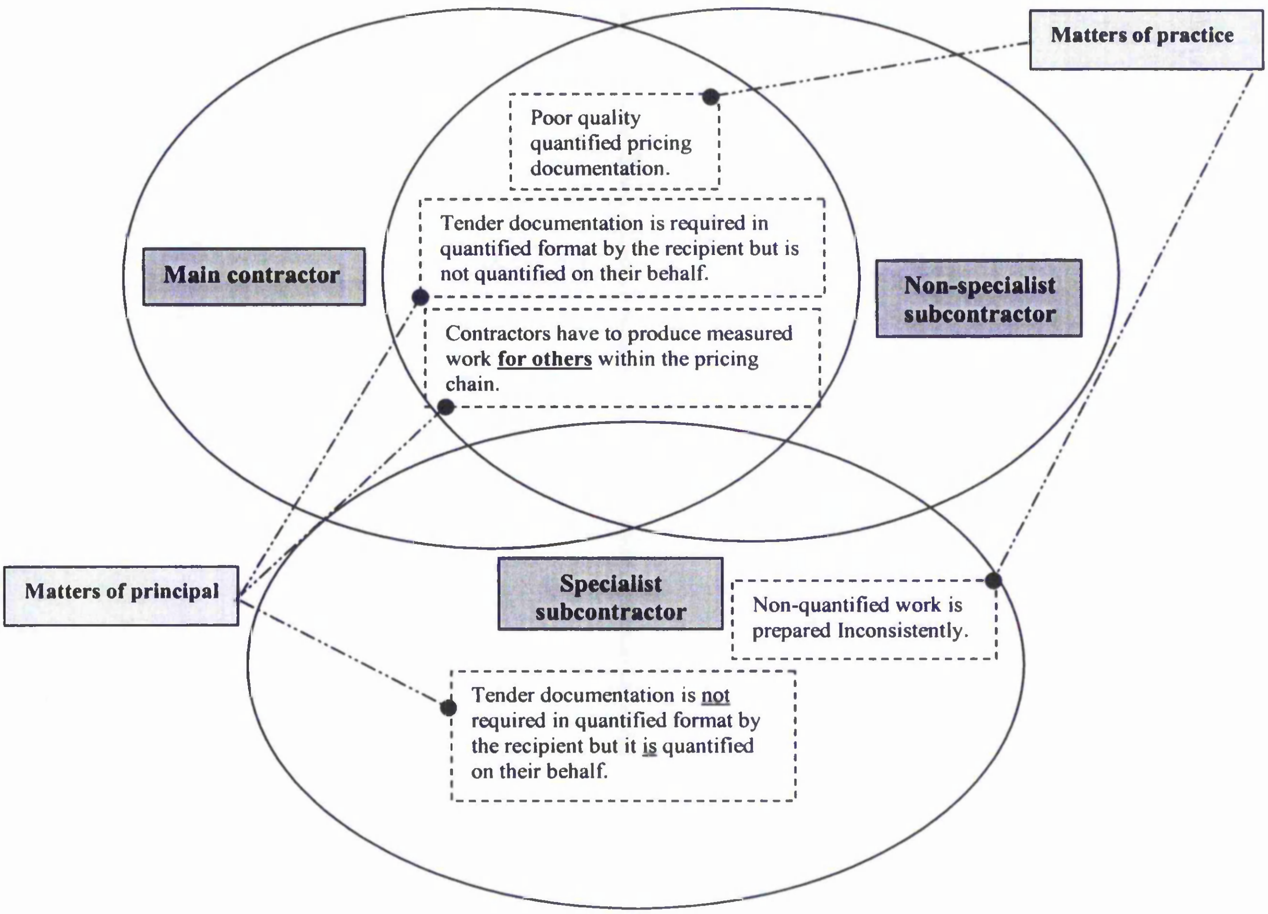
Figure 4.8 (p.206) serves to reinforce these findings. The three separates types of contracting organisation are highlighted (darker shading) and the type of problems they frequently encounter detailed (within sets).

As illustrated, these problems may be sourced back to two main areas. The first is a mismatch in the contractors' preferred format for pricing documentation and that supplied by the client side, that is, a *matter of principal*. This is further subdivided into three scenarios:-

1) When quantified information is required but not provided.
2) As a result, contractors within the pricing chain have to produce for others.
3) Quantified information is not required but it is still provided.

The second category of problem is one of a *matter of practice*. In reality, despite purporting to be in quantified format the work is often of poor quality and does not follow the rules of the Standard Method. In addition, non-quantified information required by the specialists is frequently prepared inconsistently.

Figure 4.8: Root cause analysis of problems experienced in practice



A more detailed explanation of each problem and their consequential effects is provided in table 4.5 (p.208).

To summarise, the interviews have revealed that current pricing documentation is not effective in practice.

The most significant problem is sourced to the non-quantification of non-specialist work. Although saving time for the clients representative, not quantifying the work actually increases the overall workload during the tender stage, increases the tendering cost, reduces the accuracy of the pricing process, renders the client's representative incapable of valuing the works, increases the likelihood of post tender dispute and overall risk to which the contractor is exposed. A hidden cost is therefore borne by the industry. More cynical views from the industry suggested that quantity surveyors frequently engage in the practice of doing as little work as possible for as much fee. As central coordinator of the pricing process, the main contractor bears the brunt of this risk. However, the extent of this risk would only come to fruition when the contract was underway at the post-tender stage. Many months may have elapsed between the tender submission and award of contract. Post-tender dispute would be the only means of recourse at this point.

The interviews also revealed that where bills of quantities were purported as being prepared by the client's quantity surveyor, they frequently amounted to no more than a "non-quantified" schedule. These schedules would be set out loosely around the Standard Method with little or none of the work actually measured - just itemised. The estimators commonly referred to these as "non-quantified itemised schedules".

The inconsistent manner that non-quantified specialist work was procured also caused significant problems. Despite being, in principal, in the format they required the inconsistent format was confusing for both the subcontractor for pricing purposes and for the recipient main contractor to interpret. In addition, a worrying trend reported by many of the specialist estimators was the practice of pricing what they thought was required as opposed to what was described. Estimators became so used to bills being inaccurate that they priced what they perceived the client required not what the descriptions stated. Such a form of practice inevitably increases the likelihood of inaccurate post-tender evaluation (particularly if variations are substantial) and likelihood of post-tender conflict.

Current practice within the industry therefore appeared to be the cause of significant inefficiency and created undue risk. In addition, the specialists stated that they could typically offer cheaper design solutions if their expertise was utilised. Very often they had entered long-term contracts with a limited supplier base that was not specified on a particular contract (but was more suitable). They suggested that early involvement of the specialist could reduce cost and improve performance. The main contractors supported this finding.

Table 4.5: Problems encountered during the pricing of tender documentation

Category of problem	Type of problem	Experienced by whom?	Affect of problem
1.0 Principal mismatch in the demand and supply of pricing documentation i.e. a difference between the type of information required by the contractor and that supplied.	1.1 Tender documentation is required in quantified format by the recipient but is not quantified on their behalf.	• Main contractor and non-specialist subcontractors.	The competing contractors have two main options:- a) Refuse to quantify the work themselves • Resulting in an unsatisfactory response to the client's request or uncompetitive main contractor quotation. b) Carry out the measurement themselves • Excessive duplication – each of the competing contractors has to produce their own quantities. This results in an increase in the overall workload to the industry necessitating additional tendering resource. As a result, contractors incur additional cost. • The quantities produced by each contractor are likely to differ from one another due to inevitable inaccuracies and the adoption of individual pricing techniques. In addition to this, each contractor will most probably interpret the requirements of the project slightly differently. The competing contractors will neither submit nor be evaluated on a consistent basis. • Overall, the pricing methodologies adopted lack consistency. • Discrepancies in pricing methodologies reduce the accuracy of interim payments and impair the ability to value variations. • Contractors will try and mitigate any exposure to risk from inaccurate valuations by qualifying their tender e.g. "subject to re-measure upon completion". • Risk is passed back up the pricing chain and typically resides with the main contractor. • Strategic pricing also occurs – contractors price errors on tender documentation that they will attempt to profit from post-tender. • Overall, the absence of client-supplied quantified information increases the workload of the industry, the cost of tendering, reduces the accuracy of valuations and increases the likelihood of post tender dispute. The main contractor typically takes on the majority of the risk.
	1.2 Contractors have to produce measured work **for others** within the pricing chain.	• Main contractor and Non-specialist subcontractors (when the pricing chain becomes extended).	1. In order to remain competitive the main contractor and non-specialist contractors (in an extended pricing chain) rely on a reasonable response from subcontract enquiries. To achieve this, these contractors usually have to quantify the work on the subcontractors' behalf. This results in excessive duplication of the measurement task. 2. As a result of inaccuracies and subjective assessments, no one quantification exercise will produce the same result. 3. Such a lack in consistency leaves the subcontractor that receives the pricing information with two main options:- a. Price all tenders separately (resulting in excessive work). b. Price one tender and send back to all. This reduces the subcontractors' workload but means that all but one of the recipients has to reconcile between their own quantities and those of a competing main contractor. Such an overlap between trades increases the likelihood of items being missed or of being measured twice. 4. Overall, the format of tendering documentation lacks consistency. 5. Discrepancies in pricing methodologies reduce the accuracy of interim payments and impair the ability to value variations. 6. Price risk is also more likely to be double counted, estimators price more cautiously (at greater cost to the client) and quotes are deliberately left unclear for fear of post-tender reprisal. 7. Overall, the presence of differing formats of quantified information increases the workload of the industry, the cost of tendering, reduces the accuracy of valuations and increases the likelihood of post tender dispute. The main contractor typically takes on the majority of this risk.

Table 4.5: Problems encountered during the pricing of tender documentation (continued)

Category of problem	Type of problem	Experienced by whom?	Affect of problem
	1.3 Tender documentation is <u>not</u> required in quantified format by the recipient but it <u>is</u> quantified on their behalf.	Specialist subcontractor	Two main options are available to the specialist when presented with quantified pricing information:- a) Ignore the pricing documentation: • This means that the time and effort expended in quantifying the work are wasted. b) Price the quantified pricing information: • The subcontractor will need to quantify the work first (as the measured items do not reflect how they would measure themselves) and back fit these in accordance with the supplied information. The measurement task is therefore unnecessarily duplicated. • Such an arbitrary split between the measured items will impair the accuracy of interim valuations and the ability to value variations. Overall, quantifying the work for these trades results in duplication of the measurement task, increased cost of tendering, reduces the accuracy of valuations (if the measured items are priced by the contractor) and increases the likelihood of post tender disputes.
<u>**2.0 Matters of practice**</u> i.e. even when, in principal, the appropriate choice is made problems still exist due to the quality or inconsistency of the tender documentation provided.	2.1 Poor quality pricing documentation.	Main contractors, non-specialist subcontractors and specialist subcontractors.	In reality, what are purported as being a bill of quantities measured in accordance with the Standard Method of Measurement, amount to no more than a non-quantified itemised schedule. Items of work are simply listed in Standard Method order and the word "item" appended to the description. 1. This means that the measurement process must be repeated by each competing contractor. 2. Many of the items are composite and include work from a number of trades, this makes the process of dividing the work into subcontract enquiries more difficult. 3. The workload of the industry increases. 4. The cost of tendering increases. 5. The accuracy of valuations is impaired as returned prices are heavily and inconsistently qualified. 6. Overall, the likelihood of post tender dispute increases. The main contractor typically takes on the majority of this risk. Problems 3-6 are repeated in cases where inconsistent non-quantified tendering documents are prepared for the specialist contractors.

What is the frequency and extent of each category of problem, its impact upon the relative accuracy of the pricing process and the extent of risk taken by the main contractor? (research question 3)

The overall problems identified in table 4.5 (p.208-209) are further summarised in table 4.6 (p.211) by category of consequence. The final column also gives consideration to the frequency of each type of problem experienced in practice. This provides a succinct summary of the interview findings – the problems encountered in practice, their effect and frequency of occurrence.

A summary of the interview findings is further illustrated in Figure 4.9 (p.212). This serves to highlight the level of demand for pre-quantified work by the industry (i.e. work that is measured on the contractor's behalf), the actual level of pre-quantified work supplied and thus the gap endured in practice. The illustration also details who, in practice, fills this gap in demand and supply.

Section 1 shows that 70% of the total industry workload is required to be in a quantified format (20% for the main contractors and 50% for the non-specialist subcontractor).

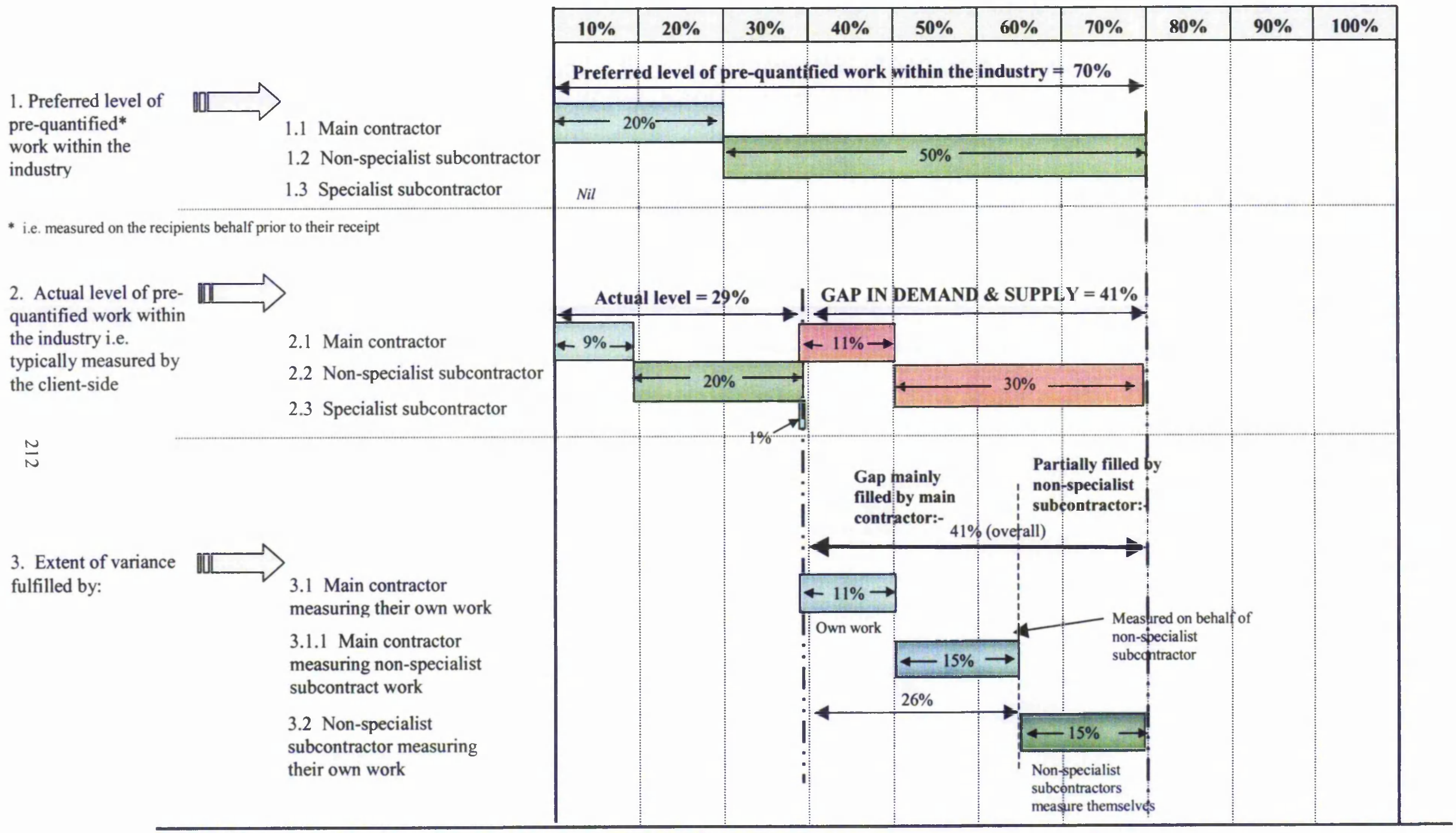
However, section 2 reveals the actual level of work that is quantified in practice. The gap between the level of pre-quantified work required and that supplied in reality is the cause of significant problem. This equates to some 41% in total. Most of this shortfall falls on the non-specialist contractor (30%) and the balance against the main contractor (11%). In addition, approximately 1% of the specialist workload is measured on their behalf - against their preference. Thus, overall, 42% of the industry workload is problematic to the end users of pricing documentation.

Section 3 then serves to illustrate how these gaps are typically filled in practice. It also highlights the duplication of the measurement task predominantly undertaken by the main contractor.

Table 4.6: Problems encountered during the pricing of tender documentation, consequential affects by category and incidence of their occurrence.

Category of problem	Type of problem	Experienced by whom?	Effect of problem: Duplication of the measurement process increases the overall workload of the industry.	Effect of problem: Increases the overall cost of tendering.	Effect of problem: Reduces the accuracy of the pricing process.	Effect of problem: The recipient of the priced information is ill equipped to value variations or make accurate interim payments.	Effect of problem: Increases the likelihood of post tender dispute.	Effect of problem: Increases the overall level of risk to which the contractor is exposed.	Incidence of the problem in practice
1.0 Principal mismatch in the demand and supply of pricing documentation i.e. a difference between the type of information required by the contractor and that supplied.	1.1 Tender documentation is required in quantified format by the recipient but is not quantified on their behalf.	• Main contractor and Non-specialist subcontractors.	✓	✓	✓	✓	✓	✓	Approximately 41% of practice (11% of the main contractors workload and 30% of the subcontractors).
	1.2 Contractors have to produce measured work **for others** within the pricing chain.	• Main contractor and non-specialist subcontractors (when the pricing chain becomes extended).	✓	✓	✓	✓	✓	✓	Approximately 15% of practice (main contractor typically measuring on the subcontractors behalf).
	1.3 Tender documentation is not required in quantified format by the recipient but it is quantified on their behalf.	• Specialist subcontractor.	✓	✓	✓	✓	✓	✓	Approximately 1% of practice.
2.0 Matters of practice i.e. even when, in principle, the appropriate choice is made problems still exist due to the quality or inconsistency of tender documentation.	2.1 Poor quality pricing documentation/ inappropriate format.	• Main contractors, non-specialist subcontractors and specialist contractors.	✓	✓	✓	✓	✓	✓	Difficult to establish the frequency in practice for the non-specialists. For the specialists this equates to approximately 29% of the total industry workload.

Figure 4.9: Frequency of problems encountered – the level of pre-quantified work required within the industry, the actual level of pre-quantified work and how the gap in demand and supply is fulfilled



What is the impact upon the client of the exposure to risk of the constructor in terms of the current pricing documentation? (research question 4)

Although the client does not take on any direct risk it is evident that substantial risks are generated from current practice. The increased risk is effectively borne by the main contractor, as overall coordinator of the pricing process, and frequently manifests itself in the form of post-tender disputes. It is proposed that, taking account of current practice and the levels of risk endured that the contribution of poor tender documentation towards post-tender dispute is significant.

In addition to paying for increased risk, either directly within the tender price or latterly through post-tender disputes, the interviews revealed that the client was often paying for a service that was not being provided – that of bill production. Not only was the measurement not being undertaken, as paid for, but the client was found to be paying for excessive duplication of the measurement task throughout the pricing chain.

A concern of the interviewed estimators, which was already being encountered in practice, was a long-term loss of knowledge from the quantity surveying profession. They considered that this would leave the profession less able to provide the required levels of service to the industry in the future.

Formulating solutions (objective 2)

Can solutions be formulated to reduce the frequency and extent of the problems identified? (research question 5)

The interviews have developed a detailed understanding of current practice, the needs of contractors' estimators, problems encountered and their consequential effects. As a result, current practice was found to be the cause of significant problems.

These problems may be categorised into two main areas – *matters of principal* and *matters of practice*. Matters of principal relate to a fundamental mismatch in the demands of the tendering contractor and the actual format of pricing information supplied – whether this is quantified or not. Matters of practice relate to the consistency or quality of the documentation.

By amending the format of pricing documentation to meet the demands of the tendering contractor, the frequency and extent of the problems identified may be reduced. Sufficient evidence exists from the interview results to suggest that by adhering to the needs of the contractors and producing good quality pricing documentation this will reduce the overall extent of problems and overall cost. Consistent non-quantified information is also required if specialist prices are to be procured effectively.

Can revisions to the processes commonly adopted in the preparation of pricing documentation be proposed and evaluated? (research question 6)

The interview findings suggest that current methods of managing the pricing process should be revised as follows:-

For specialist work:
No longer produce quantified pricing information for specialist trades and instead, procure their work on a consistent non-quantified basis.

For non-specialist work: *(main contractors and non-specialist subcontractors).*
The current Standard Method of Measurement should be adhered to in all cases where the design is substantially complete. This would result in a significant change in current practice. Benefits include a reduction in the amount of duplication of the measurement task (the entire project currently being measured between 2.68 and 6.88 times and a reduction in the overall level of risk and cost of tender preparation.

The use of the Plan and Specification methods of procurement would therefore no longer be appropriate for non-specialist trades.

Can revisions to the pricing methods commonly adopted (in light of the above) be proposed and evaluated? (research question 7)

The quantification of all such work for *non-specialist* trades would result in a revision to the pricing methods currently adopted. Main contractors would no longer duplicate the measurement of their own work nor have to prepare quantities for subcontractors. It would also reduce the measurement workload of the non-specialist subcontractor and, through greater confidence in the pricing documentation, reduce their incidence of qualification. As a consequence, the level of risk to which the parties are exposed and overall cost of the tendering process would reduce significantly.

Specialist trades would also no longer be required to back-fit their own pricing to inaccurate bills. Widespread opinion was expressed by the specialist contractors that, by allowing more innovative solutions to be proposed, they could also generate cheaper design solutions. Pricing methods should therefore reflect this.

Feedback on the presentation to the RICS

Results were also obtained from a presentation to the Nottingham and Derbyshire Quantity Surveying branch of the RICS. Despite their controversial nature, as the results directed a certain amount of criticism at the audience, the feedback during a question-and-answer session was extremely positive.

The audience recognised the low incidence of measured work for non-specialist trades, existence of poor practice (e.g. non-quantified itemised schedules) and categories of problems encountered. They also acknowledged a fall in use of the Standard Method of Measurement.

A discussion session at the end of the presentation revealed an overall lack of understanding from within the profession about the effect of such poor practice. Although the overall problem areas were recognised, both the extent of duplication and unnecessary risk generated had not been appreciated. This was an interesting outcome of the presentation and served to explain the root cause of many of the areas of post-tender disputes to the audience.

Proposals to overcome the frequently occurring problems were also put forward and well received.

Summary

The interviews were predominantly conducted within the North Yorkshire region and obtained a cross-section of views from both the main contracting and subcontracting sectors.

In depth analysis of their processes involved in preparing a price allowed a detailed understanding of the problem areas to be developed. To analyse this, the overall pricing process was divided into three subsets. Two were identified as being at the macro level - the client/ main contractor interface and the main contractors decision-making processes. The other was identified as being at the micro level - the main contractor/ subcontractor interface.

Typical contractual arrangements were subsequently established and found to involve a high number of main contracting and subcontracting organisations within any one pricing process. The overall hierarchy was found to be relatively complex. Only about 30% of the workload was actually measured by the client-side of the industry.

Based on their behavioural response to this pricing documentation, two distinct groups of contracting organisation were identified – referred to as *specialists* and *non-specialists*. The specialist firms, defined as mechanical and electrical trades, showed characteristic differences with the non-specialist firms. The latter included the likes of main contractors and the more traditional subcontract trades - plastering, brickwork, drainage and excavation works.

In sharp contrast to the non-specialist trades, specialist work was typically complex in nature, was only advanced to a conceptual design stage, required high levels of design input from the tendering contractor and was poorly understood by the quantity surveying profession. As a result, the specialist contractors preferred to quantify the work themselves. They also considered that quantity surveyors did not typically possess an adequate skill base to measure specialist work accurately and were certainly unable to do so when the design was incomplete. The non-specialist trades reported the opposite and demanded that the work should be quantified on their behalf. Therefore, as a result of a number of background characteristics, the preferred source of quantified information was found to differ between the two types of contractor – non-specialists preferred the work to be quantified for them and specialists preferred to quantify the work themselves. The information supplied in practice did not reflect these needs and, as a result, was found to cause significant problems. An element of poor practice was also identified by the interviews.

Two main problem areas were identified as:-

Matters of principal – differences between the type of information required by the contractor and that supplied (i.e. not providing quantified data for the non-specialist and providing quantified data for the specialist).

Matters of practice – poor quality or inconsistent pricing documentation (e.g. the high incidence of non-quantified/ itemised schedules purporting to be bills of quantities).

Matters of principal were found to cause excessive duplication within the industry - to increase the cost of tendering, reduce the accuracy of the pricing process, increase the likelihood of post-tender dispute and, overall; increase the level of risk to which the contractor is exposed. Approximately 41% of the total workload was identified as being the gap between the level of quantified work required by non-specialists and that supplied in reality. As a result of this, the measurement task had to be repeated by a number of competing contractors. The extent of duplication was estimated as the equivalent of the whole project being measured somewhere between 3 to 7 times over.

As the overall coordinator of the pricing process, the main contractor retained the majority of risk on a typical project. It was recognised that such a level of duplication coupled with the potential for errors within the compilation of a price would increase the cost to the client and the level of risk to which they are exposed. The inconsistent non-quantified manner that specialist work was procured was also found to cause significant problems.

Solutions were identified to reduce the frequency and extent of the problems identified. By complying with the stated preferences of the two types of contractor (matters of principal), it was confirmed that the problems experienced in practice could be overcome. This meant quantifying all work for non-specialist trades (a move away from Plan and Specification contracts) and not quantifying specialist work. It is also proposed that a consistent method of preparing specialist prices is required.

4.2.2 Interview analysis

As described within the methodology chapter, the analysis of the interview results was undertaken on an iterative basis using the technique of 'cross-case analysis' (Yin, 1989, p.57). The results of each case were analysed upon completion and changes in theory incorporated within the preceding interviews.

Analysis was therefore undertaken on an iterative basis rather than as a separate activity.

4.3 Industry Survey

The industry survey section contains the largest volume of results within the overall chapter. A consistent approach to their presentation has therefore been maintained to ensure the findings are communicated as effectively as possible.

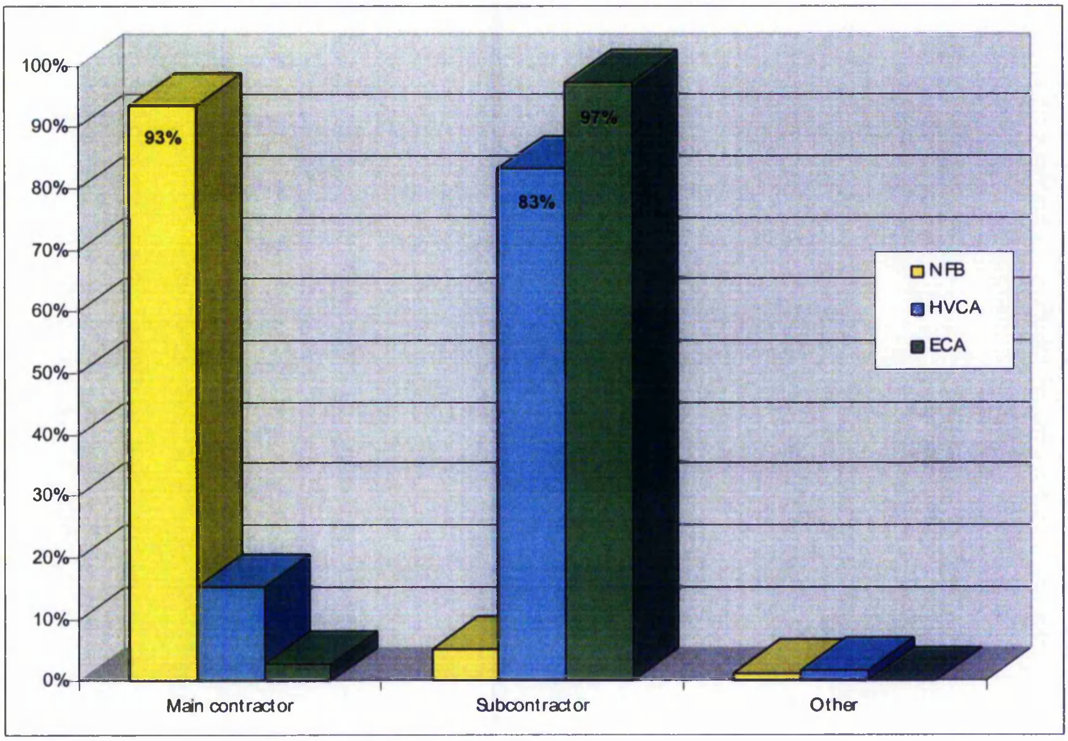
Both the results and their analysis are broken down into the objectives of the industry survey stage.

4.3.1 Industry Survey results

The individual objectives are initially detailed followed by the specific research questions that seek to address these e.g. overall characteristics of the firms (objective 1.1 below) followed by their typical role undertaken (question 3).

Objective 1.1: Overall characteristics that typify *specialist* and *non-specialist* organisations.

Chart 4.3: Typical role undertaken? (question 3)

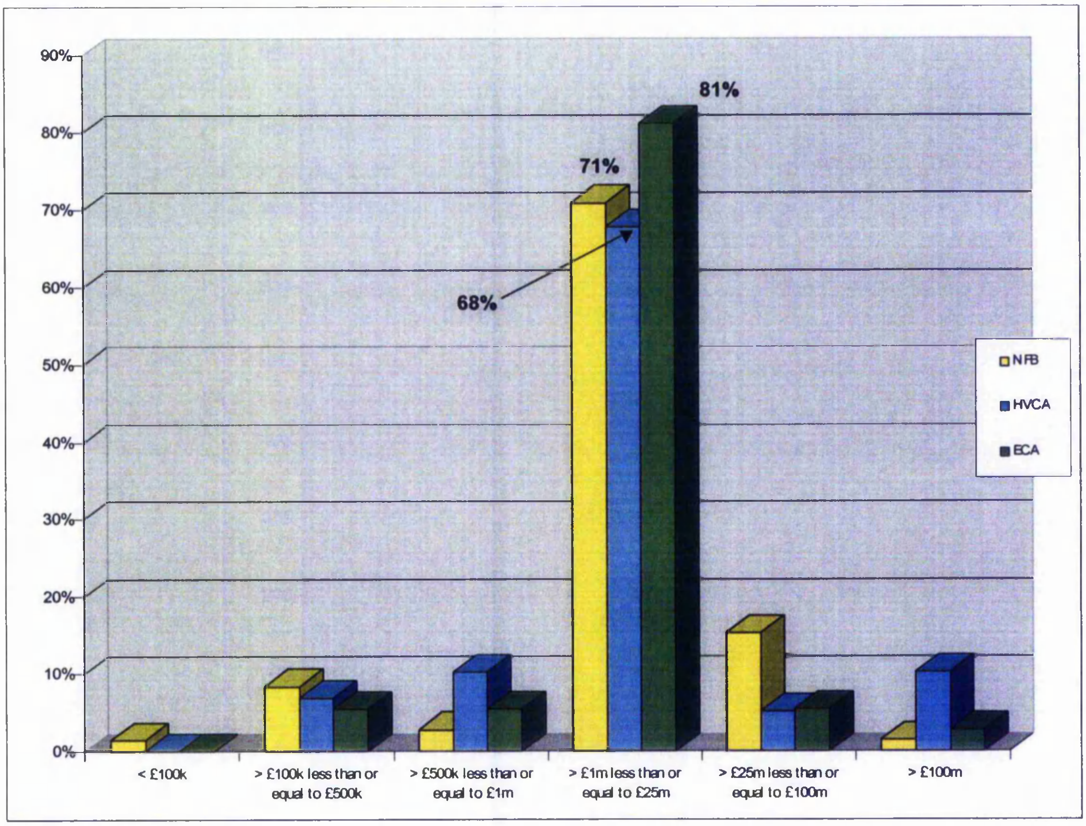


Source: Analysis of survey data (Industry Survey)

This graph illustrates the typical role carried out by the participating contractors. The majority of non-specialist contractors (93%) are typically employed as main contractors. In sharp contrast, the specialists (83% of the HVCA and 97% of the ECA) are typically employed as subcontractors. The results of the HVCA and ECA are relatively consistent with one another.

Objective 1.1 (continued): Overall characteristics that typify *specialist* and *non-specialist* organisations

Chart 4.4: Approximate annual turnover of the company, if part of a larger group of companies restricting the response to the immediate division or sector? (question 5)

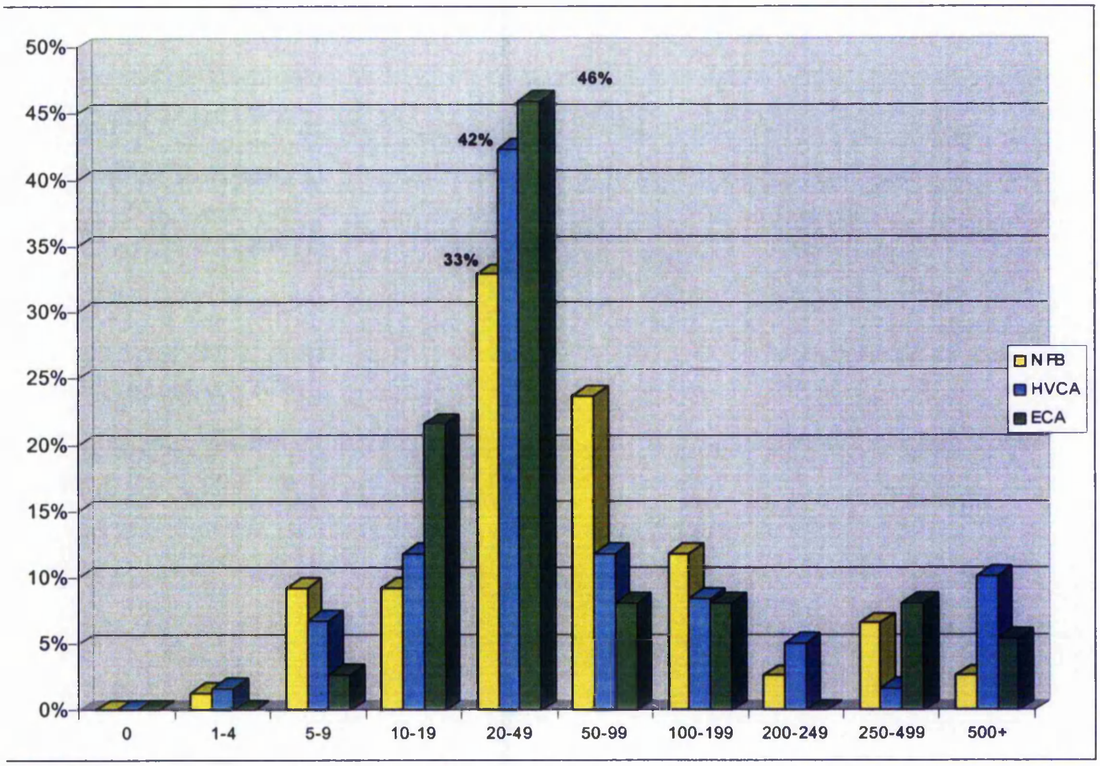


Source: Analysis of survey data (Industry Survey)

The results of all three representative bodies are relatively consistent. The turnover level of each responding firm is predominantly within the "> £1m less than or equal to £25m" bracket (71% of the NFB, 68% of the HVCA and 81% of the ECA). No discernible associations are evident within the other turnover categories.

Objective 1.1 (continued): Overall characteristics that typify *specialist* and *non-specialist* organisations

Chart 4.5: Approximate number of employees within the company - inclusive of site operatives? (question 6)



Source: Analysis of survey data (Industry Survey)

In terms of number of employees, the results of all three of the representative bodies are also comparable and follow a similar trend across each category. The greatest numbers of firms are seen to employ between 20-49 employees (33% of the NFB, 42% of the HVCA and 46% of the ECA).

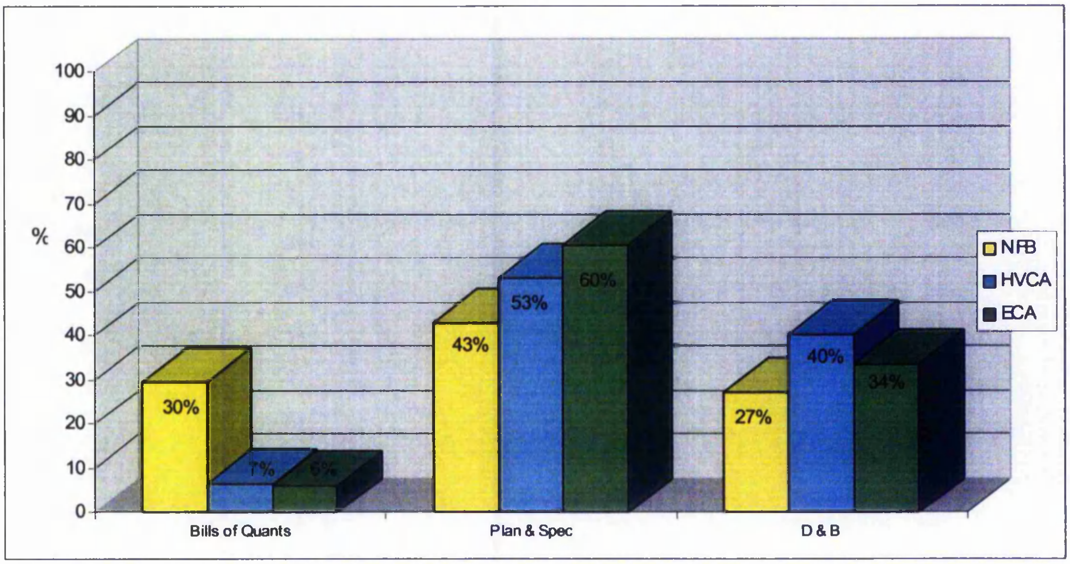
Overall, this section of the results has provided a background to the respondents involved within the survey. The results reveal that, the non-specialists (represented by the NFB) typically act as the main contractor and conversely, the specialists (represented by the HVCA and ECA) typically act as subcontractors.

All three of the representative bodies reported their most frequent turnover levels as being '> £1m and less than or equal to £25m' and similarly, the most frequent number of employees to be within the '20-49' category.

The following section investigates current practice in terms of the type of work received by contracting organisations.

Objective 1.2: Current practice in terms of the type of work received by contractors

Chart 4.6: Percentage use, by value, of different methods of procurement? (question 7)



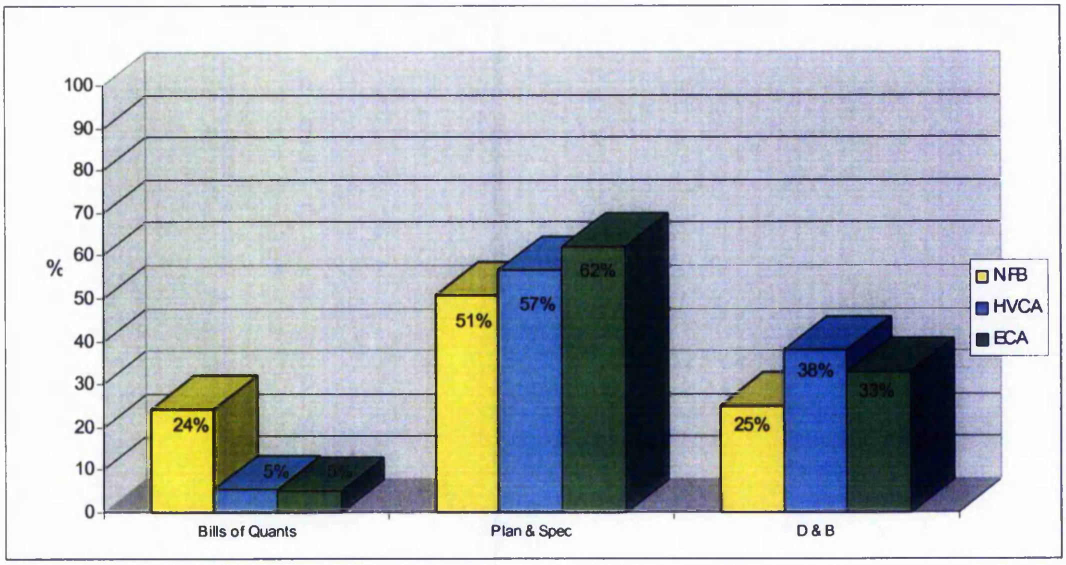
Source: Analysis of survey data (Industry Survey)

The value of different types of work received (by value) differs considerably between the specialist and non-specialist contractors. However, the responses from the two specialist groups are comparable.

The most striking difference relates to the proportion of work received in bills of quantities format (NFB, 30%; 7% HVCA and 6% ECA). All respondents receive the majority of their work in Plan & Specification format (NFB, 43%; HVCA, 53% and ECA 60%). Design and Build represents the second most common format for specialist trades (HVCA, 40% and ECA, 34%) and least common for the non-specialist trades (27% - just below that of bills of quantities at 30%).

Objective 1.2 (continued): Current practice in terms of the type of work received by contractors

Chart 4.7: Percentage use, by number, of different methods of procurement? (question 7)



Source: Analysis of survey data (Industry Survey)

The percentage, by *number*, of the type of work received follows a similar overall trend to that depicted by *value* (chart 4.6, p.226). However, all three representative bodies reveal an increase in the number of Plan & Specification contracts at the expense of both Design & Build and bills of quantities methods of procurement.

Bills of quantities represent the lowest number for all groups particularly the specialist trades and less than a quarter for the non-specialists (NFB, 24%; HVCA, 5% and ECA 5%). Plan & Specification is the most common format of tender documentation representing over half of all jobs received for each of the representative bodies (NFB, 51%; HVCA 57% and ECA 62%). Design & Build represents the second most common format (NFB, 25%; HVCA 38% and ECA 33%).

The results reveal differences in the type of work typically received by the specialist contractors and that received by non-specialists. The two groups of specialist contractor (ECA and HVCA) are seen to follow a similar trend in terms of both the number and value of work received.

Objective 2.1: The overall quality of pricing information produced by quantity surveying firms

The following questions evaluate the quality of measured work supplied by consultant quantity surveying firms. *Quality* is evaluated against a number of criteria:-

- The overall proportion of work that is actually measured.
- How accurately the descriptions specify the quality of works to be carried out.
- The accuracy of the quantities.
- How logically the information is presented.
- How closely the information relates to what is eventually built.
- The level of detail of the measured work compared with that supplied internally.
- The additional work required in order that a price may be calculated.
- Whether this allows the bids to be evaluated on a similar basis.
- Whether the information is useful for planning.
- Whether the information is useful for ordering materials.
- How accurately measured work used to prepare interim valuations reflects the cost of the work.
- How accurately measured work used to prepare the Final Account reflects the cost of the work.
- How accurately measured work used to value variations reflects the cost of the work, and finally;
- Whether the measured work is useful for internal cost controlling.

In order to maintain a manageable level of reporting within the results chapter the findings of this section are reported in Appendix J.

To summarise, the results reported in Appendix J provided an evaluation of the *quality* of measured work typically prepared by consultant quantity surveying firms. *Quality* has been assessed on a number of counts.

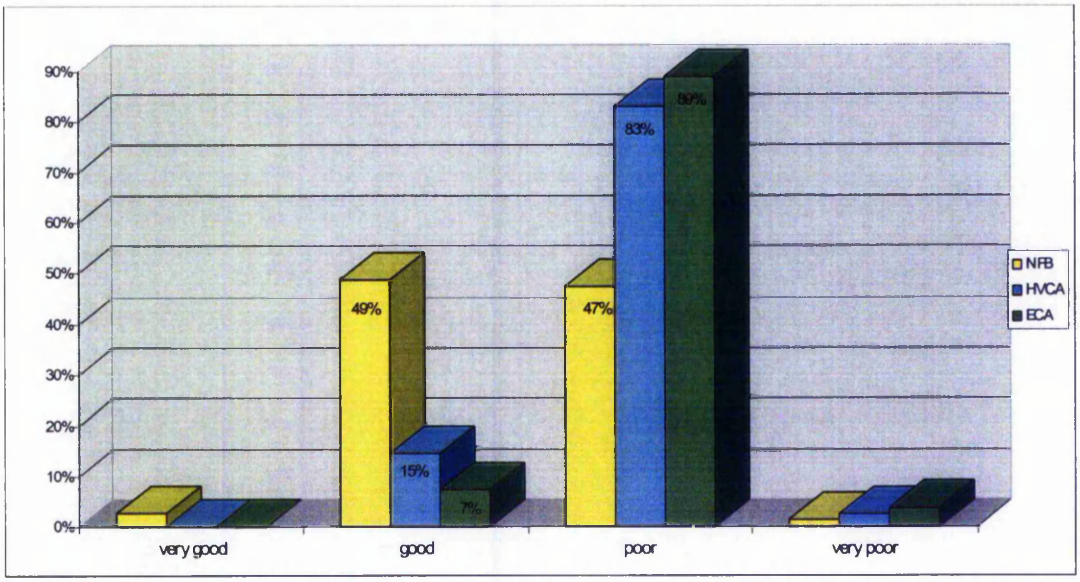
On all occasions the non-specialist views (NFB) have been more complimentary about the quality of measured work supplied by consultant quantity surveying firms. The specialists (HVCA and ECA), as well as being less positive than the non-specialists, have also been consistent in their views.

The following section of the results evaluates the abilities of quantity surveying firms to produce useful pricing information. In a similar fashion to the evaluation of quality, *ability* is assessed on a number of fronts:-

- Ability to describe the processes involved in constructing the works and resources required to achieve this (i.e. the throughputs).
- Ability to describe the performance requirements of the finished product/ the function it is required to achieve (i.e. the outputs).
- Practical awareness.
- Knowledge of construction.
- Knowledge of materials.
- Knowledge of design.
- Ability to break-down the construction into price-able units.
- How their ability has changes over time.
- Over what time period that any such changes have occurred.

Objective 2.2: The *abilities* of quantity surveying firms to produce useful pricing information

Chart 4.23: In relation to your own area of work, how do you rate consultant quantity surveying firms in terms of their *ability to describe the processes involved in constructing the works and resources required to achieve this* i.e. the throughputs? (question 12a)



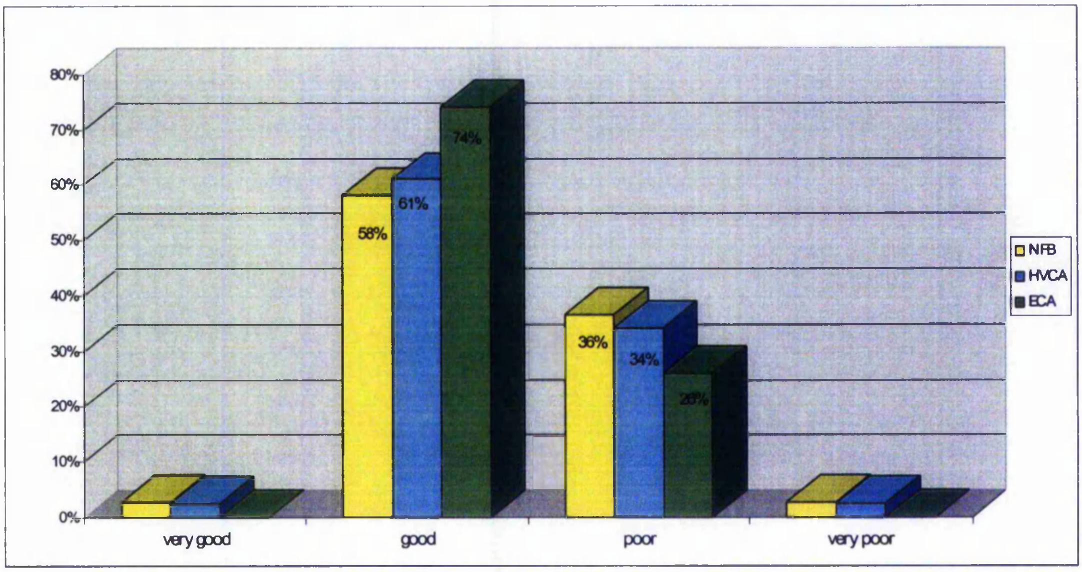
Source: Analysis of survey data (Industry Survey)

This question evaluates the ability of consultant quantity surveying firms to describe the processes involved in constructing the works and the resources required to underpin this. To achieve this successfully the consultant quantity surveyor is required to have a detailed understanding of the particular area of work and be able to articulate this through the pricing information.

The view from the NFB is relatively balanced – 49% state the ability as 'good' and 47% 'poor'. However, the view from the specialists is more critical. Only 15% of the HVCA and 7% of the ECA describe their ability as 'good'. In contrast, 83% of the HVCA and 89% of the ECA describe their ability as 'poor'. The views of the two specialist groups are comparable.

Objective 2.2 (continued): The *abilities* of quantity surveying firms to produce useful pricing information

Chart 4.24: In relation to your own area of work, how do you rate consultant quantity surveying firms in terms of their *ability to describe the performance requirements of the finished product/ the function it is required to serve* i.e. the outputs? (question 12b)



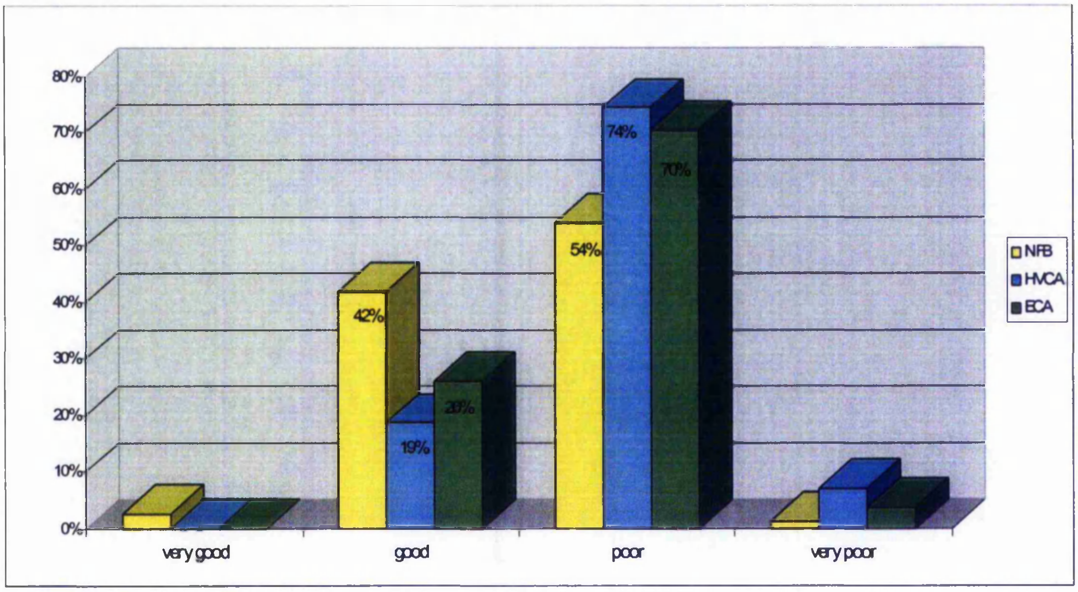
Source: Analysis of survey data (Industry Survey)

The ability of consultant quantity surveying firms to describe the performance requirements of the finished product/ functional outputs reveals a more positive response from the specialists. 58% of the NFB describe their ability in this respect as 'good' and 36% as 'poor'. However, the majority of specialist responses describe their ability as 'good' – 61% of the HVCA and 74% of the ECA. The minority, 34% of the HVCA and 26% of the ECA, describe their ability as 'poor'.

Both the specialist and non-specialist contractors are in relative agreement on this criterion.

Objective 2.2 (continued): The *abilities* of quantity surveying firms to produce useful pricing information

Chart 4.25: In relation to your own area of work, how do you rate the ability of consultant quantity surveying firms in terms of their *practical awareness?* (question 12c)



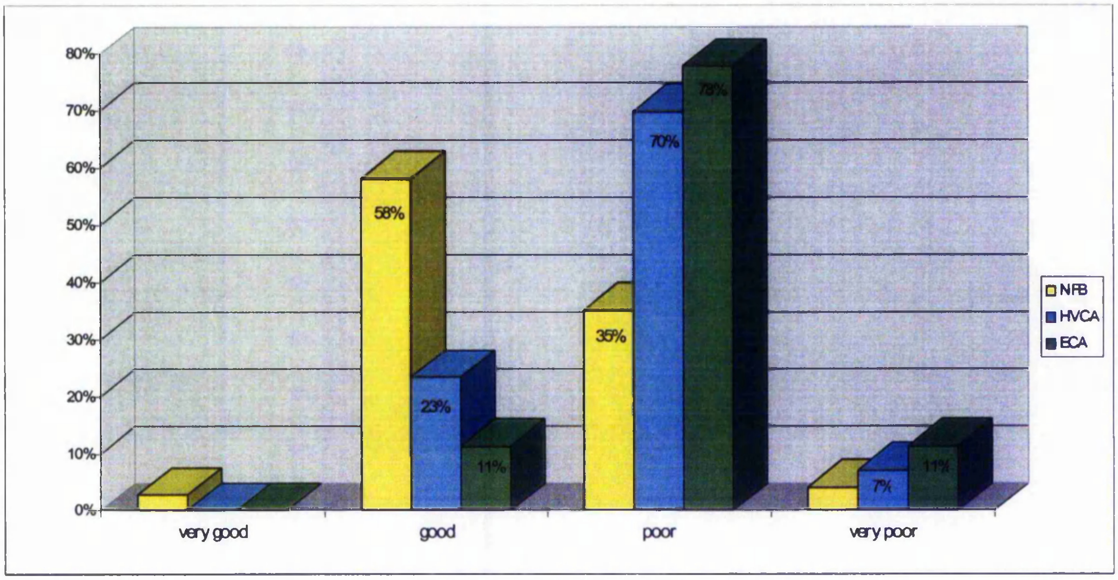
Source: Analysis of survey data (Industry Survey)

The practical awareness of the consultant quantity surveying firms reveals a less complimentary view from the specialist groups.

42% of the NFB describe their ability as 'good' and 54% as 'poor'. However, only 19% of the HVCA and 26% of the ECA describe their ability as 'good'. In contrast, 74% of the HVCA and 70% of the ECA regard their ability as 'poor'. The views from the specialists are therefore comparable.

Objective 2.2 (continued): The *abilities* of quantity surveying firms to produce useful pricing information

Chart 4.26: In relation to your own area of work, how do you rate the ability of consultant quantity surveying firms in terms of their *knowledge of construction?* (question 12d)



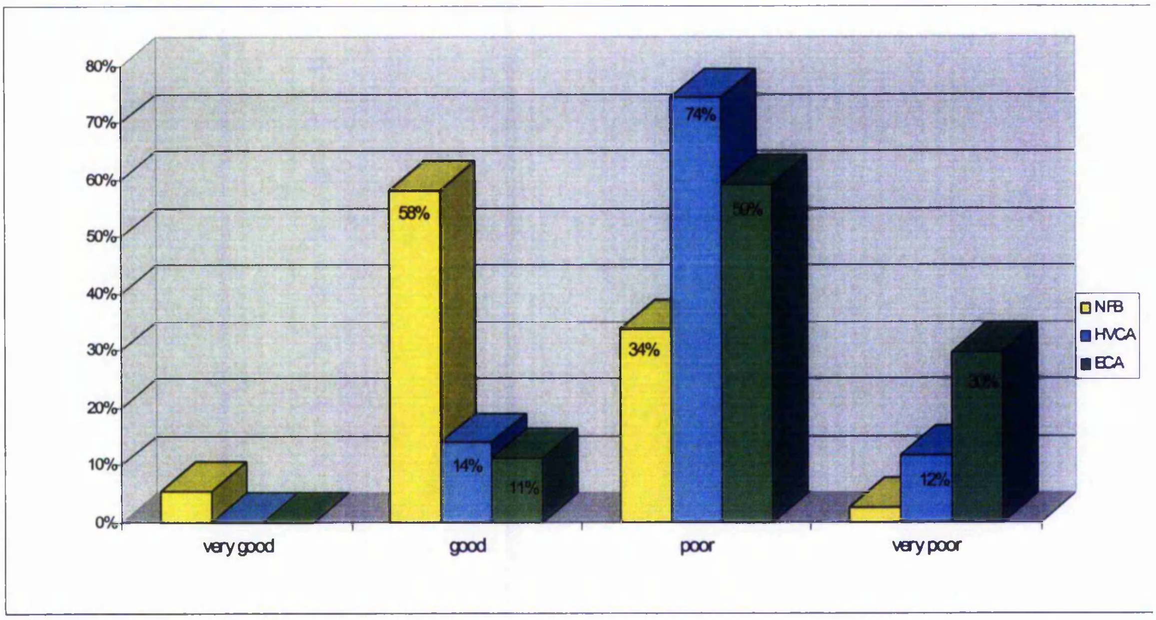
<u>Source:</u> Analysis of survey data (Industry Survey)

Views on the quantity surveyors knowledge of materials reveals a difference in opinion between the specialist and non-specialists.

58% of the NFB describe their ability as 'good' and 35% as 'poor'. This compares with a less positive view from the specialists with 23% of the HVCA and 11% of the ECA describing their ability as 'good' and the majority as 'poor' – 70% of the HVCA and 78% of the ECA. Furthermore, 7% of the HVCA and 11% of the ECA describe their ability as 'very poor'.

Objective 2.2 (continued): The *abilities* of quantity surveying firms to produce useful pricing information

Chart 4.27: In relation to your own area of work, how do you rate the ability of consultant quantity surveying firms in terms of their *knowledge of materials?* (question 12e)



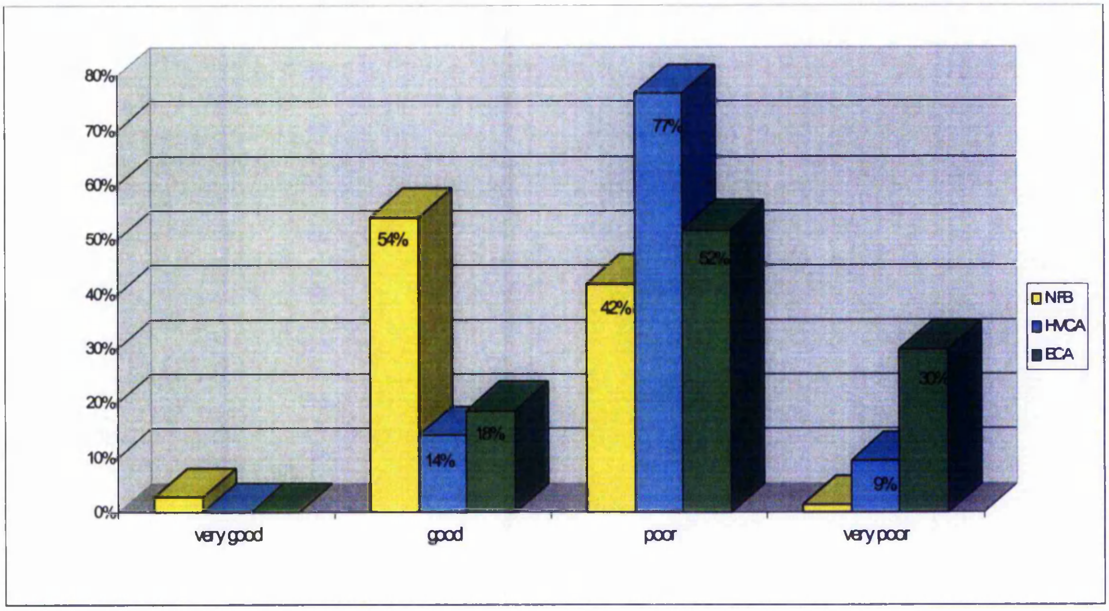
Source: Analysis of survey data (Industry Survey)

The consultant quantity surveyors' *knowledge of materials* reveals a marked difference in opinion between the specialists and non-specialists.

58% of the NFB perceive their ability as 'good' and 34% as 'poor'. This contrasts with only 14% of the HVCA and 11% of the ECA describing their ability as 'good' and 74% of the HVCA and 59% of the ECA as 'poor'. In addition, 12% of the HVCA and 30% of the ECA perceive their ability to be 'very poor'.

Objective 2.2 (continued): The *abilities* of quantity surveying firms to produce useful pricing information

Chart 4.28: In relation to your own area of work, how do you rate the ability of consultant quantity surveying firms in terms of their *knowledge of design?* (question 12f)



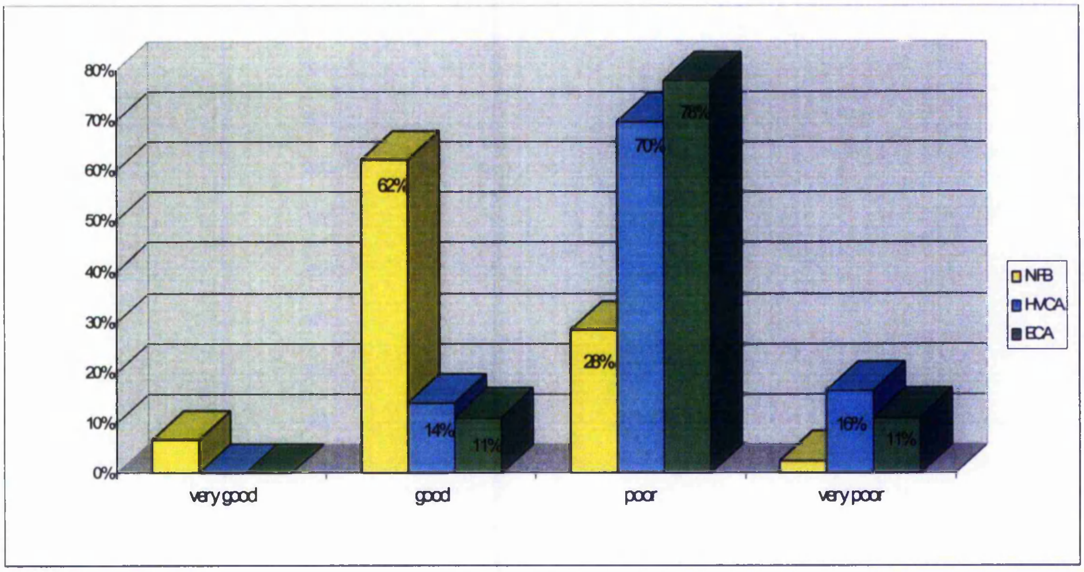
Source: Analysis of survey data (Industry Survey)

The consultant quantity surveyors' *knowledge of design* reveals a similar pattern of opinion.

The majority of the NFB (54%) believe their ability to be 'good' and 42% to be 'poor'. In contrast, only 14% of the HVCA and 18% of the ECA describe their ability as 'good'. The remainder, 77% of the HVCA and 52% of the ECA describe this as 'poor' and 9% of the HVCA and 30% of the ECA to be 'very poor'.

Objective 2.2 (continued): The *abilities* of quantity surveying firms to produce useful pricing information

Chart 4.29: In relation to your own area of work, how do you rate the ability of consultant quantity surveying firms in terms of their ability to *breakdown the construction into price-able units?* (question 12g)



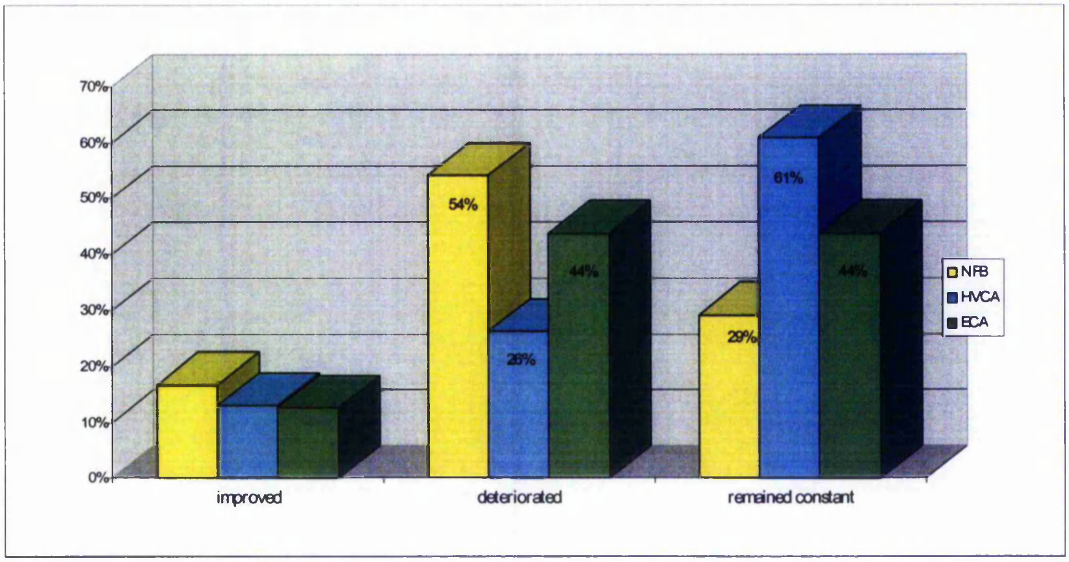
Source: Analysis of survey data (Industry Survey)

Based on the views from the estimators it would appear that the consultant quantity surveyor is better able to breakdown non-specialist work into price-able units than specialist work.

62% of the NFB describe their ability in this respect as 'good' and 28% as 'poor'. In contrast, 14% of the HVCA and 11% of the ECA describe their ability as 'good'. 70% of the HVCA and 78% of the ECA describe this as 'poor' and 16% of the HVCA and 11% of the ECA as 'very poor'.

Objective 2.2 (continued): The *abilities* of quantity surveying firms to produce useful pricing information

Chart 4.30: Do you believe that the ability of *consultant quantity surveying firms* to produce useful quantified information has changed over time? (question 13)



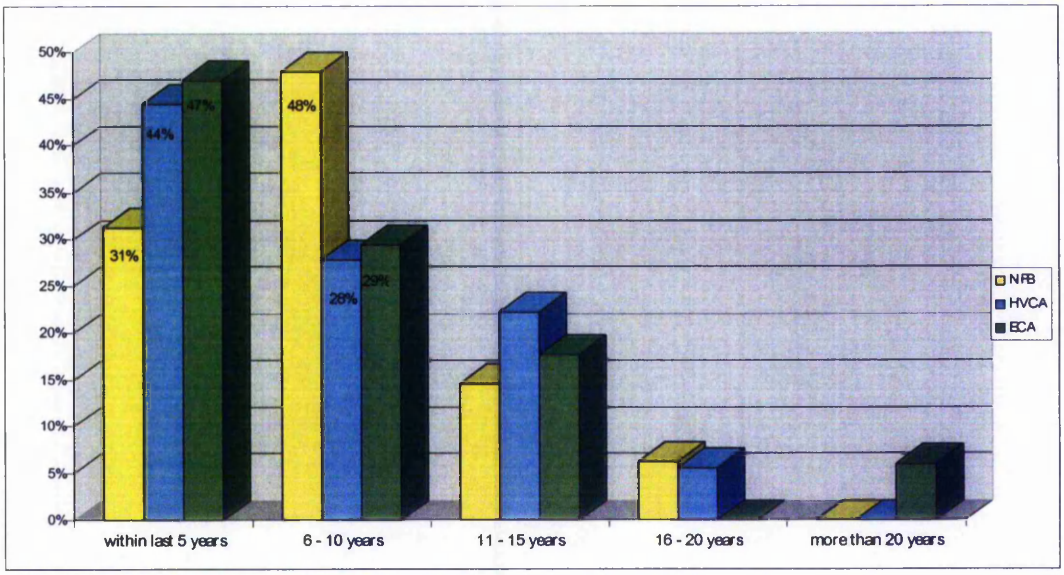
Source: Analysis of survey data (Industry Survey)

This question evaluates how the ability of the consultant quantity surveyor to produce useful pricing information has changed over time.

Approximately 10% of all the respondents believe that their ability has improved over time. However, most deterioration is reported by the non-specialist estimators. Views from NFB estimators reveal a response of 54% against the 'deterioration' category and only 29% against 'remained constant'. The views of the two specialists groups are, in this instance, in direct contrast with one another. 26% of HVCA and 44% of the ECA believe that their ability has deteriorated. However, 61% of the HVCA and 44% of the ECA believe that this has 'remained constant'. Overall, the ability of the consultant quantity surveyor to produce useful pricing information has remained relatively constant over time for specialist firms. In contrast deterioration is apparent on the non-specialist side.

Objective 2.2 (continued): The *abilities* of quantity surveying firms to produce useful pricing information

Chart 4.31: If their ability to produce useful quantified information has altered, over what time period has this shift been most noticeable? (question 13.1)



Source: Analysis of survey data (Industry Survey)

This question evaluates how recently the changes have occurred (as illustrated in chart 4.30, p.238).

Although little overall change was identified for the specialist firms (chart 4.30), changes that have occurred are most apparent within the last five years – HVCA 44% and ECA 47%. The NFB members report that most change has occurred within the last ten years – 31% within the last 5 years and 48% in the last 6-10 years.

Overall, most change is apparent within the last ten years. However, there may well be a natural bias in the results towards the immediate past as respondents are more likely to recollect this better.

This section of the results has provided an evaluation of the *ability* of consultant quantity surveying firms to produce useful pricing documentation.

The views of the specialist firms are noticeably different to those of the non-specialists. The non-specialist respondents are more positive about the ability of the consultant quantity surveyor to produce useful pricing information. In contrast, the specialist firms are far more critical of the usefulness of this pricing information.

The only exceptions to this comment relate to the consultant quantity surveyors ability to specify performance requirements (chart 4.24, p.232) and how the ability to produce useful tendering documentation has changed over time (chart 4.30, p.238).

Aside from these two exceptions, the views of the two specialist representative bodies are very similar.

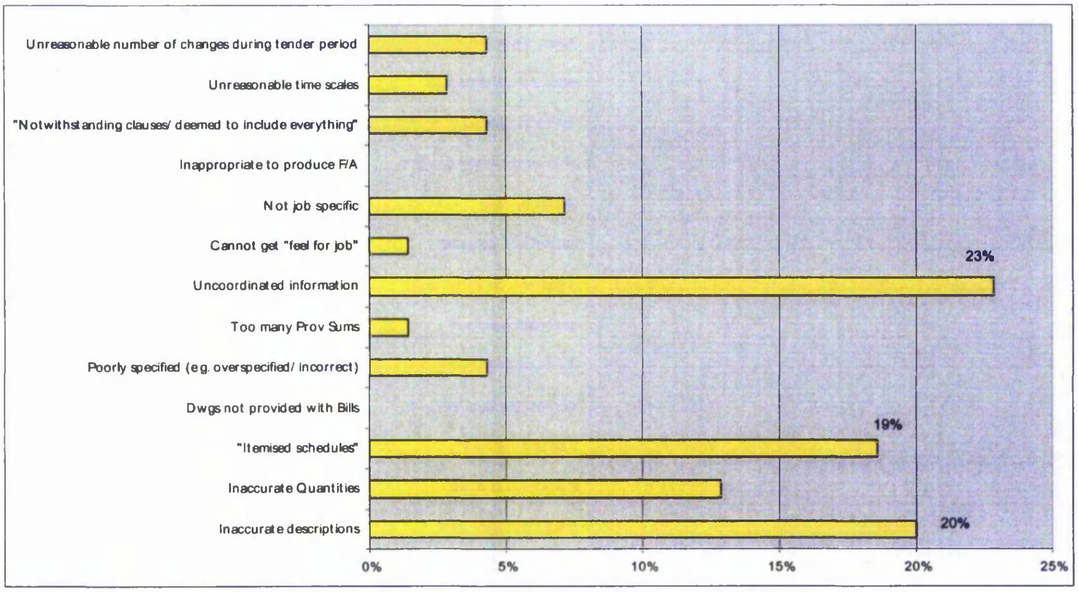
The following section evaluates the main problems experienced with bills of quantities by the contractors' estimators.

Objective 2.3: Problems encountered with bills of quantities

Dedicated graphs are provided for each representative body against the next two research objectives (objectives 2.3 and 2.4).

These sections present the estimators' views on the main problems experienced with bills of quantities. The respondents were asked, to express in written form, the main problems they encountered with bills (effectively a free text response). Their views were recorded and subsequently interpreted into the main areas as detailed below.

Chart 4.32: Views on the problems with bills of quantities: National Federation of Builders (NFB) (question 15)

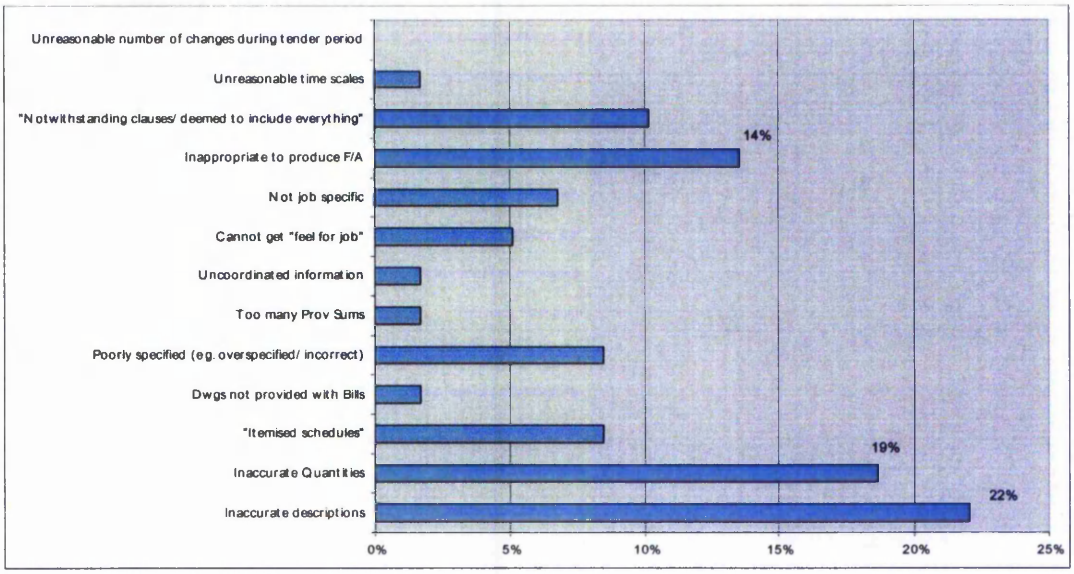


Source: Analysis of survey data (Industry Survey)

The graph illustrates that the main problem experienced with bills by the NFB relates to 'uncoordinated information' (at 23%). 'Inaccurate descriptions' and 'Itemised bills' are cited as the next most frequent problems at 20% and 19% respectively.

Objective 2.3 (continued): Problems encountered with bills of quantities

Chart 4.33: Views on the problems with bills of quantities: Heating and Ventilating Contractors Association (HVCA) (question 15)

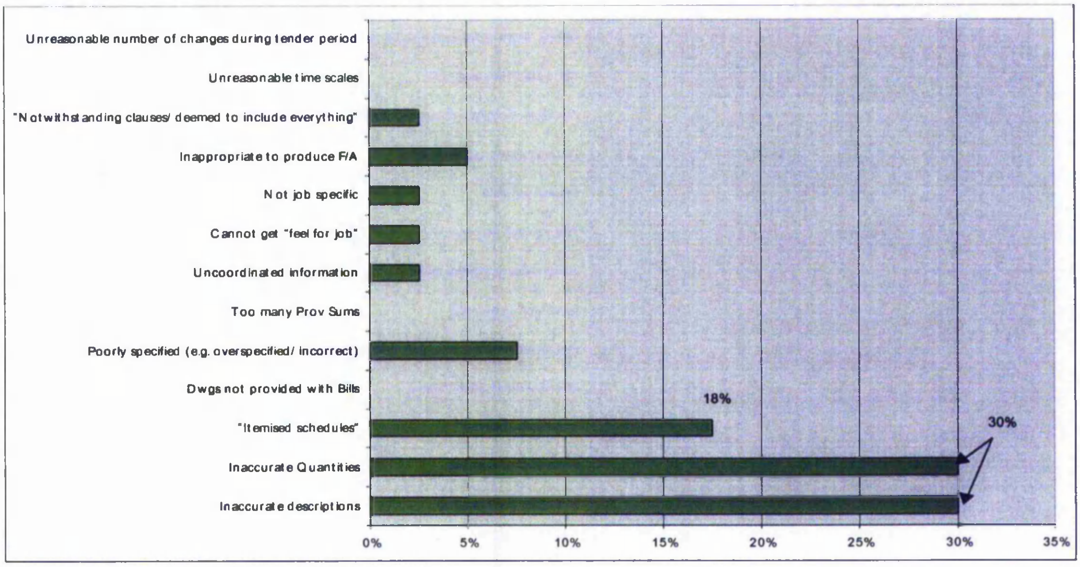


Source: Analysis of survey data (Industry Survey)

The HVCA report their main problems to be the inaccuracy of the descriptions (22%) and inaccuracy of the quantities (19%). The third main problem is regarded as the inappropriateness of the bills to produce a Final Account (14%).

Objective 2.3 (continued): Problems encountered with bills of quantities

Chart 4.34: Views on the problems with bills of quantities: Electrical Contractors Association (ECA) (question 15)



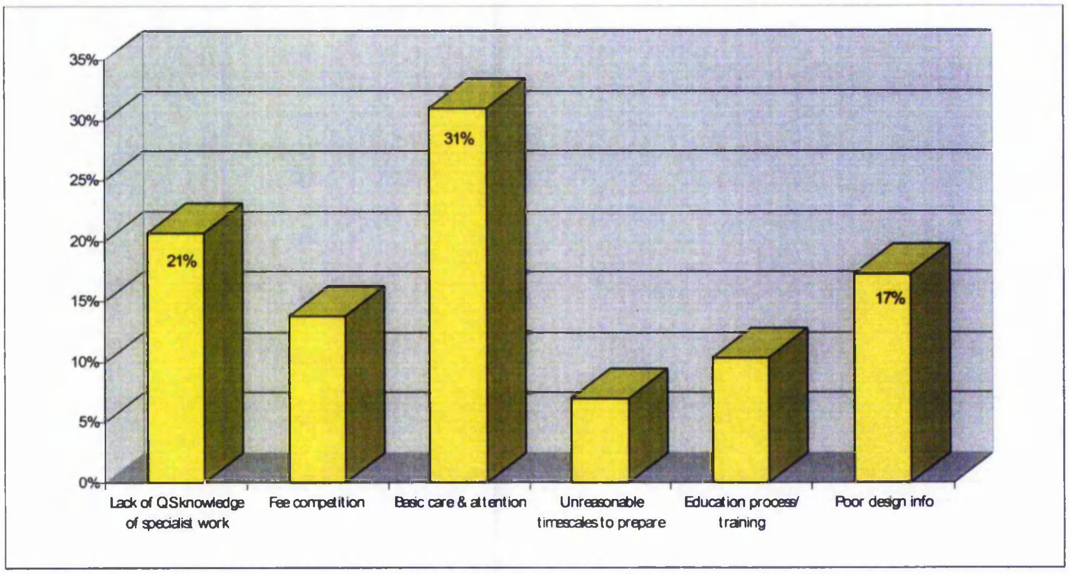
Source: Analysis of survey data (Industry Survey)

The top two ECA problems are identical to those experienced by the HVCA – 'inaccurate descriptions' and 'inaccurate quantities' (both at 30%). 'Itemised schedules' rank as the third main problem area.

In summary, non-specialist contractors find the issue of uncoordinated information to be the most problematic and inaccurate descriptions feature as their second most frequent problem area. Inaccurate descriptions are also encountered by both groups of specialist contractors (the main problem encountered by the HVCA and joint main problem encountered by the ECA). The responses reveal that inaccurate quantities also prove troublesome to the specialist estimators (joint top for the ECA and second for the HVCA).

Objective 2.4: Root causes of the problems encountered with bills of quantities

Chart 4.35: Views on the root causes of problems with bills of quantities: National Federation of Builders (NFB) (question 16)



Source: Analysis of survey data (Industry Survey)

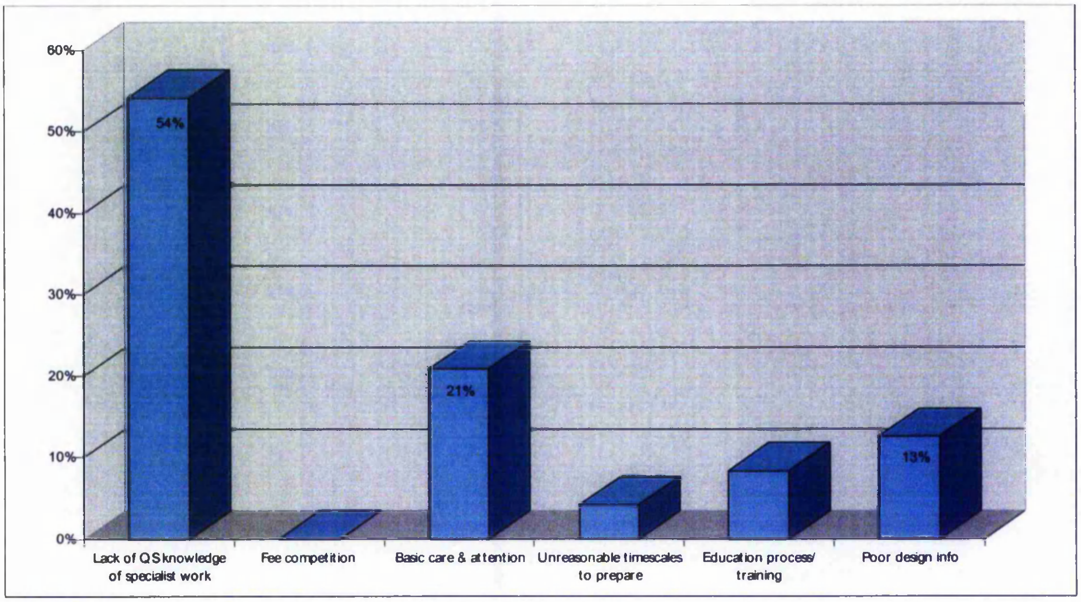
This section of the survey sought to explore the root cause of the problems encountered in practice. The results were compiled in the same manner as section 2.3 (page, 257).

The NFB cited 'basic care and attention' as the main underlying issue (31%). Essentially, the ability to provide useful information was in existence but, due to poor practice, the requisite quality of information was not being provided. 'Lack of QS knowledge of specialist work' was recorded as the second most common root cause at 21%. This inferred that the problem was more a matter of principal i.e. that a basic understanding of the work was lacking on the consultant quantity surveying side of the industry.

'Poor design information' was then recorded as the third main problem area. This would inevitably impair the ability of the consultant quantity surveyor to prepare pricing information as this can only be adequately based upon a substantially complete design.

Objective 2.4 (continued): Root causes of the problems encountered with bills of quantities

Chart 4.36: Views on the root causes of problems with bills of quantities: Heating and Ventilating Contractors Association (HVCA) (question 16)

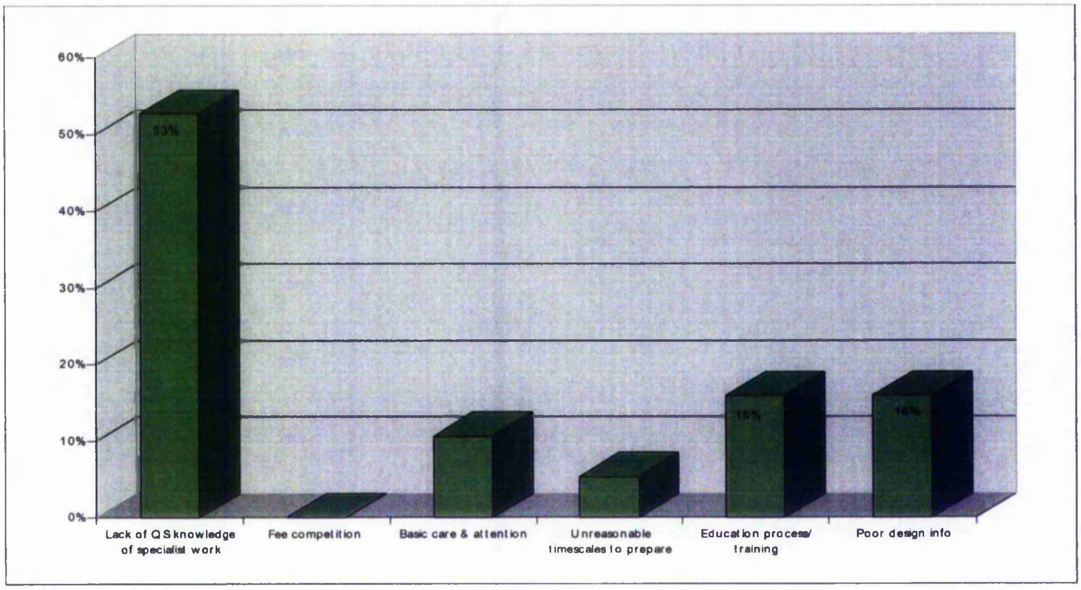


Source: Analysis of survey data (Industry Survey)

The HVCA reported the main root cause of the problems experienced to be a 'lack of QS knowledge of specialist work' (54%). This suggests a more deep-rooted problem. That is, a matter of principal as opposed to a matter of practice. 'Basic care and attention' (21%) was also cited along with poor design information at 13%.

Objective 2.4 (continued): Root causes of the problems encountered with bills of quantities

Chart 4.37: Views on the root causes of problems with bills of quantities: Electrical Contractors Association (ECA) (question 16)



Source: Analysis of survey data (Industry Survey)

The ECA response was almost identical to that of the HVCA. 'Lack of QS knowledge of specialist work' was recorded as the main root cause of problems at 53%. 'Poor design information' and the 'education process/ training' shared second place with 16% of responses.

In summary, the results from the non-specialist group suggested that the root cause of the problems related to basic care and attention – the basic understanding was in existence but the quality of work was not always provided. The specialist representative bodies (HVCA and ECA) suggested the opposite. The results revealed a basic lack of understanding of this type of work as being the root cause of problems.

The results suggest that the inaccurate descriptions and inaccurate quantities for non-specialist work could be overcome through basic care and attention. However, the same problems experienced on specialist work could not be overcome through basic care and attention as, in principal, a lack of understanding of this work type is apparent.

Objective 2.5: Overall quality of the pricing information produced by contracting firms

As a comparison against the information provided by consultant quantity surveying firms, the survey sought the views of contractors on the quality of information produced by someone within their own organisation. Exactly the same questions were posed as illustrated in charts 4.10 to 4.15 (p.437-442). *Quality* has been evaluated in a number of ways:-

- How accurately the descriptions specify the quality of works to be carried out.
- The accuracy of the quantities.
- How logically the information is presented.
- How closely the information relates to what is eventually built.
- The level of detail of the measured work compared with that supplied internally.
- The additional work required in order that a price may be calculated.

In order to maintain a manageable level of reporting within the results chapter the findings of this section are reported in Appendix K.

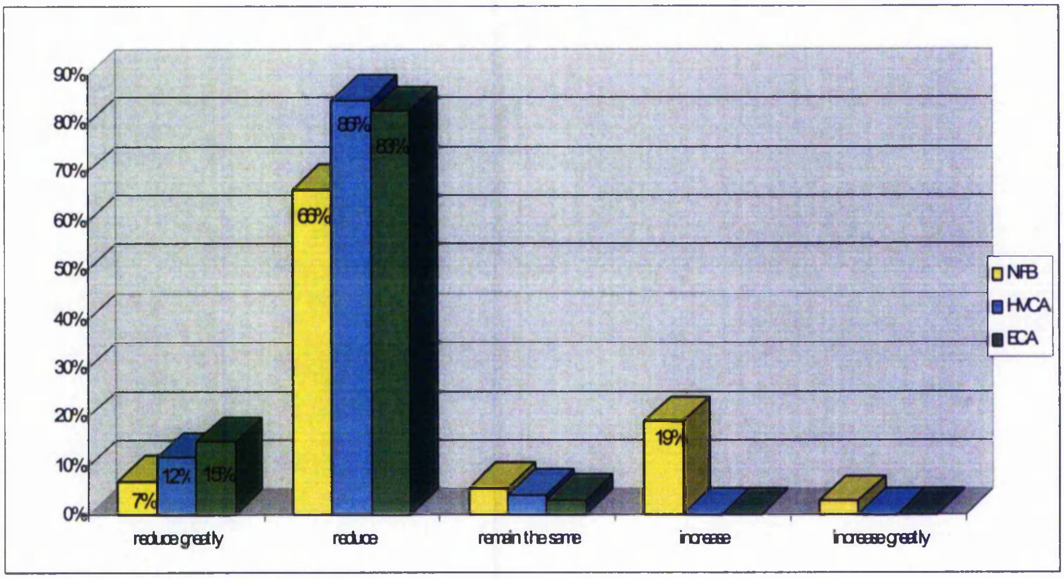
On all counts a favourable response has been provided by each of the three representative bodies. The majority of responses are recorded within the 'good' category and approximately one quarter to a third recorded within the 'very good' category. The NFB response to question 10.1 (chart 4.42, p.454) is seen as the only exception to these trends where 30% of respondents gave the opinion that the information provided internally was 'less detailed' than that supplied externally.

No discernable gap is apparent between the quality of internally and quality of externally supplied quantified information for the non-specialist contractor. The quality of the measured work therefore remains unaltered when the quantified information is produced by either source.

In contrast, a gap is evident in the two sets of views from the specialist contractors. The quality of quantified pricing information is reduced when it is provided by an external source as opposed to an internal source. The views of the two specialist groups are also very similar to one another.

Objective 3.1: Suggested solutions in terms of the contractor's preferred level of input during the tendering process

Chart 4.44: How would your price for a project alter if you were given the freedom to *design* the work yourself (as opposed to basing your price on measured work typically supplied by *consultant quantity surveying firms)?* (question 14a)



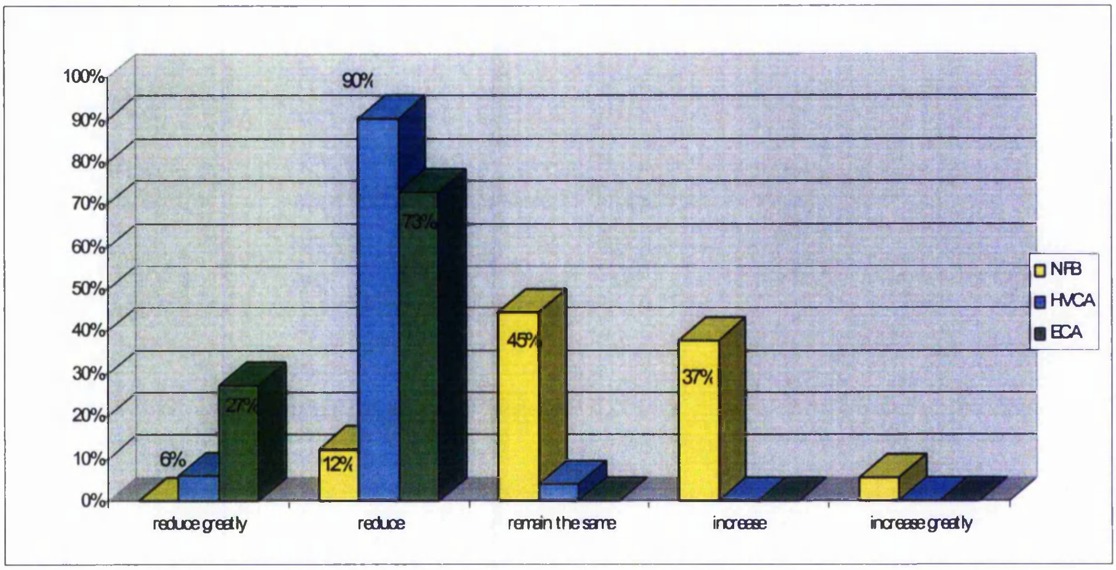
Source: Analysis of survey data (Industry Survey)

The following set of questions tests-out how the overall price for a project would alter if the contractor were able to have a more detailed input during the tender stage. However, it is recognised that the results only capture the estimators' perception of what will happen. In reality there may be a difference between what they perceive and what actually occurs, the results are therefore limited in this respect. This 'input' was evaluated in terms of how their price would alter if they designed the work themselves, quantified the work themselves or specified the materials themselves.

The above graph illustrates the effect on price if the contractors were given the opportunity to design the work themselves. The response categories allow the estimators to express whether their price will increase, decrease or remain the same. All three representative bodies recorded the majority of their responses within the 'reduce' category (NFB, 66%; HVCA, 85% and ECA, 83%). A number of respondents also stated that the price would 'reduce greatly' (NFB, 7%; HVCA, 12% and ECA, 15%). However, opposing this trend are a number of NFB respondents that state an 'increase' in overall price at 19%.

Objective 3.1 (continued): Suggested solutions in terms of the contractor's preferred level of input during the tendering process

Chart 4.45: How would your price for a project alter if you were given the freedom to *quantify* the work yourself (as opposed to basing your price on measured work typically supplied by *consultant quantity surveying firms)?* (question 14b)



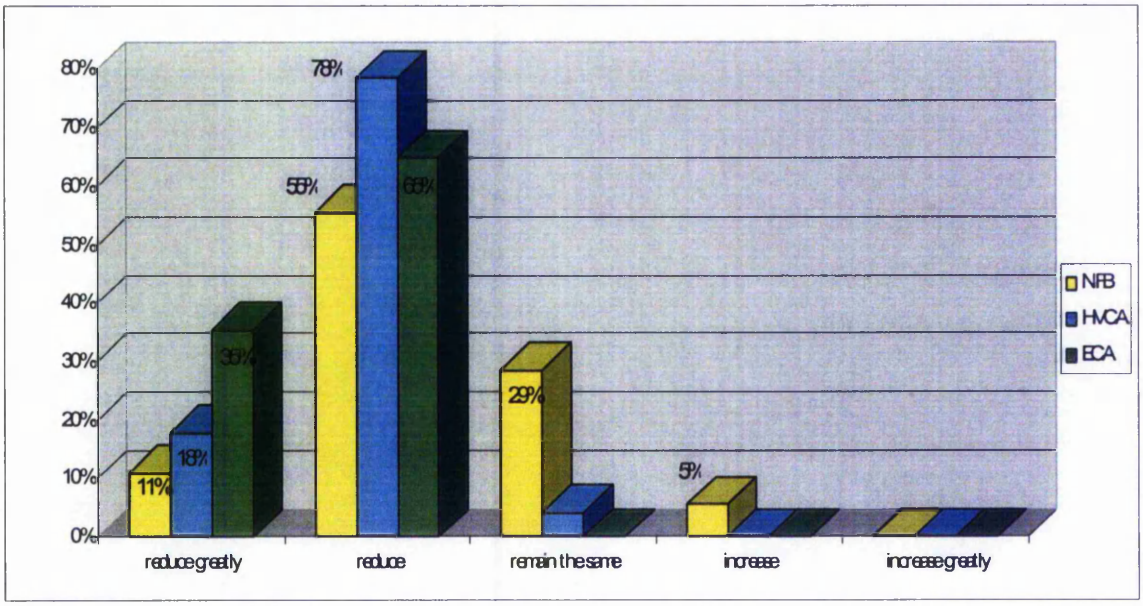
Source: Analysis of survey data (Industry Survey)

The graph displays a mixed response from the NFB if they are given the opportunity to quantify the work, 12% consider this will 'reduce' the price, 45%;'remain the same; 37% increase and 6% 'increase greatly'. If the 'remain the same' response category is ignored, as this effectively provides a price neutral situation, then the number of responses suggesting an increase outweighs those suggesting a reduction by some 31% i.e. (37+6) – 12 = 31%.

The specialists display a completely different set of responses. Neither the HVCA nor ECA report an increase in price if they are given the opportunity to quantify the work themselves. The majority state that the price will 'reduce' – HVCA, 90% and ECA 73%. Furthermore, 27% of the ECA and 6% of the HVCA state that the price will 'reduce greatly'.

Objective 3.1 (continued): Suggested solutions in terms of the contractor's preferred level of input during the tendering process

Chart 4.46: How would your price for a project alter if you were given the freedom to *specify the materials* yourself (as opposed to basing your price on measured work typically supplied by *consultant quantity surveying firms)?* (question 14c)



Source: Analysis of survey data (Industry Survey)

The non-specialists give a more mixed response than the specialists. The highest proportion - 55%, report a reduction in price if they are given the opportunity to specify the materials themselves. 11% suggest that this would reduce the price greatly and 29% - that the price would remain the same. A small proportion of the NFB respondents (5%) state an increase in price.

None of the HVCA nor ECA respondents suggest an increase in price if given the opportunity to specify the materials themselves. 78% of the HVCA and 65% of the ECA suggest that the price would 'reduce'. 18% of the HVCA and 35% of the ECA suggest that the price would 'reduce greatly'.

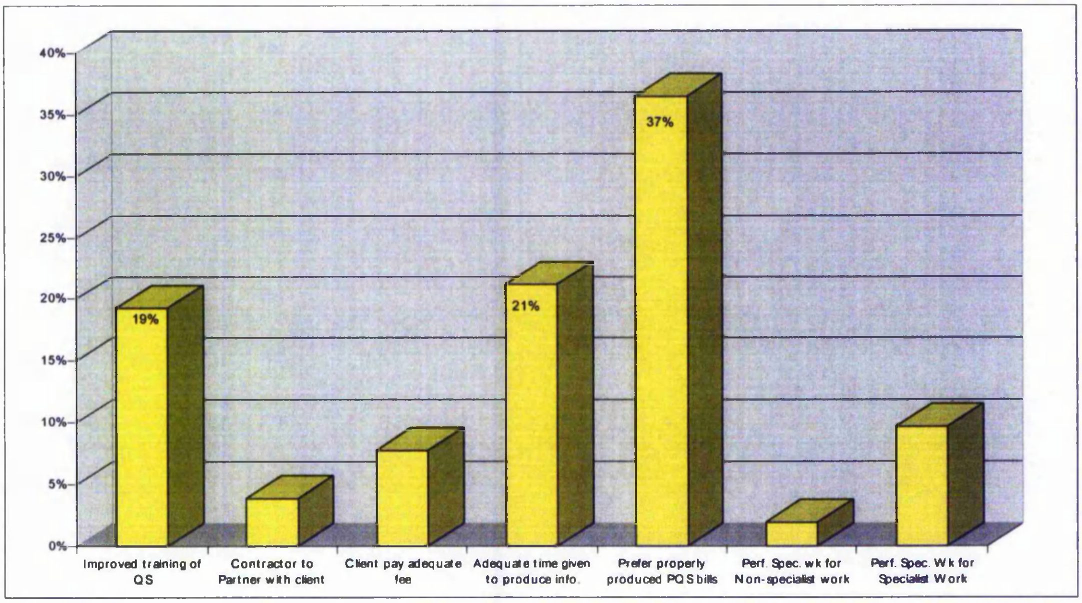
To summarise this section, none of specialist contractors stated that their overall price would increase if they were given the opportunity to design the work, quantify the work or specify the materials themselves. A negligible proportion stated that their price would remain the same. 97% of the HVCA and 98% of ECA reported a saving if they were able to design the work themselves; 96% of the HVCA and 100% of the ECA respondents reported a saving if they were able to quantify the work themselves. In terms specifying the materials themselves, 96% of the HVCA and 100% of the ECA reported a saving. The views of the two representative bodies are comparable throughout.

The views from the NFB are less straightforward. 73% of respondents reported a saving if they were able to design the work themselves, however, 19% reported an overall increase in cost. Only 12% reported a saving if allowed to quantify the work themselves against an increase in overall cost of 37%. Finally, 66% of respondents reported a saving if they were able to specify the materials, 29% that the price would 'remain the same' and 5% as an increase in cost.

Overall, the potential to save on construction cost (by allowing the contractors to design, quantify or specify the materials themselves) appears most viable for the specialist trades. Enabling the non-specialists to input in the design or specification of materials would also result in some overall savings. However, the results suggest that it is not economically viable to enforce non-specialist contractors to quantify the work themselves, if quantities are not provided for these trades then the overall cost of the tendering process and thus construction will increase.

Objective 3.2: Contractors' suggested solutions to overcome the stated problems

Chart 4.47: Views on the suggested solutions to overcome the problems with bills of quantities: National Federation of Builders (NFB)? (question 17)



Source: Analysis of survey data (Industry Survey)

The following three graphs illustrate the result of direct questions about proposed solutions. At the end of the questionnaire survey the contractors were asked, in their own words, to record how the stated problem areas could be overcome. As none of the above categories were dictated they needed to instead be derived from the free text responses. The graphs show, of those that responded, how frequently each of the issues was raised.

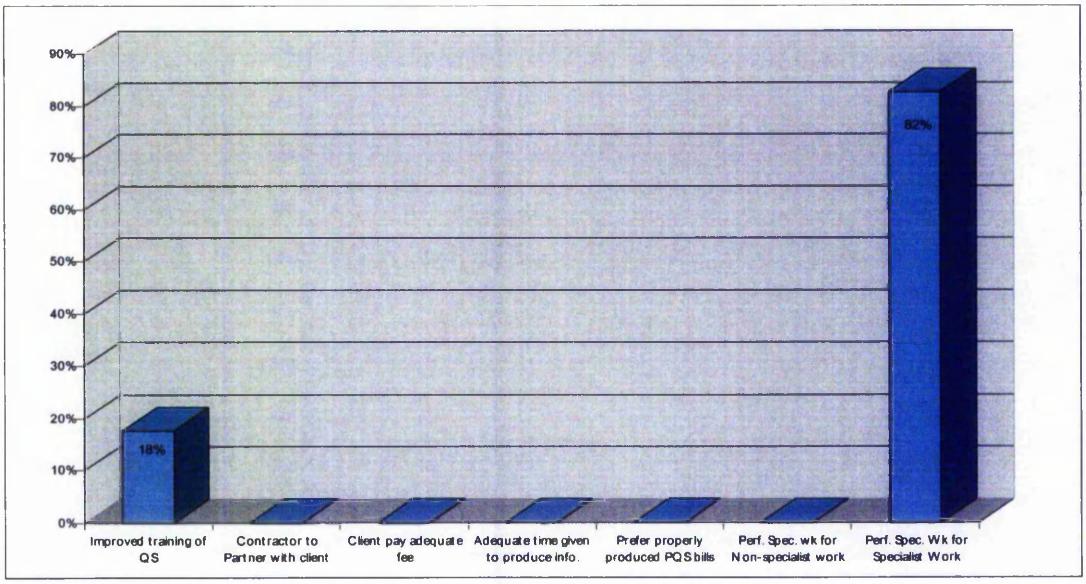
The highest response from the NFB, at 37%, simply suggests that bills of quantities should be properly prepared by the consultant quantity surveyor. This is simply adherence to existing practice. Secondly, 21% of respondents suggested that adequate time is allowed to prepare a price and 19% that the training of the quantity surveyor is improved.

It is interesting to note that 10% of the proposed solutions do not relate to their own area of work but to that of the specialist contractors. They propose that the consultant quantity surveyor should not measure specialist work and that the performance requirements or end product should to be stated instead.

The proposed solutions are based on the views of 52 respondents equating to 68% of the total NFB response.

Objective 3.2 (continued): Contractors' suggested solutions to overcome the stated problems

Chart 4.48: Views on the suggested solutions to overcome the problems with bills of quantities: Heating and Ventilating Contractors Association (HVCA)? (question 17)



Source: Analysis of survey data (Industry Survey)

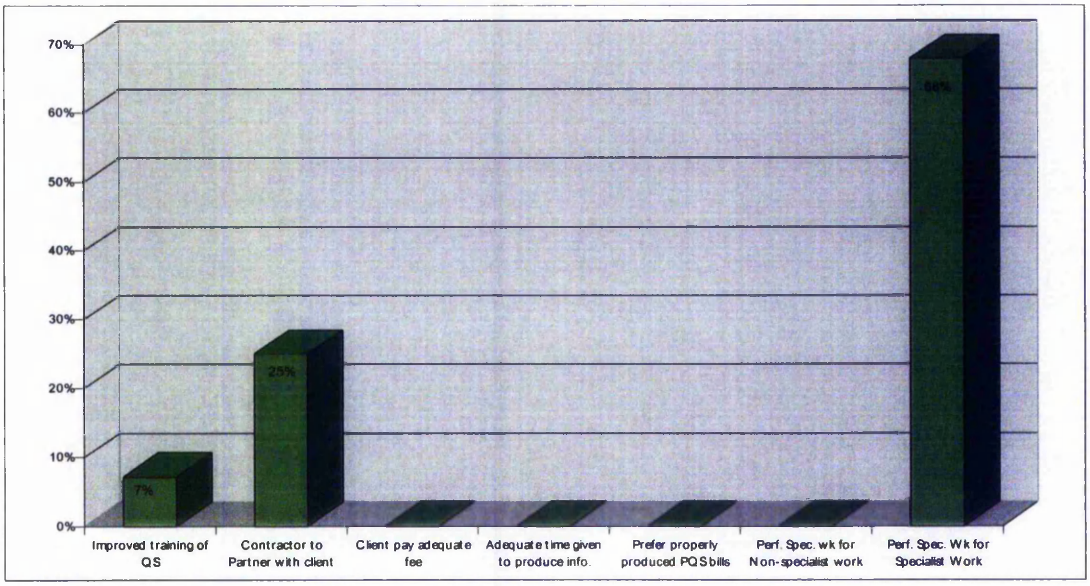
82% of the HVCA suggest that the consultant quantity surveyor should not measure specialist work. Instead, they propose that the pricing documentation should just specify the end product that the work is required to achieve i.e. specify the performance criteria.

18% of respondents also suggest that the training of the quantity surveyor should be improved.

The proposed solutions are based on the views of 40 respondents equating to 68% of the total HVCA response.

Objective 3.2 (continued): Contractor's suggested solutions to overcome the stated problems

Chart 4.49: Views on the suggested solutions to overcome the problems with bills of quantities: Electrical Contractors Association (ECA)? (question 17)



Source: Analysis of survey data (Industry Survey)

The only major difference between the views of the two specialist groups is the ECA response on the need to partner with the client. 68% of the ECA suggest that the consultant quantity surveyor should not measure specialist work. Instead, they propose that the pricing documentation should just specify the end product that the work is required to achieve i.e. specify the performance criteria.

25% of respondents propose a move away from the more traditional contractual arrangement in which the main contractor employs the specialist contractor. Instead, they suggest allowing the specialist to partner directly with the client.

7% of respondents also suggest that the training of the quantity surveyor should be improved.

The proposed solutions are based on the views of 28 respondents equating to 76% of the total HVCA response.

To summarise, the non-specialist firms stated a strong preference for bills of quantities to be prepared properly by the consultant quantity surveyor (37%). In contrast, the specialist firms state a strong preference that the work is not measured for them and instead that only the end product/ performance requirements are specified (HVCA, 82% and ECA, 68%). 10% of the NFB also agree with this logic for specialist firms. All of the representative bodies suggested that the training of the quantity surveyor should be improved (NFB, 19%; HVCA, 18% and ECA, 7%). Finally, 29% of the ECA suggest a move towards partnering with the client as opposed to the existing contractual arrangements.

Summary of industry survey results

The results of the industry survey have been individually presented against each research question. The enormity of data involved makes it difficult to form an overview of these results. In order to address this, the following section provides a summary of the results and allows a conceptual overview to be formed.

The following key helps illustrate the direction of the response within table 4.7 (p.261). Differences in opinion between the specialists and non-specialists are presented in red, levels of agreement in green and key results in yellow. These categories are mutually exclusive.

Key:-

- The majority of specialist and non-specialist opinion is in the *opposite* direction i.e. they are not in agreement

- The majority of specialist and non-specialist opinion is in the *same* direction i.e. they are in agreement

- Key result

Table 4.7: Summary of industry survey results

Ref:	Objective	Research question	Key results			Coding
			Non-specialists (NFB)	**Specialists (HVCA)**	**Specialists (ECA)**	
1.1	**Overall characteristics of specialist and non-specialist contractors**	3) Typical role	**93%** - main contractors	**83%** - subcontractors	**97%** - subcontractors	
		5) Annual turnover	**71%** within the "> £1m, less than or equal to £25m" band	**68%** - within the "> £1m, less than or equal to £25m" band	**81%** - within the "> £1m, less than or equal to £25m" band	
		6) Nr of employees	**33%** - within the "20-49" category	**42%** - within the "20-49" category	**46%** - within the "20-49" category	
1.2	**Current practice in terms of the type of work received by contractors**	7) % use by value of different procurement methods	**30%** - in Bills of Quantities format	**7%** - in Bills of Quantities format	**6%** - in Bills of Quantities format	
		7) % use by number of different procurement methods	**24%** - in Bills of Quantities format	**5%** - in Bills of Quantities format	**5%** - in Bills of Quantities format	
2.1	**Overall quality of pricing information produced by Quantity Surveying firms**	8) Proportion of Bills of Quantities actually measured	**67%** - within the "51-75%" band	**40%** - within the "51-75%" band	**38%** - within the "51-75%" band	
		8) Overall % of the workload that is actually measured by the client (by value)	**25%**	**2%**	**1%**	
		9a) How accurately the descriptions specify the quality of the works to be carried out	**65%** - "good"	**70%** - "poor"	**77%** - "poor"	
		9b) Accuracy of the quantities	**83%** - "good"	**75%** - "poor"	**85%** - "poor"	
		9c) How logically the information is presented	**60%** - "good"	**68%** - "poor"	**58%** - "poor"	
		9d) How closely the information relates to what is eventually built	**58%** - "good"	**63%** - "poor"	**69%** - "poor"	
		9.1) Level of detail of the information supplied by consultant Quantity Surveying firms compared to that supplied internally	**55%** - "more detailed"	**71%** - "less detailed"	**88%** - "less detailed"	
		9.2) Additional work required to supplement the measured work	**69%** - "a little"	**66%** - "a lot"	**85%** "a lot"	

Table 4.7: Summary of industry survey results (continued)

Ref:	Objective	Research question	Key results			Coding
			Non-specialists (NFB)	**Specialists (HVCA)**	**Specialists (ECA)**	
2.1	**Overall quality of pricing information produced by Quantity Surveying firms**	**11a)** Does measured work enable the prices to be evaluated on a level playing field	**53%** - "strongly agree"	**62%** - "disagree"	**70%** - "disagree"	
		11b) Is the measured work useful for planning	**53%** - "agree"	**78%** - "disagree"	**56%** - "disagree"	
		11c) Is the measured work useful for ordering materials	**46%** - "disagree"	**61%** - "disagree"	**78%** - "disagree"	
		11d) Does the priced measured work accurately reflect the cost of the work when used to prepare interim valuations	**61%** - "agree"	**68%** - "disagree"	**52%** - "disagree"	
		11e) Does the priced measured work accurately reflect the cost of the works when used to prepare the Final Account	**40%** - "agree"	**66%** - "disagree"	**67%** - "disagree"	
		11f) Can the measured work be used to accurately value the cost of variations	**49%** - "disagree"	**63%** - "disagree"	**74%** - "disagree"	
		11g) Is the measured work useful for internal cost controlling	**58%** - "agree"	**68%** - "disagree"	**89%** - "disagree"	
2.2	**Abilities of consultant Quantity Surveying firms to produce useful pricing information**	**12a)** Ability to describe the processes involved in constructing the works and resources required to achieve this	**49%** - "agree"	**83%** - "disagree"	**89%** - "disagree"	
		12b) Ability to describe the performance requirements of the finished product/ the function it is required to serve	**58%** - "good"	**61%** - "good"	**74%** - "good"	

Table 4.7: Summary of industry survey results (continued)

Ref:	Objective	Research question	Key results			Coding
			Non-specialists (NFB)	**Specialists (HVCA)**	**Specialists (ECA)**	
2.2	**Abilities of consultant Quantity Surveying firms to produce useful pricing information**	**12c)** Practical awareness	**42%** - "good"	**74%** - "poor"	**70%** - "poor"	
		12d) Knowledge of construction	**58%** - "good"	**70%** - "poor"	**78%** - "poor"	
		12e) Knowledge of materials	**58%** - "good"	**74%** - "poor"	**59%** - "poor"	
		12f) Knowledge of design	**54%** - "good"	**77%** - "poor"	**52%** - "poor"	
		12g) Ability to breakdown the construction into price-able units	**62%** - "good"	**70%** - "poor"	**78%** - "poor"	
		13) How has the overall ability changed over time	**54%** - "deteriorated"	**61%** - "remained constant"	**44%** - "deteriorated" and 44% "remained constant"	
		13.1) Over what time period has this shift been most noticeable	**48%** - within the last "6-10" years	**44%** - within the last "6-10 years"	**47%** - within the last "6-10 years"	
2.3	**Problems encountered with Bills of Quantities**	**15)** Views on the problems with Bills of Quantities	Top three: **23%** - "uncoordinated information" **20%** - "inaccurate descriptions" **19%** - "itemised schedules"	Top three: **22%** - "inaccurate descriptions" **19%** - "inaccurate quantities" **14%** - "inappropriate to produce F/A"	Top three: **30%** - "inaccurate descriptions" **30%** - "inaccurate quantities" **18%** - "itemised schedules"	
2.4	**Root causes of the problems encountered with Bills of Quantities**	**16)** Views on the root causes	Top three: **31%** - "basic care and attention" **21%** - "lack of QS knowledge of specialist work" **17%** - "poor design information"	Top three: **54%** - "lack of QS knowledge of specialist work" **21%** - "basic care and attention" **13%** - "poor design information"	Top three: **53%** - "lack of QS knowledge of specialist work" **16%** - "education process/ training" **16%** - "poor design information"	

Table 4.7: Summary of industry survey results (continued)

Ref:	Objective	Research question	Key results			Coding
			Non-specialists (NFB)	**Specialists (HVCA)**	**Specialists (ECA)**	
2.5	**Overall quality of the pricing information produced by contracting organisations**	**10a)** How accurately the descriptions specify the quality of the works to be carried out	**67%** - "good"	**71%** - "good"	**73%** - "good"	
		10b) Accuracy of the quantities	**71%** - "good"	**63%** - "good"	**67%** - "good"	
		10c) How logically the information is presented	**71%** - "good"	**54%** - "good"	**73%** - "good"	
		10d) How closely the information relates to what is eventually built	**72%** - "good"	**68%** - "good"	**73%** - "good"	
		10.1) Level of detail of the information supplied by consultant Quantity Surveying firms compared to that supplied internally	**59%** - "more detailed"	**75%** - "more detailed"	**85%** - "more detailed"	
		10.2) Additional work required to supplement the measured work	**64%** - "a little"	**78%** - "a little"	**79%** - "a little"	
3.1	**Suggested solutions in terms of the contractor's preferred level of input during the tendering process**	**14a)** How would the price alter if you were given the freedom to *design* the work yourself	**66%** - "reduce"	**85%** - "reduce"	**83%** - "reduce"	
		14b) How would the price alter if you were given the freedom to *quantify* the work yourself	**45%** - "remain the same" and **37%** "increase"	**90%** - "reduce"	**73%** - "reduce" and **27%** "reduce greatly"	
		14c) How would the price alter if you were given the freedom to *specify the materials* yourself	**55%** - "reduce" and **29%** "remain the same"	**78%** - "reduce" and **18%** "reduce greatly"	**65%** - "reduce" and **35%** "reduce greatly"	
3.2	**Contractor's suggested solutions to overcome the stated problems**	**17)** Suggested solutions to overcome problems with Bills of Quantities	Top three: **37%** - "prefer properly produced PQS bills" **21%** - "adequate time given to produce information" **19%** - "improved training of QS"	Top two: **82%** - "performance specified work for specialist trades" **18%** - "improved training of QS"	Top three: **68%** - "performance specified work for specialist trades" **25%** - "contractor to partner with client" **7%** - "improved training of QS"	

The above table helps maintain a conceptual overview of the results. The colour coding illustrates how the results of the specialists and non-specialists are related to one another.

The majority of specialist firms are seen to typically act as subcontractors and majority of non-specialists as main contractors. Both groups of contractor have similar annual turnover levels and numbers of employees – the majority being within the "> £1m, less than or equal to £25m" and "20-49" bands respectively.

Two key results are noted against objective 1.2. The specialist firms receive a much lower proportion of their work in bills of quantities format - both in terms of value and number.

Objective 2.1 reveals a more detailed understanding of the quality of pricing information produced by consultant quantity surveying firms. Of the work received in bills of quantities format, most reported that only between 51-75% of the work was actually measured. This means that for the specialists the value of work *actually* measured is negligible. The quality of measured work is also perceived differently by the two groups of contractor. *Quality* is evaluated in a number of ways – the specialists view this poorly whilst the non-specialists are more positive.

The two groups of contractor also differ considerably in terms of their perception of the abilities of consultant quantity surveyors to produce useful pricing information (objective 2.2). Whilst they broadly agree on their ability to describe the finished product, the specialists are far more negative than the non-specialists on overall ability. This *ability* is evaluated against a number of criteria. Key results are recorded on the deterioration in ability and its timing. The problems encountered with bills of quantities are broadly similar (objective 2.3). Inaccurate quantities and inaccurate descriptions feature highly.

The root causes behind these problems are also similar and of notable interest (objective 2.4). The specialists tend to report matters of principal more readily (e.g. lack of QS knowledge of specialist work) as opposed to the 'basic care and attention' (a matter of practice) reported by the non-specialists. The overall quality of pricing information produced within contracting organisations (objective 2.5) is regarded highly by both the specialists and non-specialists.

Objective 3.1 investigates what level of input the contractors would prefer to have during the tender process and the consequential affect on price. Both report a reduction in overall price if they are able to design the work themselves and specify the materials used. However, if given the freedom to quantify the work, both report opposing views. The specialists report a reduction in overall cost whereas the non-specialists report an increase in cost if they are forced to quantify the works themselves. Despite recording potential reductions in overall price the results do not capture their relative values. This may be seen as a limitation within the results.

Finally, solutions are suggested by the contractors to overcome their previously identified problems. These are reported against objective 3.2. The non-specialists, in support of objective 3.1, state their preference for properly produced bills by the consultant quantity surveyor. In direct contrast, the specialist contractors suggest that the work should not be measured by the consultant quantity surveyor (again, tying in with their previous views stated in objective 3.1). Instead they propose that only the performance requirements should be specified. This proposal is at odds with established principles contained within SMM7.

All three representative bodies are in agreement on one issue - the need to improve the training of the quantity surveyor. The NFB further report the need for adequate time to be given to the tender stage (critical for their role as central coordinator of the price) and ECA suggest the need for the contractor to partner with the client.

The degree of association between the two specialist groups (the HVCA and ECA) is important to note.

4.3.2 Industry survey analysis

The previous section expressed the results as a percentage of total response and presented these in graphical format. The aim of this section is to apply more stringent statistical tests to the results to enable a more in depth evaluation. Two overall objectives underpin the analysis section:-

1. To test the statistical significance of each representative body against each question.

2. To test how the views of each representative body statistically differ from one another.

Two separate techniques have been employed in order to meet these objectives. The 'sign' test has been adopted for the former (Fellows & Liu, 1997, p.148) and Mann-Whitney U test applied to measure the latter (Foster, 1998, p.19). The results of the first objective are initially explained.

Statistical significance of responses against each question

The following equation has been adopted to test the statistical significance of each response:-

$$Z = \frac{P - P_0}{\sqrt{\dfrac{P_0\,(1-P_0)}{n}}} = \frac{0.69 - 0.50}{\sqrt{\dfrac{0.50(1-0.50)}{72}}} = 3.30$$

The formula collates the number of positive and negative responses against each question and tests these against an appropriate significance level. This enables the significance of each question to be evaluated (Fellows & Liu, 1997, p.148). The formula was also adopted by Kodikara who carried out research within the subject area to address the same overall objective (1990, p.256). Kodikara applied the formula to gauge the level of acceptance from the industry against specific proposals and questions.

The test, which is classified as a one-sided sign test, assumes a normal distribution and tests the responses against the 5% significance level ($\alpha = 0.50$). At the 5% significance level a value greater than 1.64 provides a positive response i.e. sufficient evidence to conclude that the representative body agrees with the research proposal or question.

The proportion of acceptance is denoted by 'p', the null hypothesis (H_0) and alternative hypothesis (H_1) stated as:-

H_0: $p \leq 0.50$; No acceptance of the research proposal/ research question.
H_1: $p > 0.50$; Acceptance of the research proposal/ research question.

By way of example, the results of question 9a in table 4.10 (p.458) have been illustrated in the above formula. As 3.30 is greater than 1.64 (1.64 representing the area under one tail of the normal curve) it is concluded that the descriptions provided by consultant quantity surveyors *do* accurately specify the quality of works to be carried out.

The results of the industry survey analysis are summarised in tables 4.9 to 4.36 (p.456 - 475).

A summary of all these tables is detailed below which provides a useful source of reference to the industry survey analysis:-

Table 4.8: Summary of industry survey analysis tables

Objective Ref:	Description of objective	Significance test of objective	Comparative analysis			
			NFB & HVCA	HVCA & ECA	ECA & NFB	Specialists and non-specialists
1.2	Type of work received	Table 4.9, p.456	Table 4.17, p.464	Table 4.22, p.466	Table, 4.27, p.469	Table, 4.32, p.472
2.1	Overall quality of pricing information produced by consultant Quantity Surveying firms	Table 4.10, p.458	Table 4.18, p.464	Table 4.23, p.467	Table, 4.28, p.470	Table, 4.33, p.473
2.2	Abilities of consultant Quantity Surveying firms to produce useful pricing information	Table 4.11, p.460	Table 4.19, p.465	Table 4.24, p.468	Table, 4.29, p.471	Table, 4.34, p.474
2.3	Problems encountered with Bills of Quantities	Table 4.12, p.461	-	-	-	-
2.4	Root causes of the problems encountered with Bills of Quantities	Table 4.13, p.461	-	-	-	-
2.5	Overall quality of the pricing information produced by contracting organisations	Table 4.14, p.462	Table 4.20, p.465	Table 4.25, p.468	Table, 4.30, p.471	Table, 4.35, p.474
3.1	Suggested solutions in terms of the contractor's preferred level of input during the tendering process	Table 4.15, p.463	Table 4.21, p.466	Table 4.26, p.469	Table, 4.31, p.472	Table, 4.36, p.475
3.2	Contractor's suggested solutions to overcome the stated problems	Table 4.16, p.463	-	-	-	-

Comparative analysis was considered to be most appropriate in circumstances where a comprehensive response was obtained. It has not therefore been applied against objectives 2.3, 2.4 and 3.2, which relied on free text responses from a subset of the total respondents.

In order to maintain a manageable level of reporting within the results chapter the findings of this section are reported in Appendix L.

4.4 Empirical testing

The previous section described and statistically analysed differences in opinion between the specialists and non-specialists over a range of criteria.

Aims and objectives

Having narrowed the direction of the research the empirical testing stage now focuses on two main areas. The overall aim of the empirical testing stage is thus to test out:-

1. The frequency by which quantity surveying firms accurately quantify:-
   1.1 Specialist work.
   1.2 Non-specialist work.

2. The estimators preferred source of quantified information, whether they prefer the quantified information to prepared:-
   2.1 Themselves i.e. internally by the contractor, or;
   2.2 Prepared for them by a quantity surveying firm i.e. externally prepared on their behalf.

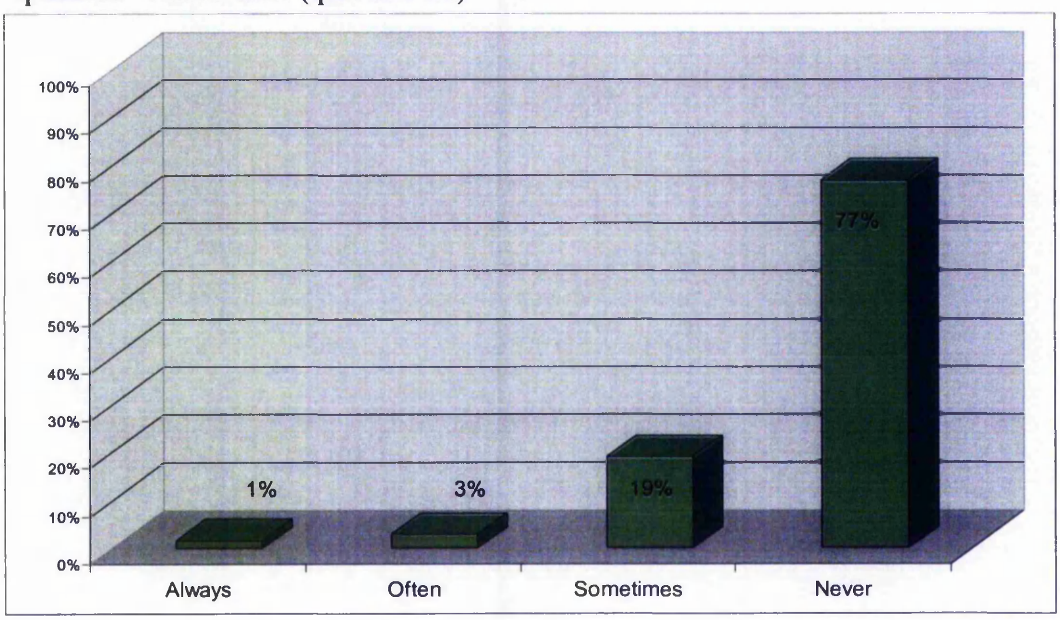
4.4.1 Empirical testing results

Objective 1.1: The frequency by which quantity surveying firms accurately quantify the work in practice for specialist contractors

The graph below illustrates collective views from both the specialist and non-specialist contractors on how frequently accurate quantified pricing information is prepared for specialist work. This is followed by two further graphs – one illustrating the individual views of the two specialist representative bodies and the third, the non-specialist views.

Chart 4.50: Combined view on specialist work

Based on pricing information typically prepared by consultant quantity surveying firms, do you consider that they are able to accurately prepare quantified pricing information for "specialist" contractors? (question 1.1)



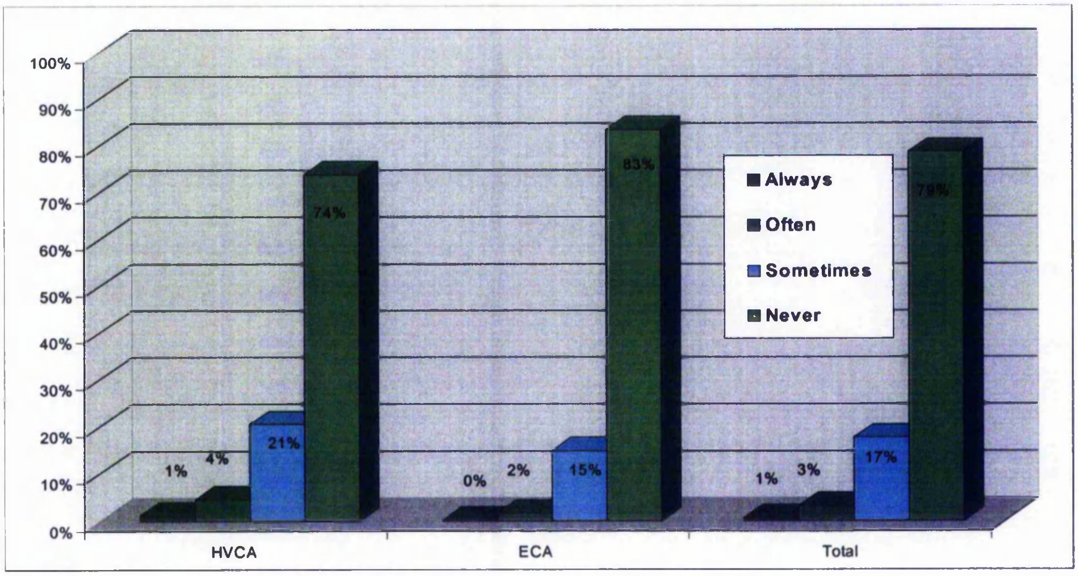
Source: Analysis of survey data (Empirical Testing)

As illustrated, only 1% of respondents believe that accurate quantified information can be 'always' prepared for specialist work, 3% consider this to be 'often', 19% 'sometimes' and 77% 'never'.

Objective 1.1 (continued): The frequency by which quantity surveying firms accurately quantify the work in practice for specialist contractors

The following two graphs break-down these results into the respective views of specialist and non-specialist contractors.

Chart 4.51: Specialist views on their own work
Based on pricing information typically prepared by consultant quantity surveying firms, do you consider that they are able to accurately prepare quantified pricing information for "specialist" contractors? (question 1.1)



Source: Analysis of survey data (Empirical Testing)

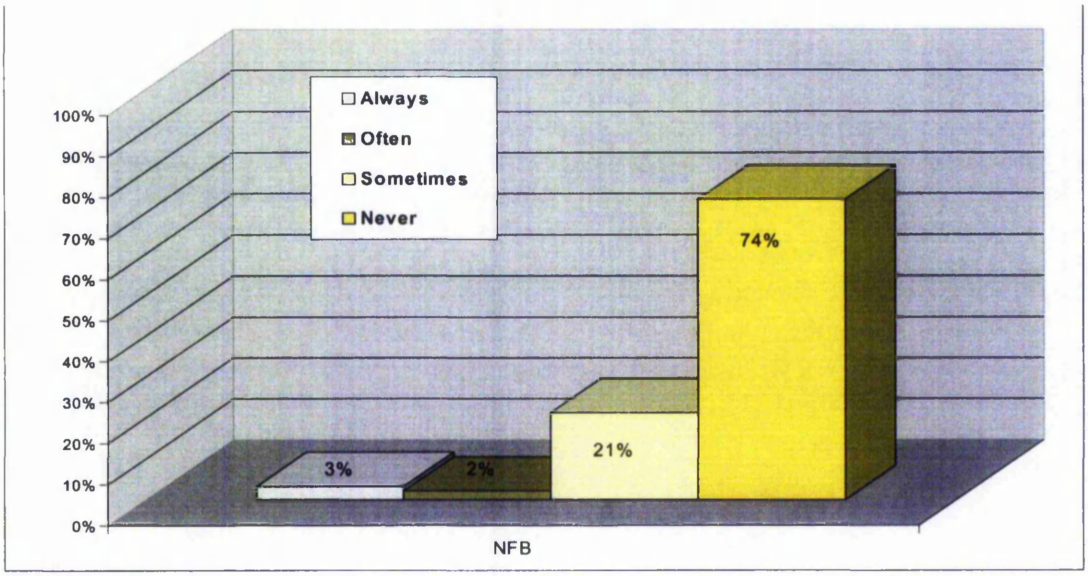
The above graph illustrates the views from the specialist contractors on how frequently accurate quantified pricing information can be prepared by the consultant quantity surveyor.

The HVCA consider this to be 1% 'always', 4% 'often', 21% 'sometimes' and 74% 'never'. The ECA are slightly less positive in their view – 0% 'always', 2% 'often, 15% 'sometimes' and 83% 'never'. The collective view (far right) from the specialist contractors summates to 1% 'always', 3% 'often', 17% 'sometimes' and 79% 'never'.

Objective 1.1 (continued): The frequency by which quantity surveying firms accurately quantify the work in practice for specialist contractors

Chart 4.52: Non-specialist views on specialist work

Based on pricing information typically prepared by consultant quantity surveying firms, do you consider that they are able to accurately prepare quantified pricing information for "specialist" contractors? (question 1.1)



Source: Analysis of survey data (Empirical Testing)

In a similar pattern to the specialists, the non-specialists state 3% 'always', 2% 'often', 21% 'sometimes' and 74% 'never'.

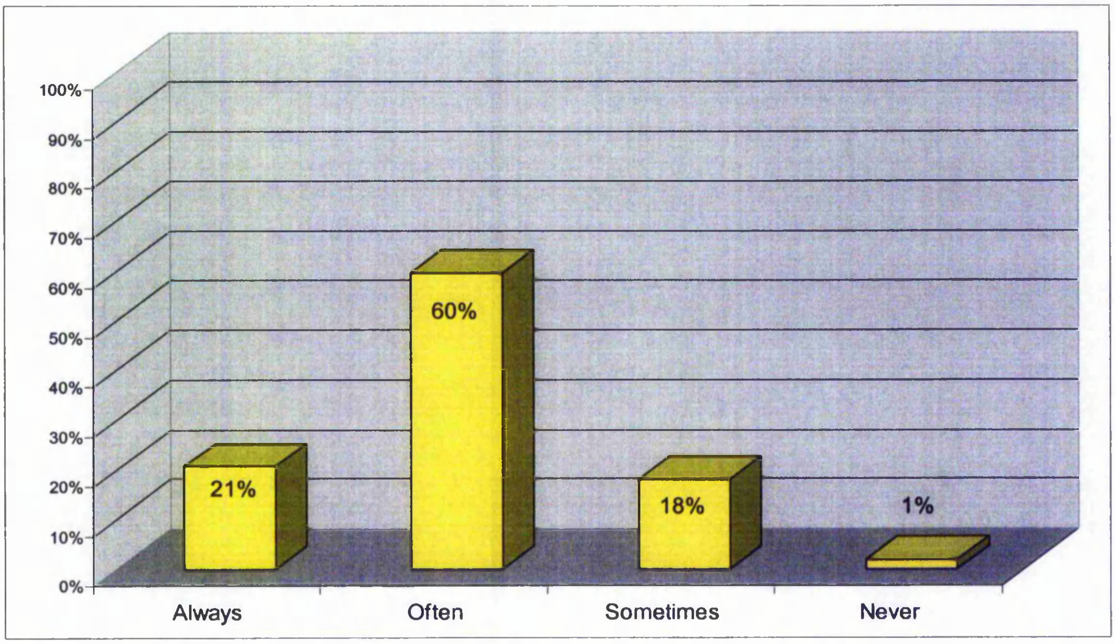
In summary, the views of the specialists and non-specialists are similar in terms of the frequency that specialist work can be accurately measured. Collectively 1% considers this to be 'always', 3% 'often', 19% 'sometimes' and 77% 'never'.

It is worth noting that the collective views of the specialists are perhaps more informative as they are faced with the prospect of using this information during pricing on a working basis - 1% consider this to be 'always' produced accurately, 3% 'often'; 17% 'sometimes' and 79% 'never'.

Objective 1.2: The frequency by which quantity surveying firms accurately quantify the work in practice for non-specialist contractors

This graph illustrates the results of the same question but this time in relation to non-specialist work.

Chart 4.53: Combined view on non-specialist work
Based on pricing information typically prepared by consultant quantity surveying firms, do you consider that they are able to accurately prepare quantified pricing information for "non-specialist" contractors? (question 2.1)



Source: Analysis of survey data (Empirical Testing)

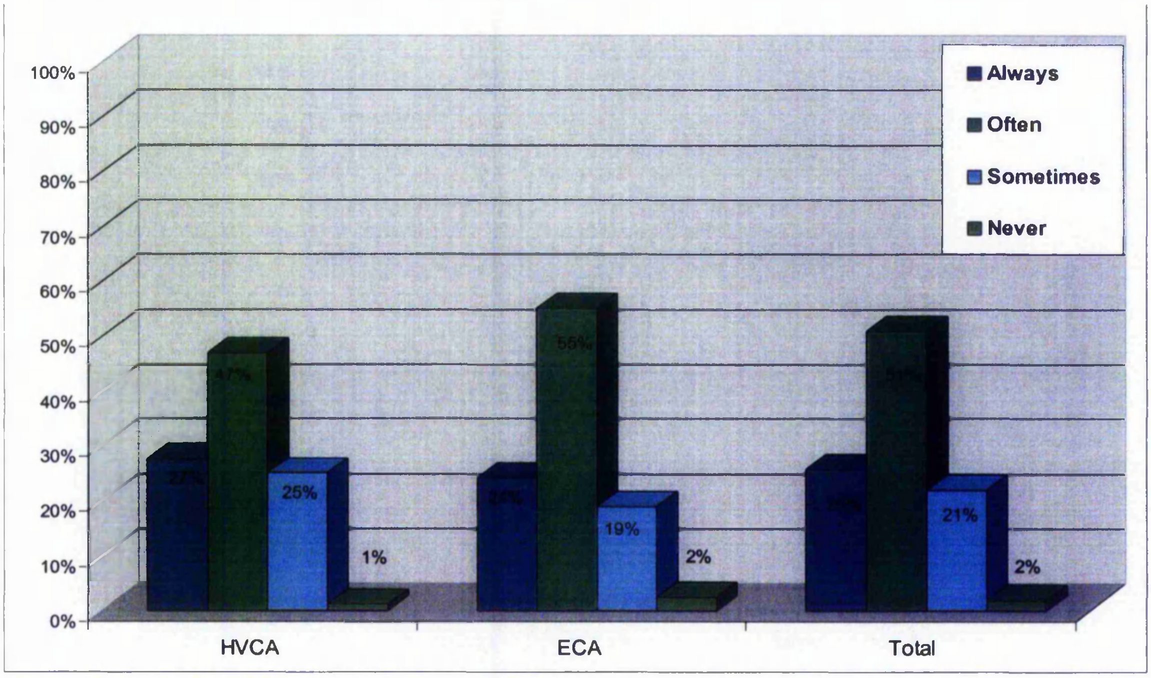
The above graph illustrates the collective view of the three representative bodies on how frequently non-specialist measured work is accurately measured. 21% state that non-specialist quantified pricing information is 'always' accurately prepared, 60% 'often', 18% 'sometimes' and 1% 'never'.

In a similar manner, the subsequent two graphs breakdown these views into the respective specialist and non-specialist groups.

Objective 1.2 (continued): The frequency by which quantity surveying firms accurately quantify the work in practice for non-specialist contractors

Chart 4.54: Specialist views on non-specialist work

Based on pricing information typically prepared by consultant quantity surveying firms, do you consider that they are able to accurately prepare quantified pricing information for "non-specialist" contractors? (question 2.1)

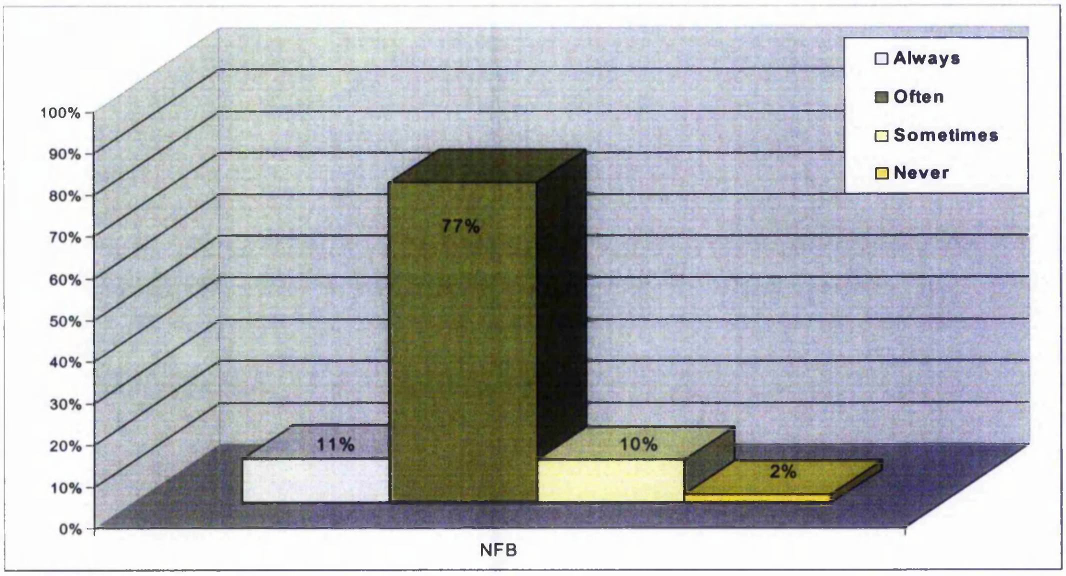


Source: Analysis of survey data (Empirical Testing)

The HVCA and ECA provide a similar pattern of results. 27% of the HVCA consider that quantified pricing information for non-specialist work is 'always' measured accurately, 47% 'often', 25% 'sometimes' and 1% 'never'. Likewise, the ECA consider 24% 'always', 55% 'often', 19% 'sometimes' and 2% 'never'. Collectively (far right) they consider that 26% of quantified pricing information is prepared accurately for non-specialist work 'always', 51% 'often', 21% 'sometimes' and 2% 'never'.

Objective 1.2 (continued): The frequency by which quantity surveying firms accurately quantify the work in practice for non-specialist contractors

Chart 4.55: Non-specialist views on their own work
Based on pricing information typically prepared by consultant quantity surveying firms, do you consider that they are able to accurately prepare quantified pricing information for "Non-specialist" contractors? (question 2.1)



Source: Analysis of survey data (Empirical Testing)

In terms of their own work, 11% of non-specialists consider that when quantified pricing information is prepared by consultant quantity surveying firms this is 'always' accurate, 77% that it is 'often' accurate, 10% 'sometimes' and 2% 'never'. It is important to note that the results of this question also serve to validate the findings of the interviews in terms of the total value of work actually measured.

The interviews estimated that approximately 30% of the total workload was purported as being in quantified format (p.186). More probing questions then established that, in reality, only about two-thirds of this workload was actually measured i.e around the 20% mark. Similarly, the industry survey quantified the value of work in bill format at approximately 30% (chart 4.6, p.226). Taking account of poor practice, the respondents valued the actual percentage at a revised figure of 25% (chart 4.9, p.435). Finally, the summation of the top two responses in the above graph gives a similar result when multiplied by the 30% originally quoted (i.e. 77% plus 11% = 88% x 30% = 26%). Approximately 20-26% of the workload is therefore likely to be accurately measured in practice.

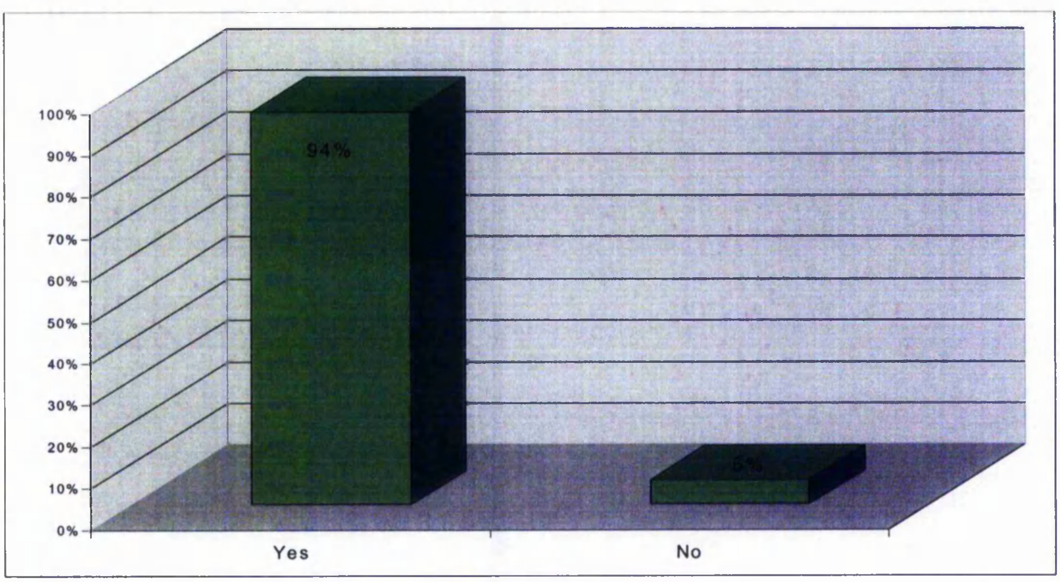
Objective 2.1: The preferred source of quantified information for specialist work

The following charts address the crux of the entire thesis – how the effectiveness of pricing documentation may be improved for the contractors' estimator.

In order to achieve this a direct question has been asked – quite simply, whether the estimators want the work measuring for them or not. The estimators were asked whether it would be more useful to them if a consultant quantity surveyor quantified their work. Two response categories were provided - 'yes' and 'no'. This question, based on the profile that has been built up of the two different types of contractors, serves as the final check on the developed solutions.

The initial chart shows the combined view of all three representative bodies on specialist work. Subsequent graphs then show the individual responses of each representative body.

Chart 4.56: Combined view on specialist work
Would it be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify the work? (question 1.2)

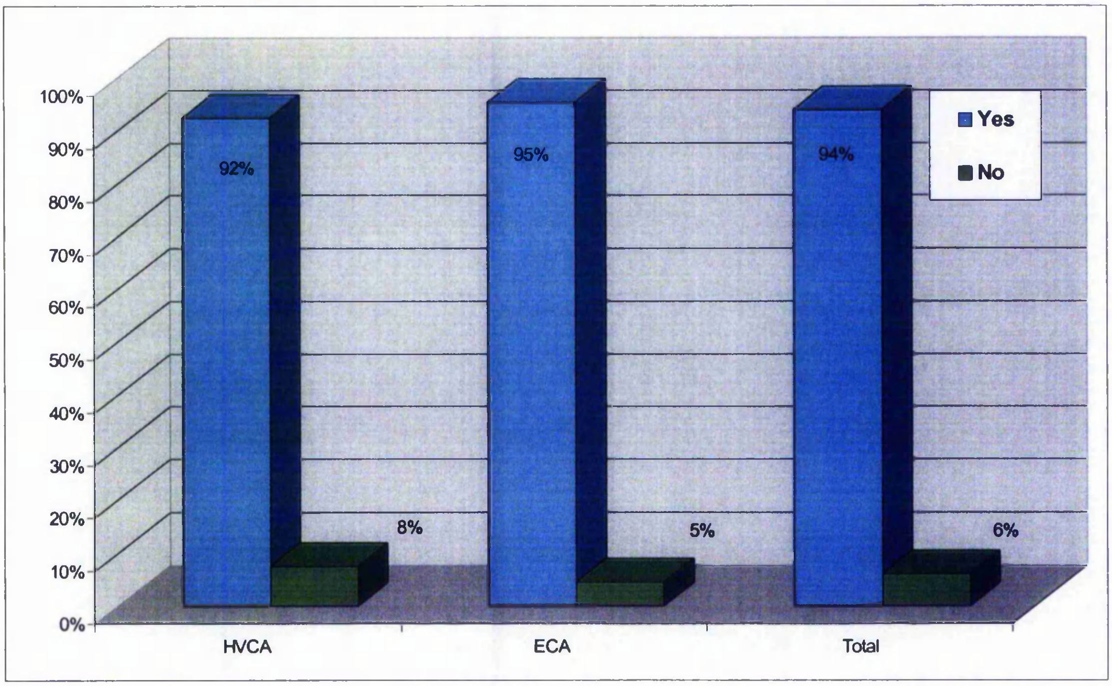


Source: Analysis of survey data (Empirical Testing)

The above graph illustrates the combined views on the preferred source of quantified information for specialist work (i.e. it includes the views of the HVCA, ECA and NFB). 94% of respondents state that it would be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify specialist work. Only 6% disagreed with the comment i.e. a very small minority considered that it would be more useful if the consultant quantity surveyor did quantify specialist work.

Objective 2.1 (continued): The preferred source of quantified information for specialist contractors

Chart 4.57: Specialist view on their own work
Would it be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify the work? (question 1.2)



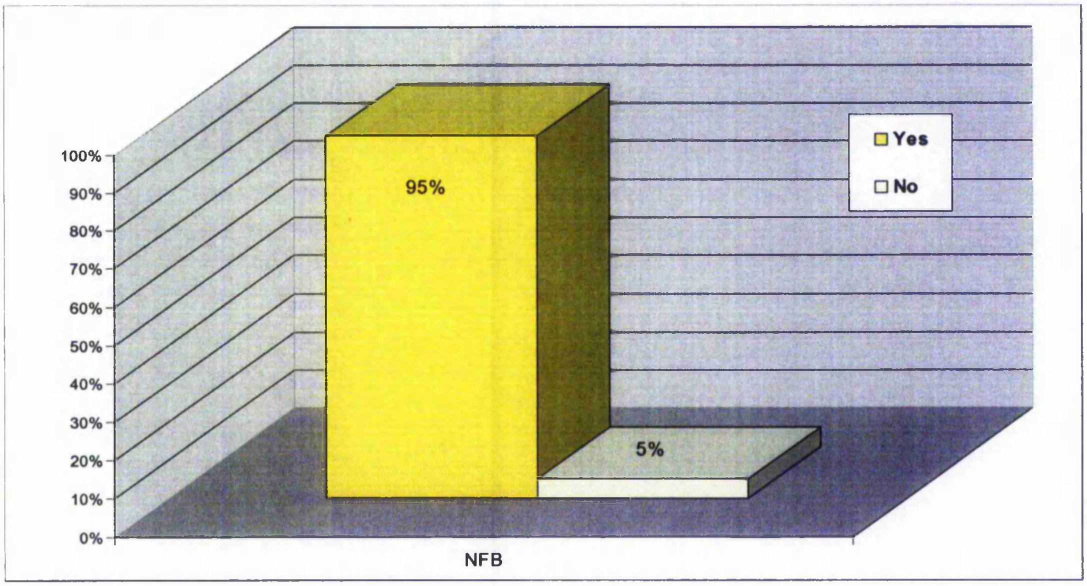
Source: Analysis of survey data (Empirical Testing)

This graphs separates the views of just the specialists on their own work from chart 4.56 (p.278). Overall, the level of agreement is the same as the combined view – 94% of respondents consider that specialist work should not be quantified by the consultant quantity surveyor and only 6% view that it should be.

More specifically, 92% of the HVCA and 95% of the ECA consider the consultant quantity surveyor should not quantify the work. Only 8% of the HVCA and 5% of the ECA view that the consultant quantity surveyor should measure it. The views of the specialists are therefore consistent with one another.

Objective 2.1 (continued): The preferred source of quantified information for specialist contractors

Chart 4.58: Non-specialist views on specialist work:-
Would it be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify the work? (question 1.2)



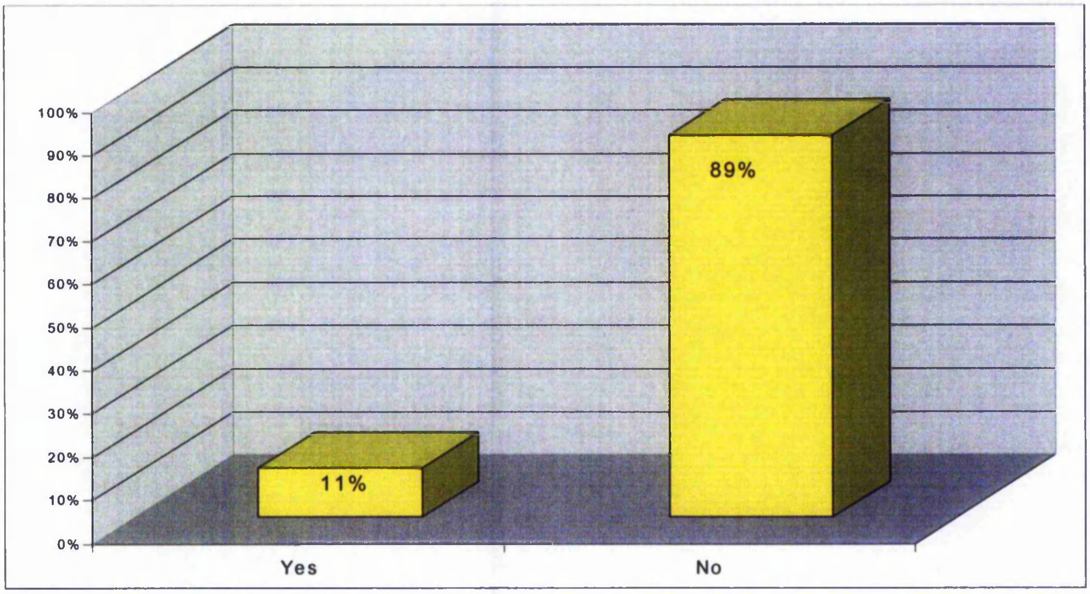
Source: Analysis of survey data (Empirical Testing)

The views of the NFB are identical to those of the ECA – 95% of respondents believe that the work should not be quantified by the consultant quantity surveyor and only 5% believe that it should be.

Overall, the results from all three representative bodies are directly comparable to one another. All indicate an overwhelming desire not to have specialist work quantified by the consultant quantity surveyor. It would therefore be more useful to estimators of specialist work if pricing documentation were presented in a non-quantified format.

Objective 2.2: The preferred source of quantified information for non-specialist contractors

Chart 4.59: Combined view on non-specialist work
Would it be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify the work? (question 2.2)



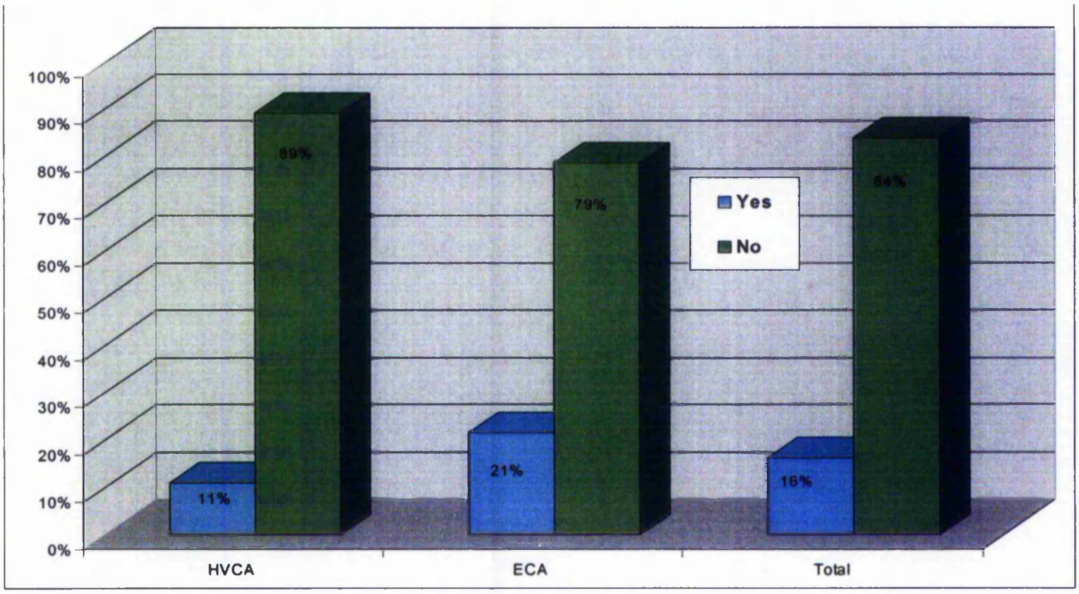
Source: Analysis of survey data (Empirical Testing)

Exactly the same questions were posed for non-specialist work. The above chart shows the combined view of the three representative bodies (i.e. the NFB, HVCA and ECA).

89% of the overall respondents disagreed with the statement that it would be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify the work i.e. they considered that the work should be measured for them. Only 11% agreed with the statement i.e. a minority stated that the work should not be quantified. This combined view is therefore the opposite of that expressed for specialist work.

Objective 2.2: The preferred source of quantified information for non-specialist contractors

Chart 4.60: Specialist views on non-specialist work
Would it be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify the work? (question 2.2)



Source: Analysis of survey data (Empirical Testing)

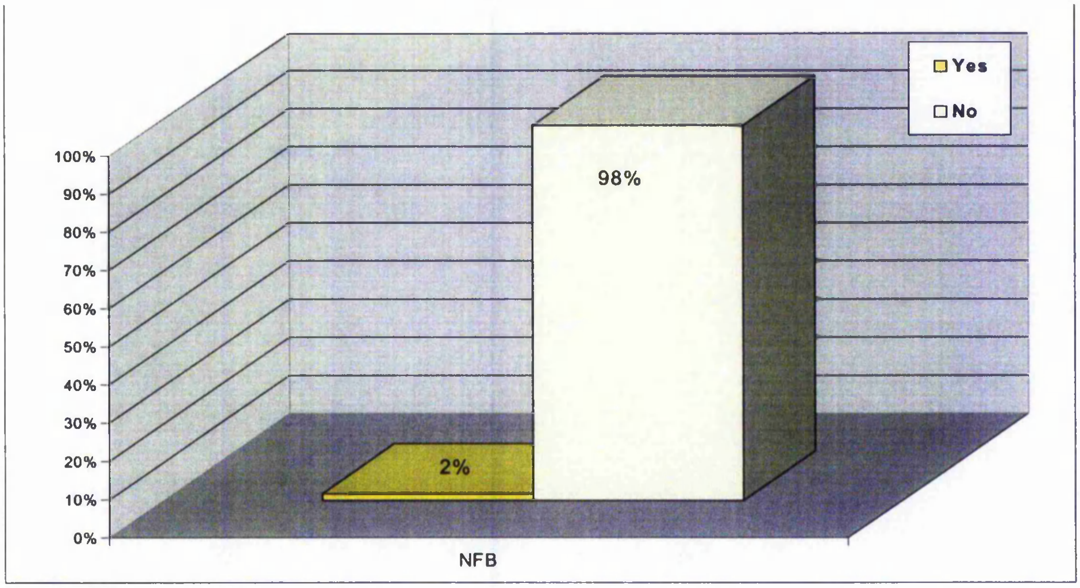
The above chart splits the combined view down into just those of the specialist representative bodies (i.e. the HVCA and ECA).

Collectively, 84% of specialists disagreed with the comment that the consultant quantity surveyor should not quantify non-specialist work. That is, they considered that it should be measured for the non-specialist contractor. Only 16% of respondents believed that it should not be measured.

More specifically, 89% of the HVCA and 79% of the ECA considered that the work should be measured and 11% of the HVCA and 21% of the ECA that it should not be.

Objective 2.2: The preferred source of quantified information for non-specialist contractors

Chart 4.61: Non-specialist views on their own work
Would it be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify the work? (question 2.2)



Source: Analysis of survey data (Empirical Testing)

The final chart represents the views of the NFB on their own work. 98% of the non-specialists disagreed with the statement that the consultant quantity surveyor should not provide quantified pricing documentation – i.e. they would prefer the work to be quantified for them. Only 2% of the NFB believed that the work should not be quantified for them. Strong views are therefore expressed by the NFB on their own type of work.

4.4.1.1 Summary of empirical survey results

The empirical survey sought to quantify the views of the three representative bodies on two specific issues:-

1) The frequency that consultant quantity surveying firms are able to provide accurate quantified pricing information for both types of contractor (i.e. for specialists and non-specialists).

2) Their preferred source of quantified information - whether they would prefer to quantify the work themselves (internally) or have it produced for them by the consultant quantity surveyor (i.e. externally).

Each of the three representative bodies was asked on their own work and on that of the other category of contractor. For example, non-specialists were asked how frequently specialist work is accurately quantified in practice. They were also asked whether it would be more useful to have the work quantified for them by consultant quantity surveyors as opposed to producing this themselves.

In the same manner that the industry survey results are presented, the results are tabulated to help maintain a conceptual overview. The following key helps illustrate the direction of the response within table 4.37 (p.286). Differences in opinion between the specialists and non-specialists are presented in red, levels of agreement in green and key results in yellow. These categories are mutually exclusive.

<u>Key:-</u>

- The majority of specialist and non-specialist opinion is in the *opposite* direction i.e. they are not in agreement

- The majority of specialist and non-specialist opinion is in the *same* direction i.e. they are in agreement

- Key result

Table 4.37: Summary of empirical testing results

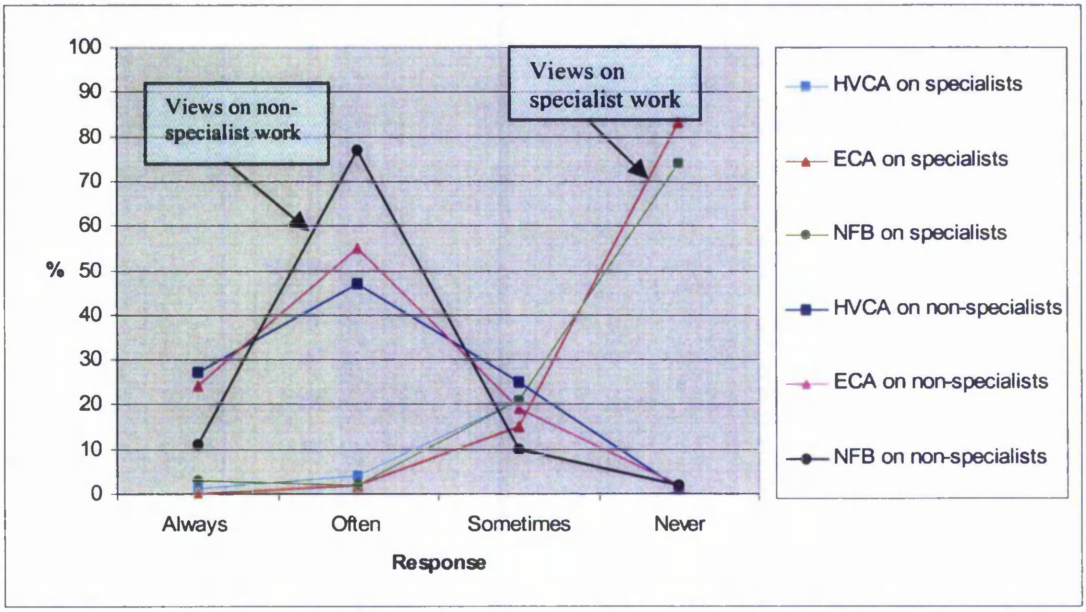
Ref:	Objective	Research question	Key results			Coding
			Non-specialists (NFB)	**Specialists (HVCA)**	**Specialists (ECA)**	
1.1	**The frequency by which QS firms accurately quantify the work in practice for Specialist work**	Combined view of specialist work	Overall:- 1%'always', 3% 'often', 19% 'sometimes' and 77% 'never			
		Individual views on specialist work	3% 'always', 2% 'often', 21% 'sometimes' and 74% 'never'	1% 'always', 4% 'often', 21% 'sometimes' and 74% 'never'	0% 'always', 2% 'often', 15% 'sometimes' and 83% 'never'	
1.2	**The frequency by which QS firms accurately quantify the work in practice for Non-Specialist work**	Combined view of non-specialist work	Overall:- 21%'always', 60% 'often', 18% 'sometimes' and 1% 'never			
		Individual views on non-specialist work	11% 'always', 77% 'often', 10% 'sometimes' and 2% 'never'	27% 'always', 47% 'often', 25% 'sometimes' and 1% 'never'	24% 'always', 55% 'often', 19% 'sometimes' and 2% 'never'	
2.1	**The preferred source of quantified information for Specialist work**	Combined view - Would it be more useful to the contractors' estimator if the Consultant Quantity Surveyor did not attempt to quantify the work?	Overall:- 94%'yes', and 6% 'no'.			
		Individual view - Would it be more useful to the contractors' estimator if the Consultant Quantity Surveyor did not attempt to quantify the work?	95%'yes', and 5% 'no'.	92%'yes', and 8% 'no'.	95%'yes', and 5% 'no'.	
2.2	**The preferred source of quantified information for Non-Specialist work**	Combined view - Would it be more useful to the contractors' estimator if the Consultant Quantity Surveyor did not attempt to quantify the work?	Overall:- 11%'yes', and 89% 'no'.			
		Individual view - Would it be more useful to the contractors' estimator if the Consultant Quantity Surveyor did not attempt to quantify the work?	2%'yes', and 98% 'no'.	11%'yes', and 89% 'no'.	21%'yes', and 79% 'no'.	

The above table reinforces the high level of agreement between the specialists and non-specialists. The coding on the right-hand side of the table confirms that the three representative bodies are in agreement with one another on all occasions.

The empirical survey results have also been further illustrated in graphical format. The chart below details the individual views of each representative body in terms of how frequently accurate measured quantity information is prepared by the consultant quantity surveyor. Views on both their own type of work and that of the other classification of contractor are provided.

Chart 4.62: All contractors views on specialist and non-specialist work

Based on pricing information typically prepared by consultant quantity surveying firms, do you consider that they are able to accurately prepare quantified pricing information? (question 2.1)



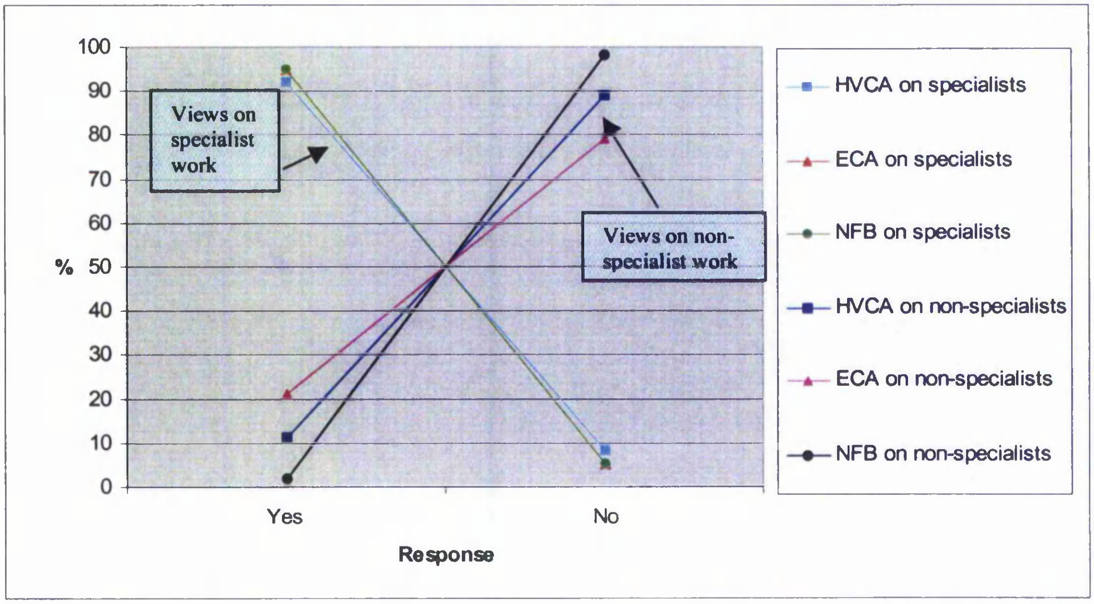
The first three items within the chart legend detail individual views on specialist work. These are represented by the three lines close together at the bottom-left of the chart between 'always' and 'often'. All three representative bodies follow the same trend and consider that accurate pricing information is rarely produced for specialist trades. Between 15-21% consider that this is produced 'sometimes' and 74-83% - 'never'.

A different pattern is evident for non-specialist work. Again, the views of the three representative bodies are comparatively similar. Between 11-27% of the respondents consider that quantified work is accurately produced for non-specialists 'always', between 47-77% 'often' and between 10-25% 'sometimes'. A negligible proportion considers that this is 'never' accurately prepared. The views of the NFB are seen to follow a slightly more positive trend line than that of the HVCA and ECA.

Overall, the views on specialist and non-specialist work are in direct contrast to one another. Specialist work is rarely prepared accurately whereas non-specialist work is often prepared accurately.

The chart below illustrates the preferred source of quantified information i.e. whether the estimators prefer this to be prepared within their own organisation or to be prepared on their behalf by the consultant quantity surveyor.

Chart 4.63: All contractors views on specialist and non-specialist work
Would it be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify the work?



The first three items within the legend refer to individual views on specialist work. These are represented on the chart by the three lines running from top-left to bottom-right (although only visibly distinguishable as two due to the level of agreement). All three representative bodies are seen to hold very similar views – the ECA and NFB being exactly the same. Between 92-95% of respondents consider that it would be more useful if the consultant quantity surveyor did not produce quantified pricing documentation. Conversely, only between 5-8% consider that the consultant quantity surveyor should produce pricing documentation.

The opposite pattern is evident for non-specialist work - represented by the darker lines from the bottom-left to top-right of the chart. The views of the three representative bodies are very similar. To summarise, between 79-98% of the respondents disagree that it would be more useful if quantified pricing information was not produced, that is, they prefer quantified information to be prepared on their behalf. The balance, between 2-21% considers that it would be more useful if pricing information were not produced. It is important to note that the overall results on non-specialists are skewed by the views of specialists – the ECA in particular. When viewed in isolation, the NFB are strongly in favour of quantified pricing documentation being prepared on their behalf – (98% for and a minority of 2% against).

Overall, the views expressed by the three representative bodies correspond closely with one another. Non-specialist work is often prepared accurately whereas specialist work is rarely prepared accurately. In addition, strong support exists to suggest that quantified pricing documentation should be prepared on the behalf of non-specialist trades and not at all for the specialist trades.

4.4.2 Empirical testing analysis

The empirical testing analysis shares the same objectives and layout as the industry survey analysis.

The initial section provides the results of statistical tests that have been applied to each question. The views from each representative body are tested for their statistical significance and illustrated in accordance with the key below:-

Key	Description
+ve	Indicates results is in a positive direction (i.e. giving a complementary response)
-ve	Indicates results is in a negative direction (i.e. not giving a complementary response)
⬆	Indicates a statistically significant result in a positive direction (i.e. giving a significant complementary response)
⇩	Indicates a statistically significant result in a negative direction (i.e. giving a significant response that is not complementary)
⇨	Not a significant result (irrespective of direction)

Table 4.38: Statistical test of empirical stage results

Objective	Research questions	Group	+ or -	+ or -	Z Crirical	Z	Result	+ve or -ve	Overall Signific.
1.1	Based on the pricing information typically prepared by consultant Quantity Surveying firms, do you consider that they are able to accurately prepare quantified pricing information for "SPECIALIST" work?	NFB	91	5	1.64	8.78	Conclude H1	-ve	↓
		HVCA	87	5	1.64	8.55	Conclude H1	-ve	↓
		ECA	94	2	1.64	9.39	Conclude H1	-ve	↓
1.2	Based on the pricing information typically prepared by consultant Quantity Surveying firms, do you consider that they are able to accurately prepare quantified pricing information for "NON-SPECIALIST" work?	NFB	85	13	1.64	7.27	Conclude H1	+ve	↑
		HVCA	66	23	1.64	4.56	Conclude H1	+ve	↑
		ECA	71	21	1.64	5.21	Conclude H1	+ve	↑
2.1	Would it be more useful to the "SPECIALIST" estimators if the Consultant Quantity Surveyor did not attempt to quantify the work?	NFB	91	5	1.64	8.78	Conclude H1	-ve	↓
		HVCA	85	7	1.64	8.13	Conclude H1	-ve	↓
		ECA	92	4	1.64	8.98	Conclude H1	-ve	↓
2.2	Would it be more useful to the "NON-SPECIALIST" estimators if the Consultant Quantity Surveyor did not attempt to quantify the work?	NFB	96	2	1.64	9.50	Conclude H1	+ve	↑
		HVCA	79	10	1.64	7.31	Conclude H1	+ve	↑
		ECA	69	23	1.64	4.80	Conclude H1	+ve	↑

The table reveals that each response from a representative body provides a statistically significant result in the same direction. None of the representative bodies differ in their opinion on any one question.

The results of objective 1.1 and 2.1 (in respect of specialist work) reveal a negative response to the question of how frequently measured work is accurately produced by the quantity surveyor. A negative response to the question of whether this information would be useful to them is also evident. These negative responses are statistically significant and are shared by each of the three representative bodies.

In direct contrast, the results of objective 1.2 and 2.2 (in respect of non-specialist work) reveal a positive response to the question of how frequently measured work is accurately produced by the quantity surveyor. A positive response to the question of whether this information would be useful to them is also evident. These positive responses are statistically significant and are shared by each of the three representative bodies.

Table 4.39: Comparative analysis of NFB and HVCA views (i.e. specialists and non-specialists)

Tests	Frequency that measured work is accurately quantified by consultant Quantity Surveying firms for specialist work	Preferred source of quantified information for specialist work	Frequency that measured work is accurately quantified by consultant Quantity Surveying firms for non-specialist work	Preferred source of quantified information for non-specialist work
Mann-Whitney U	4373.000	4310.000	4278.500	3960.000
Wilcoxon W	8651.000	8966.000	8283.500	7965.000
Z	-.152	-.671	-.259	-2.556
Asymp. Sig. (2-tailed)	**.880**	**.502**	**.796**	**.011**

A comparison of the views of the NFB and HVCA reveals no significant differences in opinion.

Table 4.40: Comparative analysis of ECA and NFB views (i.e. specialists and non-specialists)

Tests	Frequency that measured work is accurately quantified by consultant Quantity Surveying firms for specialist work	Preferred source of quantified information for specialist work	Frequency that measured work is accurately quantified by consultant Quantity Surveying firms for non-specialist work	Preferred source of quantified information for non-specialist work
Mann-Whitney U	4296.000	4560.000	4471.500	3473.000
Wilcoxon W	8952.000	9216.000	8749.500	7751.000
Z	-1.127	-.341	-.115	-4.666
Asymp. Sig. (2-tailed)	**.260**	**.733**	**.909**	**.000**

Analysis of the ECA and NFB results do however reveal a significant difference against the preferred source of quantified information for non-specialist work. These differences are further illustrated by chart 4.60 (p.283). This response is not critical to the research findings as the response from a particular representative body on their own work is more important i.e. specialist views on specialist work and non-specialist views on non-specialist work.

Table 4.41: Comparative analysis of HVCA and ECA views (i.e. specialists)

Tests	Frequency that measured work is accurately quantified by consultant Quantity Surveying firms for specialist work	Preferred source of quantified information for specialist work	Frequency that measured work is accurately quantified by consultant Quantity Surveying firms for non-specialist work	Preferred source of quantified information for non-specialist work
Mann-Whitney U	4070.000	4264.000	4048.500	3530.500
Wilcoxon W	8348.000	8920.000	8053.500	7808.500
Z	-1.280	-1.002	-.141	-2.391
Asymp. Sig. (2-tailed)	**.200**	**.316**	**.888**	**.017**

A comparison of the views of the HVCA and ECA reveals no significant differences in opinion.

Table 4.42: Comparative analysis of specialist and non-specialist views (i.e. collective views of the HVCA and ECA compared against the NFB)

Tests	Frequency that measured work is accurately quantified by consultant Quantity Surveying firms for specialist work	Preferred source of quantified information for specialist work	Frequency that measured work is accurately quantified by consultant Quantity Surveying firms for non-specialist work	Preferred source of quantified information for non-specialist work
Mann-Whitney U	8755.000	8966.000	8750.000	7433.000
Wilcoxon W	13411.000	13622.000	25221.000	23904.000
Z	-.559	-.222	-.211	-3.891
Asymp. Sig. (2-tailed)	**.576**	**.824**	**.833**	**.000**

Analysis of the collective views of the specialists (HVCA and ECA) compared against those of the non-specialists reveals a significant difference against the preferred source of quantified information for non-specialist work. For the same reason as discussed in table 4.40 (p.292) this result is not critical to the research findings. The response from a particular representative body on their own work is more important than i.e. specialist views on specialist work and non-specialist views on non-specialist work.

4.5 Summary

This chapter presents and analyses the results of the research against the original research questions. The chapter is presented in chronological order of the research process. Both the results and analysis stages are initially divided by research objective and subsequently by research question.

Care has been taken, in view of the large volume of data, to select the most appropriate method of presenting the results for any one stage. The interview results rely heavily on flow diagrams and illustrations to explain the complex flow of data and interaction between the respective parties. Both the industry survey and empirical testing stage adopt a more graphical style of presentation. Tables of the results are used throughout and prove particularly useful in helping to maintain a conceptual overview of the findings.

In depth probing during the interview stage enabled two distinct classifications of contracting organisation to be identified (based on their preference and behavioural response to pricing documentation).

The *non-specialist* contractors advocated the use of the traditional method of procuring prices i.e. fully quantified on their behalf. These trades (including the likes of plastering, brickwork and drainage work) were typically low in complexity, their design was usually substantially complete and thus required minimal input from the contractor. As these trades were also well understand by the typical quantity surveyor this allowed good quality data to be produced. Excessive duplication and risk were found to exist when these needs were not met.

In contrast, the *specialist* contractors preferred to quantify the work themselves. They did not support the use of the traditional method of procuring prices for their trade. The *specialist* trades (e.g. mechanical and electrical contractors) were typically complex, their design was not usually complete and thus required substantial input from the contractor. These factors, coupled with a poor understanding by the quantity surveyor, meant that good quality data was rarely produced. The presence of quantified information (produced by the quantity surveyor) caused confusion and resulted in a duplication of effort – because the tendering contractor ignored it.

Two main problem areas were classified:-

Matters of principal – fundamental differences between the type of information required by the contractor and that supplied (i.e. not providing quantified data for the non-specialist and providing quantified data for the specialist).

Matters of practice – (despite meeting the principal format required) the information was poorly presented. In particular, the high incidence of non-quantified/ itemised schedules purporting to be bills of quantity and inconsistent manner that specialist prices were procured (on a non-quantified basis).

The demand for quantified information by the non-specialist side of the industry was estimated at approximately 70% of the total industry workload (by value). As only about 30% of this was actually presented in the desired format a gap of around 40% existed. As a result, the extent of duplication was estimated as the equivalent of the entire project being measured between 3 to 7 times. It was postulated that the accuracy of the pricing process could be improved and levels of risk and duplication could be reduced if the needs of the two types of contractor were met. Approximately 30% of the total industry workload was estimated as specialist work and the majority (i.e. 29% of the total industry workload) procured in an inconsistent non-quantified format.

Further assessment of the frequency and impact of these problems was gained during the industry survey. The overall volume of work measured for non-specialist trades was found to be lower than originally anticipated – 25% of the total workload. A substantial amount of duplication was therefore apparent. Only about 1-2% of the total workload was found to be measured for specialist trades. The views of the specialist and non-specialist trades were compared and statistically significant differences found in terms of the overall quality of pricing information produced and the abilities of the quantity surveyor. The specialists were found to be highly critical. The overall quality of pricing documentation was found to be the cause of significant problems. The root cause of the problems encountered and suggested solutions were confirmed as acceptable by both classifications of contractor and statistically significant results obtained. The non-specialists confirmed their need for adequately prepared bills and the specialists not to have bills produced for them. The degree of association between the two specialist representative bodies (HVCA and ECA) also served to reinforce the significance of these results.

The empirical testing stage sought to quantify the views of the two classifications of contractor on two specific and refined research questions – how frequently the quantity surveyor was able to accurately prepare measured work for both types of contractor and, secondly, their preferred source of quantified information. That is, whether they preferred this to be produced for them by the quantity surveyor or produced internally by themselves.

The anticipated responses were attained. The view on the frequency that measured work is able to be accurately measured for the specialist contractor was negative in nature and, as expected, positive in nature for the non-specialists. These results were also found to be statistically significant. On the critical question of preferred source of the quantified information, the specialists stated a statistically significant vote in favour of this not being produced by the quantity surveyor and the non-specialists a statistically significant view in support of the quantity surveyor producing this on their behalf.

The results therefore support the contention that the underlying problems have been correctly interpreted and proposed solutions are conclusively acceptable.

CHAPTER FIVE

DISCUSSION OF FINDINGS

5.1 Introduction

The purpose of this chapter is to discuss the results against each of the research questions identified during the literature review and evaluate how successfully the overall problem has been addressed. The findings are also compared against the existing body of knowledge.

The chapter is structured in accordance with the seven research questions. Each research question is then further subdivided into a maximum of four subsections in keeping with how the results were collated and analysed i.e.: -

1. Interviews,
2. Industry survey,
3. Empirical testing, and;
4. Literature review.

For ease of reference, the literature review section is presented in tabular format and the main areas of research cited. References to previous research are not intended to be exhaustive but merely sufficient to display the extent of any previous work.

The penultimate section of the chapter addresses how successfully the overall research problem has been addressed. The chapter is then concluded with an overall summary of its findings.

The term *effective* is frequently adopted within this chapter. As defined within the introductory chapter (section 1.7, p.15) this refers to how well the format of pricing documentation meets the requirements of the contractors' estimator.

5.2 Summary of findings against each of the research questions

5.2.1 What processes are commonly adopted in the preparation of pricing documentation? (research question 1)

5.2.1.1 Interview results

The interviews enabled a detailed understanding of the processes involved in tender preparation to be established. These were found to be complex in nature. Typical projects were found to involve both a high number of main contractors and subcontractors within any one pricing chain (figure 4.2, p.185).

By reviewing the processes adopted in practice, two, quite separate; classifications of contractor were identified (p.188). Each was observed to differ in terms of their reaction to the format of pricing documentation and subsequent processes that ensued.

The two classifications of contractor were referred to as *specialists* and *non-specialists*. The non-specialists stated a strong preference for their pricing documentation to be in a quantified format and for this to be prepared for them. In contrast, the specialists preferred to carry out the task of measurement themselves and did not require quantified pricing documentation to be prepared for them (summarised in table 4.2, p.192). The format and quality of pricing documentation supplied by the consultant quantity surveyor was found to be dependent on a number of deep rooted issues inherent within the industry, e.g.:-

- Inadequate training on the design-side to develop an appropriate understanding of specialist work.
- Inadequate knowledge of specialist work possessed by the design-side.
- Incomplete designs supplied by the design-side – most probably as a result of a lack of understanding of the work itself or as a result of time constraints.
- Inability of the quantity surveyor to accurately quantify the work – either through lack of understanding themselves (predominantly for specialist work)

or because the design is supplied in an incomplete format (again, predominantly for specialist work).

- Extent of knowledge and design progression typically carried out by the specialist contractor.

However, both groups of contractor were found to behave adversely when their desired format of pricing documentation was not complied with. More detailed analysis of the estimator's behavioural responses (at the micro level) revealed some common traits between each of the two types of contractor (table 4.3, p.195). The estimator's position within the pricing chain was also seen to affect how they would deal with the risks imposed. For example, despite both being classified as non-specialists, the non-specialist subcontractors' response was found to differ to that of the main contractor. Non-specialist subcontractors would qualify non-quantified work as "*re-measurable upon completion*" and force the main contractor to take on the risk of quantification.

Having established the needs of the varying types of contractor the research then set out to establish how closely current tendering processes met those needs. The extent of variance between the preferred format of pricing documentation and the actual format is summarised in table 5.1:-

Table 5.1: The extent of variance between the contractor's needs and current practice

Type of contractor	Position in pricing chain	Preferred format of pricing documentation from the client-side	Extent of variance expressed a % of the total industry workload	Equivalent number of times that the entire project is re-measured due to a mismatch
Non-specialist	Main contractor	Quantified	**26%** (11% of own workload and 15% of that prepared for the non-specialist subcontractors)	**2.08 times** (26% x approximately 8 No. competing main contractors)
Non-specialist	Subcontractor	Quantified	**15%**	Between **0.60** and **4.80 times** (15% x 4 & 15% x 32*)
Specialist	Subcontractor	Non-quantified	**1%**	N/A as ignored
		Total	**42%**	Between **2.68 times** and **6.88 times**

* - Assuming a minimum no. of 4 and maximum no. of 32 subcontractors per trade

Therefore, just under half (42%) of the total industry's workload was different from the required format of the contractors' estimator. However, when multiplied by the extent of duplication this was estimated to be the equivalent of the entire project being quantified between 2.68 and 6.88 times over. Current processes were therefore found to be the cause of significant duplication and, in contrast to quantified formats of tender documentation that did not cause such duplication, the current format was found to be ineffective. The interviewed contractors aired concerns about the consequential affects of such practice (table 4.5, p.208).

Only about 30% of the total industry workload was estimated to be in bill format and the balance in a non-quantified format (either Design & Build or Plan & Specification). The specialist subcontractors also reported a much lower percentage of their work in bill format – perhaps as low as 1% (figure 4.9, p.212).

A level of poor practice was also evident from the interviews but not readily quantifiable. A common form of poor practice that of "non-quantified itemised schedules" was found to be frequently encountered. These itemised schedules were often purported to be bills of quantity by the quantity surveyor but, in reality, amounted to no more than a list of non-quantified descriptions that loosely resembled descriptions required by the SMM7. This helped to explain the subsequent divergence identified between the value of work in bill format and the value *actually* measured (i.e. 5% of the total industry workload).

As anticipated, all specialist work was subcontracted and the non-specialist work divided between the main contractor and subcontractor. The majority of non-specialist work was also subcontracted (figure 4.7, p.203).

5.2.1.2 Industry survey results

The industry survey results confirmed the findings of the interviews.

The value of work in bill format was confirmed at approximately 30% by value for the non-specialists and 6-7% for the specialists (chart 4.6, p.226). A similar trend was also reported in terms of % of methods of procurement by number. A review of the *quality* of current tendering processes revealed that:-

- A number of statistically significant results were recorded in terms of the '*quality*' of information for both the specialists and non-specialists (table 4.10, p.458).
    - Derogatory (statistically negative) views were recorded by the specialists about the quality of information, and;
    - Complementary (statistically positive) views were recorded for the non-specialists.

The differing views of the two types of contractor were evidenced more explicitly by the industry survey. The specialists regarded bills as inaccurate, illogical, in less detail than their internally produced information and requiring a substantial amount of additional work if they were to be used to generate a price. Derogatory (statistically negative) results were recorded at the 5% significance level. Of concern was the inadequacy of the measured items to reimburse the specialist contractor (via interim valuations, the Final Account and for variations). Significant levels of disparity in the original measurements and those that were eventually built further exacerbated these problems. Furthermore, specialists did not consider that their prices were compared on a like-for-like basis – a fundamental aim of the tendering documentation was therefore not being achieved.

The specialists also considered that the tasks of planning, ordering materials and internal cost controlling could not be achieved by using bills. Overall these findings helped to justify the rationale behind their refusal to price bills of quantity.

The non-specialists reported the opposite view (chart 4.8, p.434 – chart 4.22, p.449). Statistically positive (complementary) results were given against most of the criteria used to judge quality – accuracy of the quantities, accuracy of the descriptions, logic, how closely the bill items related to what was eventually built, additional work required to generate a price, planning the works and valuing interim valuations. The non-specialists also perceived that bills enabled their prices to be compared on a like-for-like basis.

Some of the results such as the ability to value the Final Account, ability to value variations and how the level of detail compared with their own internal information were not *statistically* significant (although the majority of results were positive in direction) – table 4.10, p.458. Statistically negative results were provided about the ability to use bills to order materials. This was anticipated and thus served as a useful check that the results were valid.

Based on a review of industry processes, the usefulness of quantified information for the non-specialists was justified and preference by the specialists to rely on their own pricing documentation better understood.

5.2.1.3 Literature review

Previous research has failed to gain such a detailed understanding of the *entire* pricing process, how the contracting sector typically subdivides this, the demands of the varying types of contractor and subsequent problems that are encountered. Such an understanding was recognised as a gap in previous research by leading academics within the subject area - Skinner (1979, p.75, p.215; 1981, p.9; 1981, p.29) and Pasquire (1991, p.221).

This research has revealed two diverse schools of thought on the appropriateness of bills of quantities through the identification of distinct groups of contractor – *specialists* and *non-specialists*. Although differences in opinion were held within the literature about specialist and non-specialist work (although not specifically referred to as such), it was unclear what the root causes of the problems were. The literature had also failed to address how the work was typically presented for each type of contractor, what their preferences were, the extent of divergence between the demand and supply of information and consequential affects. The characteristics of the two groups of contractor have also not been understood to the depth identified within the current research project. A detailed understanding of their preferences for pricing documentation has been documented including their behavioural response when their needs are not met (figure 4.7, p.203).

A different approach was also adopted by the research in order to evaluate how the pricing documentation was typically presented. Instead of relying on the views of quantity surveyors, the approach adopted by the RICS Contracts in Use Surveys, estimators were asked directly. For the first time, this revealed differences in the format of pricing documentation for specialist and non-specialist contractors (chart 5.1, p.306). The low incidence of specialist work in bill format (found to be approximately 1-2%), although cited within the literature, had not previously been quantified (chart 4.9, p.435). The extent of poor practice and actual value of work measured for the non-specialists had also not been previously quantified. These are illustrated overleaf.

A picture of the entire pricing process, previously not addressed within the literature, has therefore been developed (figure 4.9, p.212). By understanding the needs of the specialists and non-specialists, their typical position within the pricing chain, their response to any given format of pricing documentation and the extent of divergence between demand and supply; it was possible to evaluate the types of problems endured in practice and their frequency of occurrence. The impact of the current effectiveness of pricing documentation could therefore be quantified. The value of non-specialist work that is prepared in Plan & Spec format is important to note (43%, chart 5.1, p.306). In contrast to the RICS finding (at 10%), this indicates that the design is substantially complete for the majority of their workload (i.e. 73%) and that volume of avoidable duplication is therefore significant.

Chart 5.1: Methods of procurement adopted % by value – a comparison of the research findings against the RICS Contracts in Use Survey

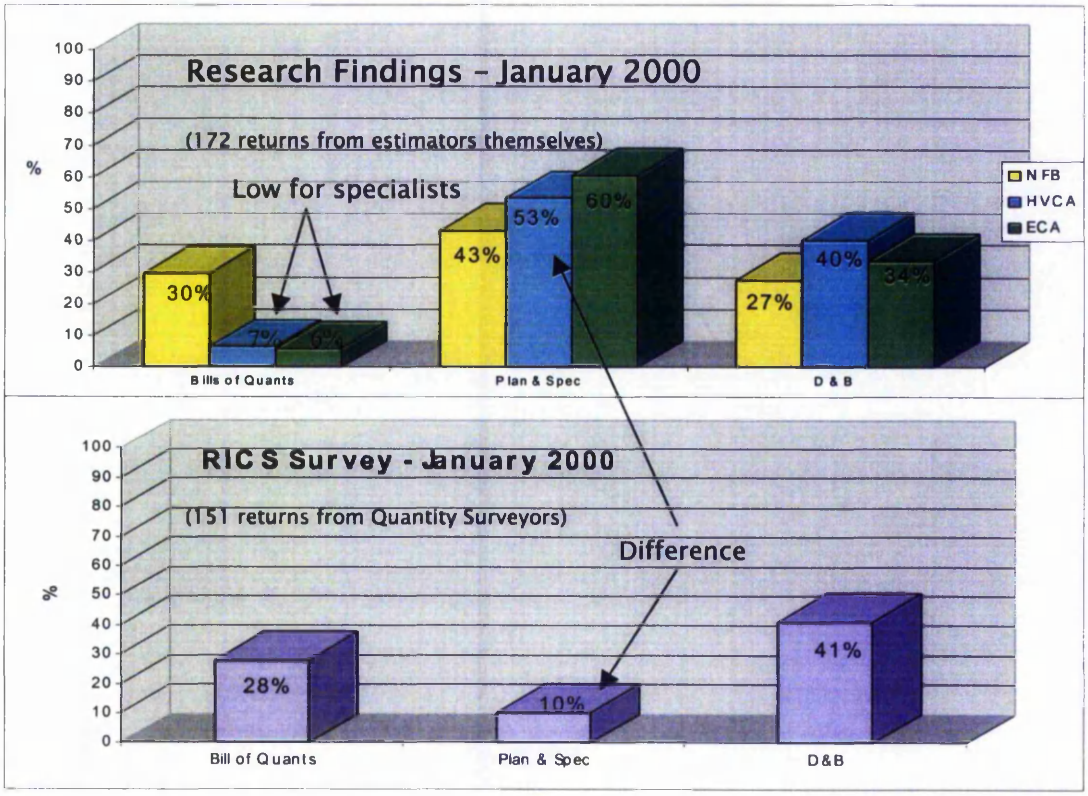
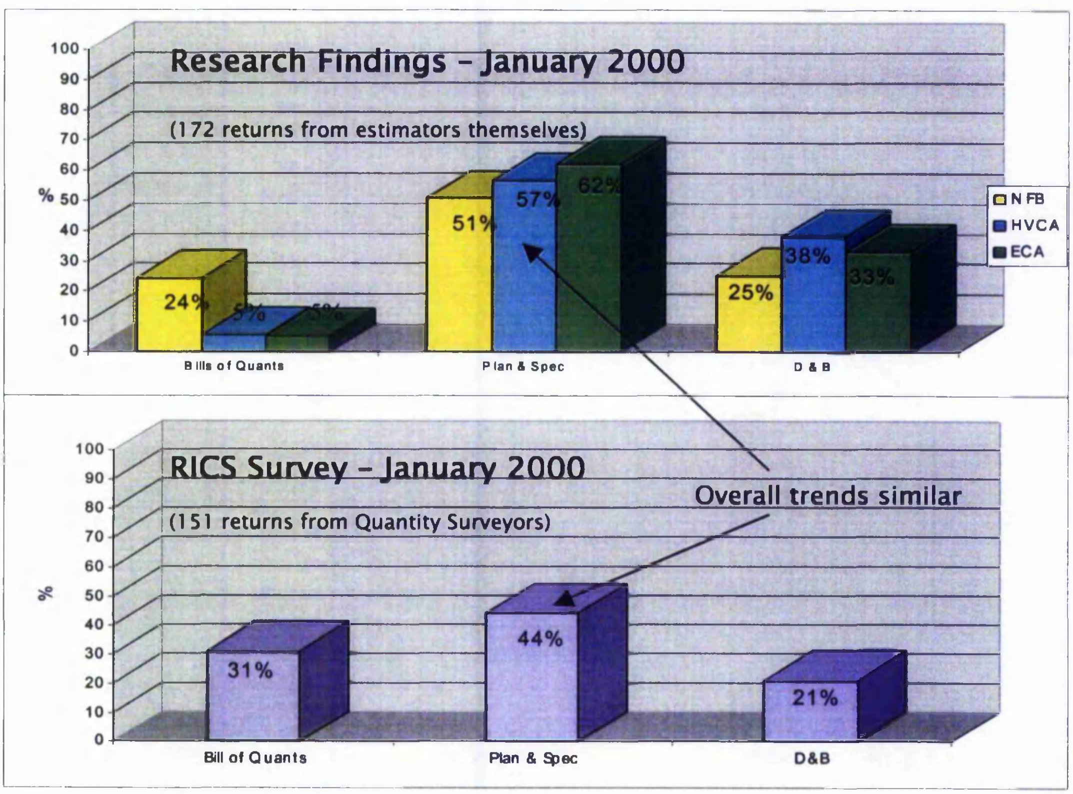


Chart 5.2: Methods of procurement adopted % by number – a comparison of the research findings against the RICS Contracts in Use Survey



The following table provides a summary of the research findings and relevant references within the literature. Comments are also included to explain the interrelationship between the two:-

Table 5.2: Research question 1: Summary of research findings that are supported by the literature

Research finding	Reference to literature	Comments on the literature
A high level of work is subcontracted (approximately 80%). The same trades are consistently kept in-house and the same trades consistently subcontracted.	Skinner, 1981. p. 9; Shash, 1993 and Abdel-Razeck & McCaffer, 1987 p.242.	The findings of the research correspond with the existing literature.
Negative views from the specialist contractors about the effectiveness of bills of quantities.	Swaffield, 1994 c, p.23; RICS, 2000 c, p.23 & 37; HVCA, 1990, p. 64; Ardley, 1994, p.63; Trounce, 1982, p.45; Rimmer, 1984; Sims 1984 a, p.25; Shakeshaft, 1994.	Widespread condemnation within the literature although this is not based on any real understanding of why or substantive data collection. With the exception of Swaffield (whose research was limited), the views within the literature are based on supposition and experience by practitioners.
Positive views from the non-specialist contractors about the effectiveness of bills of quantities.	Skinner, 1981; p.29; Pasquire 1991, p.215; Swaffield, 1994 c, p.23; Eccles, 1992, p.7.	Widespread support within the literature based on a micro understanding of the main contractors only. No understanding of the macro/ subcontractor needs has been gained previously.
The existence of deep rooted problems within the industry that render the measurement of specialist work inappropriate (i.e. state of the design).	Skinner, 1981, p. 29; Swaffield, 1994 c, p.23; RICS, 2000 c, p.23 & 37; Davies 1992, p.59-61; Coffey, 1992, p.4.	Skinner recognised the failure of designers to reflect technological change within their contract documents; other literature also acknowledges the poor state of the design and poor training etc. Little understanding of the extent of these problems has been previously gained.
The extent of additional work required by the specialist contractor to formulate a price from billed information.	RICS, 2000 c, p. 23; HVCA, 1990, p. 64.	Only recognised in isolated instances. The views within the literature are based on supposition and the experience of practitioners. No substantive data collection has been carried out.
The inadequacy of bills of quantities to reimburse the specialist contractor.	Skinner, 1981, p.29; RICS, 2000 c p.23 & 37; Coffey, 1992, p.4; RICS Research Paper 19; HVCA, 1990, p.65.	Supposition evident within the literature but not based on any quantitative analysis.
The inappropriateness of bills to value specialist work.	Skinner, 1981, p.29; RICS, 2000 c, p.23 & 37; Swaffield, 1994 c, p.23; HVCA, 1990, p.66.	Very much an unknown within the literature. The literature contains a number of isolated views but these assertions are not based on any quantified evidence. This also addresses one of Skinners recommendations for further research (1979, p.214)
The fact that specialist contractors do not use bills in practice.	Swaffield, 1994 c, p.23.	With the exception of Swaffield, this issue has not been addressed at all within the literature. However, Swaffield's research was based on limited data.
The inability of bills to compare specialist tenders on a like-for-like basis.	RICS, 2000 c, p.23.	Barely addressed within the literature. Although cited by the RICS M&E panel, their views were based upon industry practice (from the quantity surveyors viewpoint) and not derived from any survey of estimators as conducted by this research. This also addresses one of Skinners recommendations for further research (1979, p.214)
The specialists behavioural response to measured work that is prepared by a consultant quantity surveyor.	-	Not previously addressed within the literature. This is a key area of understanding that is central to the effective procurement of prices from these trades.
That specialist trades prefer to measure the work themselves (and not have this quantified for them).	-	This has neither been previously investigated nor evaluated within the literature. In a similar vein to the above, this is a key principle that has been overlooked by previous research. This addresses one of Skinners recommendations for further research (1979, p.214)
The existence and extent of poor practice.	Rabbets, 1992, p.18; Emmett; 1990, p.24.	Isolated recognition from the literature but no wider understanding of the types of poor practice, their frequency or impact as identified by this research.
A high incidence of post-tender changes.	Kodikara, 1993 b, p.344; Bennet, 1983, p.84; Rimmer, 1982, p.24.	Although only a few of the references are cited here, this is a relatively well recognised trait inherent within the industry.
Ability of bills to compare non-specialist work on a like-for-like basis.	Skinner 1979, p.29; Pasquire, 1991, p.215; Kodikara, 1990.	Well endorsed by academic research within the subject area.
The extent that current practice causes post-tender conflict.	Skinner, 1979, p.214; Davies, 1992, p.61 & 63; Dodd & Langford, 1990, p.385.	The occurrence of post-tender dispute is well documented. However, the *root cause* and frequency are poorly understood. These have only partially been recognised by the likes of Davies. This addresses one of Skinners recommendations for further research (1979, p.214)

Overall, the literature reveals a limited understanding of the current processes that are commonly adopted in the preparation of tender documentation. Previous research has failed to gain an in depth understanding of the current procedures and instead focused on the main contractors' needs post-tender.

This research has filled a gap in the current body of knowledge by reviewing the entire pricing process and interfaces between contracting organisations. The current research has charted how prices are divided by the main contractor and the typical format of this information. In addition, by understanding the needs of each type of contractor and how well these needs are met, the research has developed an understanding of how the pricing process is altered by current practice.

Whilst some of the results are comparable with the existing literature (e.g. the specialist contractors negative views on bills) the literature is predominantly based on supposition by practitioners. Views expressed by the representative bodies are perhaps more reliable (e.g. HVCA and ECA) but these are similarly not based on any substantive data collection.

5.2.1.4 Summary

The research has developed a detailed understanding of the *entire* pricing process. This macro level understanding is in contrast to previous research that has predominantly reviewed the internal needs of the main contractor (i.e. at the micro level).

The interviews enabled a detailed understanding of the processes involved in tender preparation to be established. They also identified two groups of contractor (the *specialist* and *non-specialist*), these were critical to the overall research project as many of the processes that were adopted in practice were brought about by their behavioural responses. The format of pricing documentation was found to adversely affect many of the processes undertaken and cause substantial duplication.

The industry survey findings confirmed the findings of the interviews and proved many of the responses to be statistically significant.

A comparison of the research findings with views held within the literature reveals substantial gaps within the existing body of knowledge. The idea of understanding the needs of the subcontractors, particularly in light of the increased proportion of the work they now represent, was recognised as a gap in previous research efforts by the major contributors themselves - Skinner (1981, p.29; 1979, p.215 and 1981, p.9) and Pasquire (1991, p.221).

Views that do conform with the research findings are predominantly based on the isolated opinion of practitioners, limited previous research or the views of representative bodies – none of which are supported by substantive data collection.

5.2.2 How effective is current pricing documentation as indicated by those problems commonly encountered by constructors during the pricing of tender documentation? (research question 2)

5.2.2.1 Interview results

The interviews revealed that pricing documentation, as currently prepared in practice, is not effective. Furthermore, not only was this information found to be ineffective, but the cause of a number of adverse affects (table 4.5, p.208):-

- Significant duplication (equivalent of the entire project being measured between 2.68 and 6.88 times over).
- Increase the overall workload within the industry.
- Increase the cost of tendering (as a result of the above).
- Reduce the accuracy of the tendering process.
- Render the client's representative incapable of accurately understanding the cost and thus valuing the works post-tender.

- Increase the likelihood of post-tender dispute, and;
- Overall, increasing the level of risk endured – particularly by the main contractor as central coordinator of the price.

The root cause of this ineffectiveness was recognised as belonging to one of two principal problem areas (figure 4.8, p.206 and p.214):-

1) Matters of principal

– a *principal* mismatch between the type of information required by the contractors estimator and that supplied, three sub-elements were recognised:-

- **Not providing quantified information when it is required** (i.e. for the non-specialist contractors) – estimated to represent approximately 26% of practice (11% of the non-specialist main contractors workload and 15% for the non-specialist subcontractor).
- **Having to produce quantified information for others** (i.e. non-specialist main contractor having to quantify for the non-specialist subcontractor - equating to 15% of practice).
- **Receiving quantified information when it is not required** (i.e. by the specialist contractor – approximately 1% of practice).

2) Matters of practice

- Poor quality pricing information (i.e. even though, in principal, the information may suit the needs of the contractor it is often of poor quality and thus not effective).
  - The extent of this was difficult to quantify accurately from the interview results alone as the sample was limited and could not be reliably extrapolated to the industry as a whole. However, this was certainly a common issue in the interviews sampled.
  - Of particular concern was the inconsistent format that specialist work was procured. Despite complying with their need for the work to be non-quantified (equating to approximately 29% of the total industry workload) its inconsistency was found to be the cause of significant problems.

As the flow of pricing information is chartered through the pricing chain it is apparent that the affects of these problems are further exacerbated (figure 4.9, p.212). The number of main contractors competing on any one contract increases the amount of duplication that is involved in measuring their own work as each will need to measure the same work themselves i.e. 26% multiplied by X (X being the number of competing main contractors). The same problem occurs for the non-specialist subcontractor i.e. 15% multiplied by Y (Y being the number of competing subcontractors for each trade).

However, this problem is compounded in practice. The non-specialist subcontractors receive a number of differing formats of pricing documentation prepared separately by each main contractor (factor of X). All of the interviewed subcontractors stated that, to save time and expense, they would price the most accurate (and quickest) and then send that back a single price to all of the main contractors. As a result, only one main contractor would therefore receive the format of information that they sent out and the rest would receive a completely different version (p.202). This may cause significant problems for the main contractor. Earthworks are a prime example of this practice where each of the main contractors' approach to the work will differ considerably. In addition to this all of the interviewed subcontractors stated that the main contractors approach to the task of measurement would differ (even when the main contractors approach to the work was similar).

Although the majority of the specialist work was not quantified (which suited the needs of this trade), prices were sought in an inconsistent manner. As a result, the estimators stated the need for a standard method of preparing the pricing documentation on a non-quantified basis (p.206).

A further area where methods of obtaining tenders were found to be ineffective was in the incorporation of specialist subcontract innovation (p.207). Both the main and subcontractors interviewed stated that alternative methods of construction or products were not drawn out of the tendering process. Findings from the interviews suggested that more effective products could be utilised and for less cost. Many of the specialist firms stated that they were engaged in longer-term (often volume based) contracts with named suppliers. As a result their supplier base was restricted. This was recognised as being typical practice within the specialist sector of the industry (p.207). However, when equipment was specified by the client-side that was outside their supplier base the specialist contractor was unable to compete on an even basis. A less prescriptive method of specifying performance would therefore allow the specialist to develop a more economic solution.

To further compound these problems, the research revealed that tender timescales were often unduly restrictive and afforded the contractor little time to prepare their price (p.201).

5.2.2.2 Industry survey results

To gain further evidence that pricing documentation was not effective and understand why this was the case, the industry survey posed a number of related questions.

In support of the interview findings, the results confirmed that the quantity surveyor was typically better able to describe the detailed processes involved in (constructing) the work for non-specialist trades than for specialist trades (chart 4.23, p.231). The results also identified that, against a number of criteria identified below, the ability of the quantity surveyor was viewed positively for non-specialist work and negatively for specialist work (p.233-237):-

- Practical awareness,
- Knowledge of construction,
- Knowledge of materials,
- Knowledge of design, and;
- Ability to break down the price into price-able units.

The results suggested that the ability of the quantity surveyor had changed little over time for the specialist trades but had deteriorated most noticeably for the non-specialist trades. This deterioration had taken place predominantly within the last 6-10 years (chart 4.30, p.238 & chart 4.31, p.239).

A further set of questions to the contractors' estimators identified the quality of information produced by their own contracting organisations. Both the specialists and non-specialists reported statistically significant positive results in terms of accuracy of descriptions and quantities, logic, how closely the information relates to what is eventually built and additional work required in order to generate a price (chart 4.38, p.450 – chart 4.43, p.455). This served as a useful check against the same set of questions for measured work supplied by consultant quantity surveyors (chart 4.8, p.434 – chart 4.22, p.449). It was evident why the specialist firms preferred quantified information from internal sources as the quality of information deteriorated significantly when prepared by consultant quantity surveying firms.

The industry survey also reinforced the interview findings in terms of value for money through the adoption of specialist contracting expertise. Both the specialists and non-specialists stated that their price would reduce if they were given the freedom to design the work themselves, particularly the specialists with an 85% and 83% response in this direction (chart 4.44, p.250). Similarly, the specialists proposed the greatest saving if they were given the option to specify materials (chart 4.46, p.253).

5.2.2.3 Literature review

Table 5.3: Research question 2: Summary of research findings that are supported by the literature

Research finding	Reference to literature	Comments on the literature
The extent of duplication caused by the non-quantification of non-specialist work in practice.	-	This has not been investigated by previous research. Ferry & Holes (1967, p.22) did however recognise that if work was consistently procured from such firms in SMM format then they would adopt similar methods of pricing when this was not provided for them – thus, inferring duplication. Despite a reduction in client-supplied information, a number of isolated views are evident within the literature that logically suggest that the *need* for measured data still remains and thus infers duplication will occur (McDonagh, 1992, p.3; Eccles, 1992, p.7).
The overall increase in workload endured by the industry from the above.	-	In a similar vein, a lack of understanding of the duplication caused has meant that no understanding has been gained of its effect on workload. Love & Li (2000) did however recognise the extent of re-work caused by poor documentation.
The increased cost of tendering (arising from the initial point).	-	As described above, no research has previously attempted to evaluate the consequential affect on cost.
The reduced accuracy of the tendering process (arising from the initial point).	-	No previous research has evaluated how the extent of duplication and assumptions made within the pricing chain affect its overall accuracy.

Table 5.3: Research question 2: Summary of research findings that are supported by the literature (continued)

Research finding	Reference to literature	Comments on the literature
Inability of the client's representative to interpret the priced works.	Coffey, 1992, p.4.	Isolated reports of the consequential affects are evident within the literature. However, these are not based on a detailed understanding of the underlying problems or based on substantive data collection.
An increased likelihood of post-tender dispute.	Skinner, 1979, p.214; Davies, 1992, p.61 & 63; Dodd & Langford, 1990, p.385.	The frequency of post-tender dispute is well documented. However, the *root cause* is poorly understood and only partially recognised by the likes of Davies.
An overall increase in risk (particularly for the main contractor).	-	The risks endured in practice have not been reflected in the existing literature. Without a detailed understanding of the format of tender documentation and how this corresponds with the demands of the individual contractor, it is not possible to comprehend the extent of risk (as achieved).
Poor utilisation of the specialists expertise during the tender period.	RICS, 2000 c, p.9 & 26; Latham, 1994, p.30.	This has been raised consistently within the literature and more so within the last 5-10 years. However, the benefits have been made on supposition and not backed up by any quantitative data. This has been provided by the current research project.
The extent of poor practice (**matters of practice**).	Rabbets, 1992, p.18; Emmett; 1990, p.24.	Isolated recognition from the literature but no wider understanding of the types of poor practice, their frequency or impact. Insufficient tender periods were also highlighted by Bayliss at the 1992 Nottingham Trent University conference.
Matters of principal: • Not providing quantified information when it is required. • Having to produce quantified information for others. • Receiving quantified information when it is not required.	Skinner, 1981; p.29; Pasquire 1991, p.215; Swaffield, 1994 c, p.23; Eccles, 1992, p.7.	Although previous research has identified the principal needs of the main contractors it has not gained an understanding of the needs of the non-specialist or specialist subcontractors (which, between them are estimated to represent approximately 80% of the industry's workload, by value). It has also failed to gain an understanding of how the main contractor interacts with subcontractors in order to obtain prices. A comprehension of this takes us from a micro level understanding to a macro level and includes the interfaces between contractors. The lack of comprehension of the matters of principal are regarded as a major gap in previous research efforts.
Inconsistent manner in which specialist work is sought.	-	This has not been picked up by previous research as detailed investigations have not been conducted.
A good knowledge of non-specialist work by the quantity surveyor (evaluated in terms of practical awareness, knowledge of construction, materials and design and ability to break down the price into price-able units).	Swaffield, 1994 c, p.23.	Although not evaluated against exactly the same criteria and not quantified to the extent gained within this research, views on the knowledge of the quantity surveyor have been complementary and would tend to support the findings made.
A poor knowledge of specialist work by the quantity surveyor (evaluated in terms of practical awareness, knowledge of construction, materials and design and ability to break down the price into price-able units).	RICS, 2000 c, p.23 & 37; QS2000 (1991); Coffey, 1992, p.4.	Again, these specific criteria have not been evaluated or quantified to the extent of this research. However, isolated reports would tend to support these findings.
A recent decline in the ability of the quantity surveyor to accurately measure non-specialist work (chart 4.30, p.238 & chart 4.31, p.239).	-	There is certainly a well documented shift in the responsibility to measure from the client-side of the industry to the contracting-side. What is unclear from the literature is whether this has resulted in a reduced ability. The research findings confirm this assertion which inevitably is of concern to the industry.
A consistent inability of the quantity surveyor to accurately measure specialist work.	RICS, 2000 c, p.37; HVCA, 1990, p.66; Latham, 1994; p.28; Swaffield & Pasquire, 1995, p.8	Although suggested to be the case by the research, the literature does not address this issue specifically. The consistency of detrimental views over time would tend to support this however.

In a similar vein to the last research question, a review of the research findings against the existing literature reveals an acute lack of understanding. Although the resultant affects of current practice are cited in an isolated fashion (e.g. post-tender dispute) their root causes are poorly understood.

In particular, the enormity of the duplication endured in practice has been overlooked by the literature. With a focus on the post-tender stage; the resultant increase in workload that is caused by such duplication, increased costs of tendering and reduced accuracy of the tendering process have not been addressed.

Although the desire for measured work to be produced for the non-specialist main contractor is acknowledged, the consequential affects of not providing this documentation are also not understood by the existing body of knowledge. Nor is the harm caused by inconsistent non-quantified information for the specialists.

The benefits derived from changing the specialists' position within the supply chain and differing abilities of the quantity surveyor (against each type of contractor) match with those within the literature. It is evident that, overall, the research fills a gap within the literature by explaining the root cause of many of the problems and chain of events that are caused. It also provides quantitative support to practitioners' views.

5.2.2.4 Summary

Current pricing documentation has been evaluated by the research and, from the perspective of meeting the needs of the contractors' estimator, found to be ineffective. Of further concern are the adverse behavioural responses to this information by the contracting sector.

Current practice is therefore not only ineffective but also the root cause of further detrimental problems. These include an increase the amount of duplication encountered, increase in the overall workload of the industry, resultant cost, increase in the likelihood of post-tender dispute and, overall; increase the risk experienced by the industry. It was also revealed that the accuracy of the pricing process was reduced and the ability to interpret prices and add value to the cost management of construction subsequently impaired (p.213). The findings of the interviews were confirmed by the industry survey and statistically significant results obtained.

Problems were categorised into two areas – matters of principal and matters of practice (figure 4.8, p.206). Problems of principal related to a fundamental mismatch between the need for a particular format of pricing documentation and the format that it was actually supplied in. Matters of practice captured the level of abuse that was evident in practice further rendering the documentation ineffective (e.g. *non-quantified itemised schedules*).

The industry survey confirmed the negative views on quantified specialist work and positive views on quantified non-specialist work. Of further concern was the perceived recent decline in the ability to measure non-specialist work; this may well compound the problem of ineffective pricing documentation in the future (p.254).

Although some of the research findings are supported by the literature, significant gaps in the existing body of knowledge are apparent. For example, the extent of duplication, subsequent problems caused and categorisation of the problem areas have not been previously recognised. In addition, the supportive views within the literature were primarily based on the opinion of practitioners.

5.2.3 What is the frequency and extent of each category of problem, its impact upon the relative accuracy of the pricing process and the extent of risk taken by the main contractor? (research question 3)

5.2.3.1 Interviews

The interviews provided a detailed explanation of each category of problem. These problems were broadly classified into two areas - matters of principal and matters of practice (figure 4.8, p.206).

The matters of principal related to a fundamental mismatch in the needs of the contractors' estimator and the type of information they were supplied. For example, quantified information not being supplied for the non-specialists (both main and subcontract) and the issue of quantified information being supplied for specialists.

The latter problem, the matter of practice, related to situations where, despite conforming with the contractors' stated preference, the information was *poorly* prepared. For example, the practice of 'non-quantified itemised schedules', as defined by the interviews, was well known within the industry. These problems are summarised in table 4.5 (p.208) and show by whom they are experienced, the consequential affects and incidence of occurrence.

Overall these problems result in extensive levels of duplication, increase the overall cost of tendering, reduce the accuracy of the pricing process, render the quantity surveyor incapable of accurately valuing the work, increase the likelihood of post-tender dispute and extent of price and quantification risk taken by the contractor (table 4.6, p.211).

As central coordinator of the price the main contractor was found to take on the majority of this risk (approximately 26% of practice multiplied by the number of contractors competing). The non-specialists, were found to endure approximately 15% of the quantification risk (again, multiplied by the number of contractors involved). The specialists only encountered about 1% of the industry workload in an undesirable format (approximately 3% of their own workload). However, the lack of standardisation of the non-quantified pricing documentation was seen to cause substantial problems (figure 4.9, p.212).

To summarise, the extent of price and quantification risk borne by the contractor was found to be extensive and the frequency that good quality, accurate information was provided was considered to be low.

5.2.3.2 Industry survey

The industry survey sought to quantify the problem areas experienced by the contractors.

The responses on the overall quality of measured work supplied by quantity surveyors are applicable to addressing this research question (chart 4.8, p.434 – chart 4.22, p.449). To recap, statistically negative (derogatory) views were given by the specialists in terms of the accuracy of both the descriptions and quantities and how logically this was presented; it was less detailed than their internally produced information and required substantial re-work if it was to be used to generate a price (table 4.10, p.458). Further areas of concern included the inadequacy of the measured items to reimburse the specialist contractor (via interim valuations, the Final Account and for variations), the fact that this information poorly reflected what would be eventually built (and thus exacerbate this disparity) and, finally, that tenders could not be compared on a like-for-like basis.

The specialists also considered that the tasks of planning, ordering materials and internal cost controlling could not be achieved by using bills (table 4.10, p.458). Overall these findings helped to justify the rationale behind the interview results. Statistically significant negative results were similarly recorded against a number of criteria – practical awareness, knowledge of design, construction and materials (table 4.11, p.460).

Again, the non-specialists reported the opposite view. Positive views were given in terms of the accuracy of the quantities and descriptions, logic, how closely this relates to what is eventually built, additional work required to generate a price, planning the works, valuing interim valuations and allowing prices to be compared on a like-for-like basis (table 4.10, p.458).

Problems areas cited within the free text sections of the questionnaire were categorised. Having categorised the responses the frequency that each response occurred was then totaled and presented in a histogram format. The non-specialists reported 'uncoordinated information', 'inaccurate descriptions' and 'itemised schedules' as their three main problems encountered in practice (chart, 4.32, p.241). The issue of 'itemised schedules' supported the findings of the interview stage. Both the HVCA and ECA reported their top problem as 'inaccurate descriptions' followed by 'inaccurate quantities' (charts 4.44 & 4.34, p.250-243).

Again, free text responses were categorised to help establish the *root cause* of the above problems. Both the HVCA and ECA stated a 'lack of knowledge of specialist work' (charts 4.26 & 4.37, p.234-246). The issues of training and the poor state of the design also appeared within their top three. This supported the findings of the interviews in that the state of the design played a major role in the effectiveness of pricing documentation not just the ability of the quantity surveyor. That is, the quality of the pricing documentation very much relied upon the extent of the development of design on which it was based.

The most frequent response from the non-specialists was that of 'basic care and attention' (31% - chart 4.35, p.244). This also ties in with the interview findings, that is, the ability exists but is just not being applied. This is an important issue to note and one that is further explored during the empirical survey (chart 4.53, p.274). The non-specialists also stated the 'lack of QS knowledge of specialist work'.

5.2.3.3 Empirical testing

The empirical testing stage built on these findings. To recap, a number of underlying problems and modes of practice were identified during the interview and industry survey stages that affected the accuracy of pricing documentation. The empirical testing stage established how frequently the quantity surveyor was able to accurately quantify the work for the specialists and non-specialists.

Statistical analysis of the results revealed that the views on the ability of the quantity surveyor to measure work accurately were the complete opposite for both groups of contractor (table 4.38, p.291). All three representative bodies believed that the quantity surveyor was able to accurately measure non-specialist work but not able to accurately measure specialist work. These views were all statistically significant. Furthermore, all three of the representative bodies were in unanimous agreement with one another (table 4.39–4.42, p.292–293).

Their collective views on non-specialist work established that quantity surveyors would accurately measure 'always' 21% of occasions, 'often' – 60%, 'sometimes' – 18% and 'never' – 1% (chart 4.53, p.274). The individual views of the NFB went further stating that accurate information would typically be provided 88% of occasions (chart 4.55, p.276).

The results on the accuracy of the measurement of specialist work follow the opposite tendency. Collective views stated that this work would 'always' be accurately measured by quantity surveyors on 1% of occasions, 'often' – 3%, 'sometimes' – 19% and 'never' 77% of occasions (chart 4.50, p.271). The views of the ECA gave an even worse indication of the frequency by which their work would be accurately measured 'always' – 0%, 'often' – 2%, 'sometimes' – 15% and 'never' – 83% (chart 4.51, p.272).

These views correspond with both the interview and industry survey findings. The wording of the question posed during the empirical testing stage helps to explain the level of poor practice present within the industry. The estimators of each representative body were asked how frequently, based upon the information they typically received, the quantity surveyor was *able* to accurately quantify the works. *Ability* is a key issue in the question posed. Of notable interest is the positive response from the non-specialists. This helps explain the level of poor practice within the industry; if the top root cause of the problems, 'basic care and attention' were addressed (31% - chart 4.35, p.244) the problem areas of 'uncoordinated information', 'inaccurate descriptions' and 'inaccurate quantities' could therefore be overcome (chart, 4.32, p.241). Quite simply, the typical quantity surveyor has the skill and the design is usually complete enough – there is no reason why good quality data should not be prepared. The only reason why good quality data is not produced is a matter of poor practice.

In contrast, and in line with the original interview findings, the reason for poor quality measured work for specialist trades is more deeply rooted within the building industry (figure 4.5, p.191). The estimators hold a very strong view (one proven to be statistically significant – table 4.38, p.291) that the quantity surveyor is not able to prepare accurate measured work. This finding was in line with the original interview results in that, as the design was rarely complete and many of the design decisions would be taken by the contractor themselves, it was not possible for the quantity surveyor to quantify the works even if they possessed the skills to do so (table 4.2, p.192).

5.2.3.4 Literature review

Table 5.4: Research question 3: Summary of research findings that are supported by the literature

Issue	Reference to literature	Comments
High levels of risk endured by contractors as a result of current practice.	-	Previous research has failed to identify the extent of price and quantification risk endured in practice. This research, based on a detailed understanding of current practice, has identified the underlying problems, their frequency and thus quantified the extent of risk (table 4.4, p.197).
Low frequency of good quality, accurate information.	Rabbets, 1992, p.18; Emmett; 1990, p.24.	This was inferred within the literature although it was difficult to estimate the extent and thus detrimental affect of poor practice. The "non-quantified itemised schedules" have been recognised by this research and found to be used frequently in practice (p.207).
Statistically significant negative views on the quality of quantified information produced for specialists (also in terms of quality, logic, extent of re-work, inadequacy to reimburse the contractor, inability to compare tenders on a like-for-like basis).	Swaffield, 1994 c, p.23; RICS, 2000 c, p.23 & 37; HVCA, 1990. p. 64; Ardley, 1994, p.63; Trounce, 1982, p.45; Rimmer, 1984; Sims 1984 a, p.25; Shakeshaft, 1994.	The findings of the research (against specific issues such as the extent of re-work) were inferred by the literature but not explicitly defined or quantified to the extent achieved.
Statistically significant positive views on the quality of quantified information produced for non-specialists (also in terms of quality, logic, extent of re-work, inadequacy to reimburse the contractor, inability to compare tenders on a like-for-like basis).	Skinner, 1981; p.29; Pasquire 1991, p.215; Swaffield, 1994 c, p.23; Eccles, 1992, p.7.	In a similar vein to the above, a positive view of quantified non-specialist work was inferred by the literature but not quantified.
High incidence of uncoordinated work for the non-specialists.	-	This has not been picked up by previous research.
Quantification of the main problems experienced by the specialists and non-specialists.	-	Previous research has failed to quantify the problems encountered by both groups of contractor e.g. the inadequacy of bills to reimburse the contractor for variations being a problem for the specialists and not for the non-specialists.
Fundamental lack of understanding of specialist work by the typical quantity surveyor.	Skinner, 1981, p. 29; Swaffield, 1994 c, p.23; RICS, 2000 c, p.23 & 37; Davies 1992, p.59-61; Coffey, 1992, p.4.	The existing literature suggested that this may well be the case but failed to substantiate the assertions made. This research collated widespread views from the industry to reveal such a lack of understanding.
Low frequency that specialist work is able to be measured accurately by the quantity surveyor.	Swaffield, 1994 c, p.23; RICS, 2000 c, p.23 & 37; HVCA, 1990. p. 64; Ardley, 1994, p.63; Trounce, 1982, p.45; Rimmer, 1984; Sims 1984 a, p.25; Shakeshaft, 1994.	This was inferred by the literature but not backed up by any quantitative analysis. Statistically significant proof was provided by this research to confirm the low frequency that the quantity surveyor could accurately measure specialist work.
High frequency that non-specialist work is able to be accurately measured by the quantity surveyor.	Skinner, 1981; p.29; Pasquire 1991, p.215; Swaffield, 1994, p.23; Eccles, 1992, p.7.	Again, this was inferred by the literature but not backed up by any quantitative analysis. Statistically significant proof was provided by this research to confirm the high frequency that the quantity surveyor could accurately measure non-specialist work.

A comparison of the research findings against the existing body of knowledge reveals a similar tendency – a more detailed understanding of the underlying problems and their consequential affects by the research than currently found within the literature.

The existing literature is also based entirely on assertions made by practitioners (e.g. negative views about the ability of the quantity surveyor to accurately measure specialist work). These assertions have not been supported by any substantive data collection. This research provides a far greater depth of understanding on the effectiveness of pricing documentation in terms of the levels of risk endured in practice, quality and usefulness of the information provided, the level of understanding of the work type by the quantity surveyor and ability of the quantity surveyor to accurately measure the work.

5.2.3.5 Summary

Principal differences in the desired and actual format of information were most apparent on the non-specialist side. Approximately 41% of the total industry workload, that was required to be in a quantified format, was not quantified in practice (figure 4.9, p.212). The measured work therefore had to be prepared by the contractors themselves (11% by the main contractor and 15% by the non-specialist subcontractor). This lack of quantified data also meant that the main contractor was forced into measuring a further 15% of the total industry workload on behalf of the non-specialist subcontractors (i.e. 26% in total). Approximately 5% of the non-specialist work (as a percentage of total industry workload) was also poorly prepared.

On the specialist side, only 1% of the total industry workload was found to be at odds with their required format. However, despite being in the required *non-quantified* format, the remainder of their workload (29% of the total industry workload) was poorly prepared and in an inconsistent format – this caused significant problems (p.214).

Overall, approximately 42% of the total industry workload was found to be at odds with the needs of the estimators (in principal). To compound this, the extent of duplication by competing contractors was estimated to be equivalent to the entire project being measured between 2.68 and 6.88 times (table 4.4, p.197).

The industry survey confirmed statistically significant results against a number of criteria (accuracy of descriptions, accuracy of quantities, how logically the information was presented, whether this was less detailed than their own internal information and the amount of re-work required to generate a price). Problems were cited by the specialists and positive (complimentary) results were recorded by the non-specialists (table 4.10, p.458). The same pattern of responses was also recorded against the abilities of the quantity surveyor (in terms of practical awareness of the particular trade, knowledge of design, construction and materials – table 4.11, p.460).

Specialists expressed concern about the appropriateness of bills of quantities to adequately value their work. They also stated that the measured items, as built, bore little resemblance to the items measured within the bills at tender stage (questions 11d-f, table 4.10, p.458). This posed significant risk to the specialist contractor. In addition, specialists did not consider that bills allowed their prices to be compared with their competitors on a like-for-like basis (question 11a, table 4.10, p.458).

The empirical testing stage provided statistically significant results about the frequency that quantity surveyors were able to accurately measure both types of work (table 4.38, p.291). Again, specialist views were negative and non-specialist views positive. The results were also tested further to analyse their comparative views (tables 4.39-4.42, p.292-293).

To summarise, the identified problems were found to occur frequently in practice and to impair significantly the relative accuracy of the pricing process. As central coordinator of the price, the main contractor was found to take on the majority of price and quantification risk experienced in practice. The research findings are also poorly represented within the existing literature.

5.2.4 What is the impact upon the client of the exposure to risk of the constructor in terms of the current pricing documentation? (research question 4)

5.2.4.1 Interviews

The interviews established that, as a result of ineffective pricing documentation, the contracting sector was exposed to significant risk and an increase in workload (table 4.4, p.197). This was found to impact upon the client at the tender stage in the form of increased costs and, at the post-tender stage, in the form of contractual disputes (p.202).

The main contractor, as coordinator of the pricing process, was found to take on board the majority of the price and quantification risk. Most apparent was the demand placed on the main contractor to quantify the work and be held responsible for its accuracy (figure 4.9, p.212). Approximately 50% of their own workload was quantified by them (11% of the total industry workload) and, in addition, 15% of the non-specialist subcontractors (i.e. 26% of the total industry workload). They therefore expended more effort in quantifying for others than for themselves.

In addition to this, the main contractor was often forced into assuming responsibility for work that was measured by the non-specialist subcontractors (representing 15% of the total industry workload) – table 4.5, p.208. Their quotes would typically be qualified to ensure that the work was "*re-measurable upon completion*". Reimbursement would then be sought by the subcontractor should the quantity of work increase post-tender. Effectively, the main contractor would take responsibility for approximately 41% of the total industry workload (26% + 15%). If a back-to-back arrangement were not in place with the client then one of the two parties would ultimately suffer financially. In turn, this increased the likelihood of post-tender dispute. If the opposite occurred and the quantity of work reduced, then the same parties would not volunteer any such savings to the next level up within the pricing chain. Payment would therefore be received for work that was not delivered. In practice, the risk of taking on board the non-specialist subcontractors qualified tender or quantifying the work on their behalf was often outweighed by the opportunity to profit in this manner. This would therefore result in a nett increase in cost to the client. Many of the interviewed contractors stated that they often found work that they believed to be deliberately over-measured by the quantity surveyor to cover for inadequacy of the design (p.199).

In addition to this the time the elapsed between tender submission and award of the subcontract was often many months (particularly for the finishing trades). The risk taken by the main contractor would therefore remain unknown until the contract was underway – post-tender dispute being the only means of recourse at this point in time (p.207).

Overall, the absence of measured work for the non-specialist sector of the industry resulted in an increase in quantification risk. The interviewed contractors stated that additional allowance would often be included within their tenders to account for potential post-tender conflict (p.202). Both the subcontractors and main contractors also stated that, if responsible for the accuracy of quantities, they would allow additional money within their tender to compensate for their own inaccuracy. Time and resource constraints would not allow the contractor to quantify the work in detail. Items would often not be quantified in detail and assumptions rounded-up to compensate for error. Little time would be spent on low item values. It was evident that an element of double counting of this risk also occurred. Inconsistent approaches to pricing risk meant that those at a higher level within the supply chain receiving the prices would be unsure of what had been priced and what had not. The main contractors approach was also found to be inconsistent and often the determining factor as to whether their bid would be the lowest. In this respect winning the work was not based on accurate pricing but more a matter of which contractor made the greatest mistake. As stated in the last paragraph such errors may only be recognised post-tender when the work is underway and thus only allow the main contractor to be compensated through the route of post-tender dispute. In addition, the main contractor would allow for items that were over-compensated by the subcontractor. This was compounded by the fact that the assumptions of the subcontractor were deliberately left unclear for fear of post-tender reprisal. Overall, there was a lack of openness within the industry and air of mistrust. From the clients perspective the non-provision of quantities for non-specialist work increased the initial cost and, post-tender, the likelihood of dispute (table 4.5, p.208).

On the specialist side, the tenders would be returned to the main contractor in an inconsistent format, as each of the competing specialist contractors would adopt their own method of presenting non-quantified prices. The main contractor would need to abstract these to ensure that they were interpreted consistently. The time and effort expended in this activity was directly proportional to the value and complexity of the specialist tender. This again would increase the cost of tendering to the client (table 4.5, p.208).

Although less frequently encountered in practice, the measurement of specialist work was also seen to increase the overall cost. The fear of post-tender reprisal, against items that were priced unnaturally, also led to the practice of pricing risk.

Overall, the interviews established that significant risk was experienced within the industry as a result of current practice. As central coordinator of the price, the majority of quantification and price risk was borne by the main contractor. The cost of having to quantify their own work and that of the non-specialist subcontractor was seen to increase their overall price. Quotations were often deliberately ambiguous and contractors would state assumptions strategically against items they would attempt to profit from post-tender (table 4.5, p.208). Such a lack of clarity meant that variations were difficult to value which resulted in over or under-compensation to the contractor. Contingency allowances, made by each level in the pricing hierarchy were double-counted and, again, increased the overall cost. Such a lack of clarity was seen to impact upon the client by increasing the overall cost and likelihood of post-tender dispute.

An indirect impact was also stated as a result of current practice. The lack of measurement by the client-side and ambiguous prices returned by contractors meant that the quantity surveyor had less of an understanding of cost. Cost data held by the quantity surveyor would therefore become outdated and unreliable. This was seen to impair their ability to provide professional advice, generate accurate estimates, cost report, accurately value variations and, overall, reduce their ability to offer the full range and quality of service they could potentially provide (p.213).

5.2.4.2 Industry survey

A number of responses from the industry survey are seen to support these findings.

Quality was evaluated against a number of criteria and found to be positive for non-specialist work and negative about specialist work in terms of (p.437-449):-

- How accurately the descriptions specify the quality of work to be carried out.
- The accuracy of the quantities.
- How logically the information is presented.
- The level of detail.
- The extent of additional work required to supplement this information.

The industry survey confirmed that good quality information could be produced for the non-specialist contractors but not for the specialist trades (charts 4.35-4.37, p.244-246). This supported the assertion that a lack of quantified information for the non-specialist contractor would actually harm the effectiveness of tender procurement.

It is important that the measured items reasonably reflect the manner in which costs are incurred. However, in reality, a direct relationship is unlikely as each contractor is likely to have its own unique method of collating and appropriating cost. If the measured items do not reasonably reflect the manner in which costs are incurred this could well result in either overpayment to the contractor or, conversely, underpayment – at interim stages, Final Account stage and particularly if variations occur (chart 4.13, p.440). All scenarios will inevitably impact upon the client. The will lead to post-tender dispute and the latter, to an overall increase in cost. The industry survey found the specialists to be derogatory and non-specialists to be complimentary about the accuracy of measured work in terms of how:-

- Accurately it reflected the cost of the work when used to prepare interim valuations (chart 4.19, p.446).
- Accurately it reflected the cost of the work when used to prepare the Final Account (chart 4.20, p.447).
- Accurately it could be used to value variations (chart 4.21, p.448).
- Useful it was for internal cost controlling (chart 4.22, p.449).

Overall, the industry survey confirmed that the measured items poorly reflected how specialist contractors incurred cost and thus, in terms of impact upon the client, the practice of measuring specialist work was found to increase the likelihood of inaccurate payments and post-tender dispute (p.230).

The industry survey also established that when specialist work was measured on their behalf, it showed little resemblance to what was eventually built. This fact was found to further compound the above problem. Discrepancies between the specialist contractors' cost base and arbitrarily assigned values within the bill would therefore be further exacerbated by changes in the measured items. In turn, this is likely to lead to an over or under payment to the contractor and increase the likelihood of post-tender dispute.

The specialists also differed from the non-specialists in terms of whether they considered their prices to be compared on a comparable basis with competitors (chart 4.16, p.443). The specialists did not consider that their prices were compared on a like-for-like basis. It is therefore likely that, through incorrect interpretation, the client will incur an inflated cost. This could be either through the selection of a more expensive bid or by interpreting one to be artificially low. The selection of an artificially low bid will, in turn, increase the likelihood of post tender dispute.

The results on how the quality of data had changed over time also supported the views stated within the interviews (charts 4.30-4.31, p.238-239 & p.213). Although the quality of work prepared for the non-specialists was higher than the specialists it showed a steeper decline more recently. However, despite this fact, the perceived ability of the quantity surveyor still remained high (chart 4.35, p.244). The opposite result was found on the specialist side. The ability of the quantity surveyor to produce quality information for the specialist contractor had remained consistently poor over time. This suggested an overall lack of expertise within the industry on specialist work (supported by charts 4.36 & 4.37, p.245-246). It also questioned the ability of the quantity surveyor to provide professional advice elsewhere within the construction process for specialist work. The overall tendency was also of concern for the non-specialists despite the ability of the quantity surveyor being perceived highly at present. If the quantity surveyors' ability to provide professional advice was impaired by understanding that was traditionally gained through measurement, then a fall in the volume of measurement could result in a loss of expertise in non-specialist work. The deterioration in quality was most apparent within recent years (chart 4.31, p.239). There may well be a time lag between the fall in quality of the measured data and overall loss of knowledge from within the industry. This being the case, the quantity surveyor would fail to provide the current level of service to the client.

All three representative bodies stated that one of the major problems they encountered in practice was a lack of understanding of specialist work by the quantity surveyor (charts 4.35-4.37, p.244-246). This supported views aired within the interviews that, as a result of a poor understanding, incorrect interpretation of the submitted prices would be made; the accuracy of valuations would be impaired and variations would be inappropriately valued. These would impact on the client in the form of increased cost, through potential overpayment, and increase the likelihood of post-tender dispute through under payment. It also allowed the profiteering of the main contractor to go unnoticed as the quantity surveyor would be oblivious to what the true costs were and what constituted a variation (table 4.5, p.208).

The main problem experienced by the non-specialists was stated as the 'basic care and attention' given to the measurement task (chart 4.35, p.244). In the first instance, the client would not be obtaining value for money for the fee paid to produce the bill - effectively paying for a service that was not being delivered. In addition to this, the lack of basic care and attention, would result in different assumptions being made by the non-specialist estimators, different prices being returned and, in turn, impairing the ability of the quantity surveyor to compare prices on an equal footing (table 4.5, p.208). Again, the impact on the client would be twofold – an increase in overall cost and increased likelihood of post-tender dispute.

Many of the above problems suggested that if measured work were supplied on behalf of the specialist contractor then this would increase the level of risk experienced and their overall cost (supported by chart 4.45, p.252). The opposite view was held for non-specialist work – the supply of measured work that was prepared on their behalf would reduce the overall cost of tendering. The industry survey posed this issue of cost directly (chart 4.45, p.252). The non-specialists concurred that an absence of measured work prepared on their behalf would indeed increase their overall price for a given construction project. In contrast, the specialists stated that their overall tender price would reduce if they did not have to deal with measured work prepared by a quantity surveyor.

The differing affects of bills on cost were further supported by each of the contractors views on the extent of remedial work required to generate a price (chart 4.15, p.442). The specialists stated that substantial levels of additional work were required and the non-specialists, that only a little additional work was typically required to generate a price.

Suggested solutions that were put forward by each of the two groups of contractor and further confirmed these findings. The non-specialists suggested an improved way forward as properly produced bills prepared on their behalf (chart 4.47, p.255) and the specialists wanted not to have to contend with bills of quantities at all (charts 4.48-4.49, p.257-258). The specialists also suggested that a change in the supply chain would improve the current situation. They suggested earlier involvement in the design process to help direct the attainment of a more effective design solution. As a minimum they wanted the performance requirements of a project stating so that they could innovate and generate their own solution around this (charts 4.48-4.49, p.257-258).

Overall, the industry survey helped to explain the background and rationale to many of the views expressed within the interviews. The overall price to the client was found to be cheaper when bills of quantity were produced for non-specialist trades (chart 4.45, p.252 & chart 4.15, p.442); it also reduced the likelihood of post-tender dispute. Conversely, bills were found to cause harm to the procurement of tenders from specialist trades. If bills were not produced for specialist work then both the price (chart 4.45, p.252 & chart 4.15, p.442) and potential for post-tender conflict would be reduced. Earlier involvement in the supply chain by the specialist would also bring about savings and eliminate the potential for the main contractor to profit further from contractual dispute (table 4.5, p.208; charts 4.48-4.49, p.257-258; chart 4.46, p.253 & chart 4.44, p.250).

5.2.4.3 Empirical testing of results

The two questions posed within the empirical testing stage served to finally confirm the affects of the impacts established within the interviews and industry surveys.

Accurate measured work was found to be infrequently prepared for specialist trades (chart 4.50, p.271) and frequently prepared for the non-specialist trades (chart 4.53, p.274). Finally, the non-specialists stated a strong preference for their work to be quantified by the quantity surveyor (chart 4.59, p.282) and, the specialists, for their work not to be quantified on their behalf by the quantity surveyor (chart 4.57, p.280).

These findings reinforced the results of the previous two stages and that, through compliance with these preferred sources of quantified information, the following detrimental impacts could avoided by the client:-

- Increased cost of the tendering process as a result of a duplication of the measurement task by the non-specialist contractor (table 4.4, p.197).
- Increased cost and likelihood of post-tender dispute due to the extent of quantification risk endured by the main contractor (table 4.5, p.208; chart 4.16, p.443; charts 4.48-4.49, p.257-258; chart 4.46, p.253 & chart 4.44, p.250).

- Potential overpayment of the work due to a lack of appreciation of the price build-up (p.213) and potential underpayment of the work due to a lack of appreciation of the price build-up leading to an increased likelihood of post-tender dispute (p.229-230).
- Potential for the contractors and, in particular, the main contractor to profit from the above ambiguities (table 4.5, p.208).
- *Additional allowances* included within bids to compensate for detrimental financial affects of current practice and the potential for post-tender conflict (table 4.5, p.208).
- Duplication of the above allowances at different levels within the pricing chain as a result of the lack of clarity (table 4.5, p.208).
- A reduction in the expertise of the quantity surveyor and ability to provide professional advice (p.213).
- The extent of additional work required by the non-specialist contractor to formulate a price and thus overall increase in cost (figure 4.9, p.212).
- Inaccurate valuations of interim payments, Final Accounts and variations (chart 4.10, p.437; chart 4.11, p.438; chart 4.13, p.440; chart 4.19, p.446; chart 4.20, p.447 and chart 4.21, p.448)
- Bids being evaluated on a different bases i.e. not on a like-for-like basis (chart 4.16, p.443) and paying the quantity surveyor a fee for a service that was not being adequately delivered i.e. bill production (p.213).

A further recommendation was a change in the position of the specialist contractor within the supply chain resulting in better value for money to the client (p.255-259).

5.2.4.4 Literature review

Table 5.5: Research question 4: Summary of research findings that are supported by the literature

Issue	Reference to literature	Comments
Extent of risk taken on board by the main contractor – taking on the risk of both the non-specialists and specialists (figure 4.9, p.212).	-	This has not previously been recognised or quantified by the existing literature. The in depth understanding gained by the research has identified how the risk is passed up the pricing chain to the main contractor (i.e. through qualification or the main contractor having to quantify the work themselves)
Increased cost to the client due to pricing risk, duplication of measurement, paying for work that is not undertaken, having to pay for quantification mistakes (either directly or through disputes) and paying a fee for a bill that is not delivered.	Skitmore & Wilcock (1994, p.139).	These findings are unique to the research. The extent of duplication and cumulative risk endured was found to be substantial, multiplied by the many layers within the pricing chain. The impact on the client was found to be substantial. The work of Skitmore and Wilcock is supported by the research – particularly when tender timescales were restricted.
Chance for the main contractor to profit from such poor practice.	-	This controversial area of practice had not been recorded elsewhere within the literature. Both the subcontractors and main contractors themselves admitted that the ambiguities brought about by current practice allowed them to profit.
Impaired ability of the quantity surveyor to give professional advice due to reduction in cost data.	Skinner, 1981, p.29; RICS, 2000 c, p.23 & 37; Coffey, 1992, p.4.	This was particularly evident on the specialist side. Of concern was the recent fall in bills being produced for the non-specialists and potential fall in expertise that this would entail. This research provided more substantive support to the isolated views of practitioners held within the literature.
Accuracy of the descriptions.	Swaffield, 1994 c, p.23; RICS, 2000 c p.23 & 37; HVCA, 1990. p. 64; Ardley, 1994, p.63; Trounce, 1982, p.45; Rimmer, 1984; Sims 1984 a, p.25; Shakeshaft, 1994.	Statistically significant responses were recorded by both groups of contractor. Despite the existence of isolated views of practitioners, no substantive work had been undertaken within the literature.
Accuracy of the quantities.	Swaffield, 1994 c, p.23; RICS, 2000 c p.23 & 37; HVCA, 1990. p. 64; Ardley, 1994, p.63; Trounce, 1982, p.45; Rimmer, 1984; Sims 1984 a, p.25; Shakeshaft, 1994.	Statistically significant responses were recorded by both groups of contractor. Despite the existence of isolated views of practitioners, no substantive work had been undertaken within the literature.
How logically the information is presented.	Rabbets, 1992, p.18 & Emmett, 1990, p.24 suggested that abuse occurred in practice but did not suggest what form this took.	The literature has not specifically covered this issue. The research therefore provides substantive views on an un-researched area of practice.
Level of detail.	Rabbets, 1992 & Emmett, 1990 suggested that abuse occurred in practice but did not suggest what form this took.	The literature has not specifically covered this issue. The research therefore provides substantive views on an un-researched area of practice.
Extent of additional work to derive a price	Rabbets, 1992 & Emmett, 1990 suggested that abuse occurred in practice but did not suggest what form this took.	The literature has not specifically covered this issue. The research therefore provides substantive views on an un-researched area of practice.
Suggested solutions: non-specialists preferred properly prepared bills of quantities.	Skinner, 1981, p. 29; Swaffield, 1994 c, p.23; RICS, 2000 c, p.23 & 37; Davies 1992, p.59-61; Coffey, 1992, p.4.	This research provided quantitative support to the isolated views of practitioners within the industry. It also, based on consequential affects found to occur, disregarded the Plan & Specification style of tender procurement as an economically viable method of procuring non-specialist prices. This marked a significant departure in current understanding – one that had not been previously addressed within the literature.
Suggested solutions: specialists preferred the work not to be quantified for them.	Swaffield, 1994 c, p.23; RICS, 2000 c, p.23 & 37; HVCA, 1990, p. 64; Ardley, 1994, p.63; Trounce, 1982, p.45; Rimmer, 1984; Sims 1984 a, p.25; Shakeshaft, 1994.	Although the effectiveness of the bill of quantities was brought into question by the literature, no detailed analysis had been undertaken to establish why (understood by the interviews) and provided substantive evidence to this effect (industry survey and empirical testing). The suggestion that the work should not be quantified for these trades therefore represents a significant change in current understanding.
Suggested solutions: Earlier involvement of the specialists within the supply chain.	Latham, 1994, p.30; RICS, 2000 c, p.24; Egan, 1998, p.22	The suggestion had been repeated within the literature but remained a matter of opinion based on the views of practitioners and views aired by the representative bodies (e.g. the HVCA and ECA via the SEGC who contributed to the Latham Report). This research quantified the views of the specialists' estimators and conclusively supported their preference for this type of arrangement. It also provided an economic basis for taking on board specialist expertise at the tender stage.

Table 5.5: Research question 4: Summary of research findings that are supported by the literature (continued)

Issue	Reference to literature	Comments
Inadequacy of the measured work to reimburse the specialist contractor.	RICS, 2000 c, p.23 & 37; HVCA, 1990, p.64 & 65.	Again, hinted by the views of practitioners within the literature but not based on any detailed understanding or widespread collection of views. This research provided both. The case of Henry Boot v. Alstom Combined Cycles illustrates the detrimental effect of this finding i.e. where the work is of a similar nature and executed under similar conditions then bill rates shall apply – even if the rates are unusually high or low. The profitability or otherwise of the rate is not relevant. Either the contractor or client will therefore be directly affected. (Brewer, 1999, p.24).
Adequacy of the measured work to reimburse the non-specialist contractor.	Swaffield, 1994 c, p.23.	This had been raised within the literature but not based on any detailed understanding or substantive views.
Recent decline in the ability of the quantity surveyor to produce accurate non-specialist work.	Pasquire, 1991.	Pasquire recognised an overall shift in the measurement task from the client-side to contracting-side of the industry. A number of commentators also expressed concern at the lack of involvement of the quantity surveyor. Previous research did not quantify such a recent decline in ability as highlighted by this research. This represents a significant area of concern for the industry.
Consistently poor ability of the quantity surveyor to produce accurate specialist work.	Swaffield, 1994 c, p.23; RICS, 2000 c p.23 & 37; HVCA, 1990, p. 64; Ardley, 1994, p.63; Trounce, 1982, p.45; Rimmer, 1984; Sims 1984 a, p.25; Shakeshaft, 1994.	Widespread criticism was evident within the industry, however, the research enabled this to be substantiated by a representative sample of estimators.
Lack of understanding by the quantity surveyor of specialist work.	RICS, 2000 c, p.37; QS 2000 (1991); Coffey, 1992, p.4.	This research quantified the isolated views contained within the literature.
Poorly interpreted prices and cost management as a result of the above.	Coffey, 1992, p.4.	The interviews identified that as the returned prices from specialist estimators were inconsistent and did not reflect actual cost (if forced to split the price down into bill items) then the ability of the quantity surveyor to accurately manage cost was impaired. The findings were confirmed during the industry survey where the specialists recorded their concern about the ability of bills to accurately value the work. Previous research has not obtained such a level of understanding.
Lack of basic care and attention displayed by the quantity surveyor when preparing non-specialist measured work	Rabbets, 1992, p.18; Emmett; 1990, p.24.	The extent of poorly prepared bills was estimated as being approximately 5% of the total industry workload and 'basic care and attention' confirmed as one of the major problems experienced in practice. Despite isolated views recorded within the literature the extent of such a lack of basic care and attention had not been previously recorded.
Increase in price if specialist work was measured for them.	-	This had not been previously recognised within the literature. This therefore represents a significant finding.

This research reveals a greater depth of knowledge than the existing literature. Many of the views cited within the literature represent the quantity surveyors' perception of the estimators' requirements and are, as such, not substantiated with any representative collation of data. This research has obtained representative views of the estimators. In itself this is a significant difference between this and previous research particularly when viewed in the context of Skinner's discrepancies between the perceived views of the quantity surveyors and actual needs of the estimators (Skinner, 1981, p.15).

The extent of risk endured in practice is an important finding. A number of further areas of importance are also recorded such as the practice of main contractors profiting from current processes, reduced ability of the quantity surveyor to cost manage specialist work, poor quality measured work for the specialists and good quality measured work for the non-specialists.

5.2.4.5 Summary

The research reveals that current practice causes significant levels of risk to be encountered within the pricing chain and increases the overall cost of construction. The main contractor, as coordinator of the price, takes the burden of these problems (figure 4.9, p.212). As a consequence, this impacts upon the client in the form of increased costs (at the tender stage) and in the form of an increased likelihood of contractual disputes (at the post-tender stage).

The contracting sector is well versed in the management of these risks and may frequently profit from ineffective pricing documentation. In practice, quotations from subcontractors are heavily qualified to counter potential disputes (table 4.5, p.208). Should the priced risks not come to fruition or the quantity of work decrease then savings are unlikely to be passed on to a higher level within the supply chain. The pricing of risks is often duplicated a number of times by the various levels within the pricing chain – further increasing the eventual cost. Specialist quotations, in particular, were found to cause confusion as to what had been allowed within their price and result in the contractor allowing for costs that may have already been incorporated. These problems were exacerbated within an extended pricing chain.

Specialists perceived that measured work did not allow their work to be accurately valued (chart 4.10, p.437; chart 4.11, p.438; chart 4.19, p.446; chart 4.20, p.447 and chart 4.21, p.448). This would also be compounded by large discrepancies found to exist between tender quantities and what was eventually built (chart 4.13, p.440). Specialists further considered that when work was measured on their behalf it did not allow their prices to be evaluated on a like-for-like basis with competitors (chart 4.16, p.443). The presence of client-supplied measured work for the specialist contractor would therefore increase the likelihood of post-tender conflict and increase the overall cost of construction – this therefore rendered the advice contained within SMM7 inappropriate. As confirmed by the industry survey, the client was also not reaping savings from the specialist contractor that could be obtained by their involvement at the tender stage (chart 4.44, p.250 and chart 4.46, p.253).

A low incidence of measured work for the non-specialist contractor (only 25% - chart 4.9, p.435) and poor quality of documentation (the latter estimated to be approximately 5% of the total industry workload) were found to increase the overall cost of construction (chart 4.45, p.252) and increase the likelihood of post-tender conflict. As the value of work that was not measured for these trades (and could be) was approximately 48% of their total workload (43% in Plan & Spec format and 5% as above) then the impact on the client was significant (figure 4.9, p.212).

Statistically significant results supported the worth of measured work for the non-specialist contractor and the detrimental effect if this was not provided (table 4.38, p.291). An absence of client-supplied measured work would impact upon the client in the form of increased cost and increased likelihood of post-tender conflict.

An indirect impact of current practice, resulting from the quantity surveyors reduced frequency in measurement, was also seen to be their ability to provide professional cost management expertise to the overall construction process. Ambiguities within tender documentation would impair their ability to understand the true cost of any one project (table 4.5, p.208). A recent decline in the ability of the quantity surveyor to accurately measure non-specialist work was therefore a cause for concern (chart 4.31, p.239).

The findings of the research provide evidence in support of many of the unsubstantiated assertions contained within the literature.

5.2.5 Can solutions be formulated to reduce the frequency and extent of the problems identified? (research question 5)

5.2.5.1 Interviews

The initial stage of the research enabled all of the different types of problems that surfaced during the interviews to be sourced back to a common theme – the format of the pricing documentation. More specifically the source problems related to a mismatch between the requirements of the contractor's estimator and the format of pricing documentation that was supplied to them (figure 4.8, p.206). Far from being of a superficial nature, these *preferences* were identified as being deeply rooted in the wider practices and knowledge base of the industry (figures 4.4 & 4.5, p.190 & 191).

Solutions were forthcoming from the interview stage of the research. These were identified as being capable of reducing the frequency and extent of problems that were identified. The level of agreement about these solutions by the estimators interviewed suggested that they could indeed be acceptable to the industry as a whole (p.214).

For the specialist trades it was proposed that prices should be obtained on a consistent non-quantified basis. This principal covered both situations where the design was substantially complete and where it was not substantially complete. The former therefore constituted a departure from traditional advice as the Standard Method recommended quantifying the works when the design was substantially complete.

Furthermore, it was proposed that the position of the specialist contractor within the supply chain should be amended on two fronts (p.215). Firstly, that the specialist should have a closer link with the client and/ or client's representatives in order to provide a greater input into the design process. This could, given sufficient complexity, be prior to tenders being sought and, without exception, at the design stage. Secondly, it was proposed that the specialist contractor should be more closely aligned to the client at the post-tender stage e.g. a direct contractual link and partnering approach. Both proposals bypassed the main contractor.

For the non-specialist contractor it was proposed that pricing documentation should always be prepared in a quantified format i.e. in accordance with SMM7 (p.214). In accordance with this proposal, it was proposed that the Plan and Specification form of procurement should not therefore be applied in practice. Despite purported benefits to the client, the contractors found this approach to be harmful to effective pricing. In a similar vein to the specialists, this proposal constituted a departure from current procurement advice.

Adherence to these solutions is believed to be likely to result in a reduction in the overall frequency and extent of problems currently encountered. In turn, the detrimental impacts encountered by the client would be mitigated by (table 4.5, p.208; table 4.6, p.211 and figure 4.9, p.212):-

- Reducing the cost of the tendering process by eliminating the duplication of the measurement task undertaken by the non-specialist contractor.
- Reducing the cost and likelihood of post-tender dispute due to a fall in the extent of quantification risk endured by the main contractor.
- Reducing the potential overpayment of the work due to a lack of appreciation of how the price had been built-up.
- Reducing the potential underpayment of the work due to a lack of appreciation of the price build-up leading to an increased likelihood of post-tender dispute.
- Reducing the potential for the contractors and, in particular, the main contractor to profit from the above ambiguities.
- Reducing *additional allowances* included within bids to compensate for the detrimental financial affects of current practice and the potential for post-tender conflict.
- Reducing potential duplication of the above allowances at different levels within the pricing chain as a result of ambiguity.

- Ensuring that the quantity surveyor receives priced documentation that better reflects the cost base of the tendering contractors and thus maximising their ability to provide professional advice.
- Reducing the likelihood of inaccurate valuations of interim payments, Final Accounts and variations.
- Ensuring that bids are evaluated on a like-for-like basis.
- Ensuring that the quantity surveyor is only paid for the services provided.
- Maximising the likelihood of cost savings by involving the specialist within the design process.

5.2.5.2 Industry survey

The industry survey tested out these findings and found statistically significant levels of support for the proposed solutions.

Direct questioning about the solutions that were most appropriate confirmed that the non-specialists required bills to be prepared for them (chart 4.47, p.255). The specialists also confirmed that they did not require bills and, instead, would prefer non-quantified tender documentation (chart 4.48, p.257 & chart 4.49, 258). A number of related questions also served to confirm that the interview findings were representative of the wider industry e.g. that the non-specialist prices would rise if they were forced to quantify the work and the specialists would reduce (chart 4.45, p.252). Further related questions, covered elsewhere within the discussion chapter, validated the background to the problems experienced and the rationale behind each of the two contractors stated preferences.

The industry survey also confirmed that greater involvement of the specialist within the design would be of benefit to the client. This was directly proposed by the specialists themselves (chart 4.49, p.258) and also supported by a number of related questions e.g. how their price for a project would alter if they were given the freedom to design the work or specify materials (chart 4.44, p.250 & chart 4.46, p.253).

It is important to note the statistical significance of the results recorded within the analysis of data section. The analysis revealed that, not only were the results statistically significant, but also that no unexpected variances were recorded between the two specialist representative bodies or between the specialists and non-specialists (table 4.17, p.464 – table 4.36, p.475). Furthermore, the results were consistent with the rationale developed during the interviews - statistically significant differences in opinion were recorded between the specialists and non-specialists for questions relating to the abilities of the quantity surveyor and quality of data provided (table 4.10, p.458). Statistically significant levels of agreement were recorded about the quality of internally supplied data (i.e. in-house) and proposed solutions for each classification of contractor (table 4.17, p.464 – table 4.36, p.475). Overall, this revealed a high level of support to the direction of the research programme.

5.2.5.3 Empirical testing results

Final validation was provided during the empirical testing stage.

The two key solutions were confirmed as the non-quantification of specialist work (chart 4.57, p.280) and for the quantification of non-specialist work (chart 4.61, p.284). The same pattern of results was revealed as for the industry survey – the specialists and non-specialists showed statistically significant levels of agreement about what the solutions should be for one another (chart 4.58, p.281; chart 4.60, p.283). Furthermore, the two specialists recorded no unexpected statistically significant differences of opinion (chart 4.41 & chart 4.42, p.453 & 454).

The background quality of tender documentation was also validated in terms of how frequently accurate measured work was supplied in practice (chart 4.62, p.287 – chart 4.63, p.288).

These results were based on a relatively large sample of the representative bodies involved (309 responses).

5.2.5.4 Literature review

Table 5.6: Research question 5: Summary of research findings that are supported by the literature

Issue	Reference to literature	Comments
Non-specialist work to be quantified on their behalf.	Skinner, 1981; p.29; Pasquire 1991, p.215; Swaffield, 1994 c, p.23; Eccles, 1992, p.7.	This research provided quantitative support to the isolated views of practitioners within the industry.
Abolition of the Plan & Spec method of procurement.	-	The above findings also, based on the consequential affects found to occur, disregarded the Plan & Specification as an economically viable method of procuring non-specialist prices. This marked a significant departure in current understanding – one that had not been previously addressed within the literature.
Specialist work not to be quantified for them (both when the design was complete & when it was not complete).	Swaffield, 1994 c, p.23; RICS, 2000 c, p.23 & 37; HVCA, 1990, p. 64; Ardley, 1994, p.63; Trounce, 1982, p.45; Rimmer, 1984; Sims 1984 a, p.25; Shakeshaft, 1994.	Although the effectiveness of the bill of quantities was brought into question by the literature, no detailed analysis had been undertaken to establish why (understood by the interviews) and provided substantive evidence to this effect (industry survey and empirical testing). The suggestion that the work should not be quantified for these trades therefore represented a significant change in current understanding. This proposal is further supported by the findings of Carr (1965, p.550) reporting on the intrusiveness of operational bills on the contractor's decision-making process and inadequacy of prescriptive decisions made by the quantity surveyor.
Specialist work to be procured in a consistent manner.	-	The lack of consistency has not been previously identified as a problem within previous research.
Specialist contractor to play a more proactive role in the design process.	Latham, 1994, p.30; RICS, 2000 c, p.24; Egan, 1998, p.22.	The suggestion had been repeated within the literature but remained a matter of opinion based on the views of practitioners and views aired by the representative bodies (e.g. the HVCA and ECA via the SEGC who contributed to the Latham Report). This research has quantified the views of the specialist estimators and conclusively supported their preference for this type of arrangement. It has also provided an economic basis for taking on board specialist expertise at the tender stage (i.e. a business case).
For the specialist to have a direct contractual link with the client and even act as the main contractor (if the contract value warrants such a change in position and provided that the specialist has sufficient management expertise).	RICS, 2000 c, p.24; Langford, Kennedy & Sommerville (1992, p.65 & 66).	Of notable interest are the views expressed by the RICS M&E Panel within their Building Services Procurement Guide. Advice on the procurement of prices from these trades is seen to be contradictory of the traditional method of procurement. This research provides substantive findings in support of this proposal.

Previous research has failed to delineate the overall "*problem*" of measurement into anything other than an industry wide problem. As a result of this, the literature is littered with a plethora of diverse views on the subject that, until now, have been left unexplained (in terms of how they relate to one another).

McDonagh summarised his own perceptions of the situation at the 1992 measurement conference, The Nottingham Trent University:-

> "In their haste to become contemporary and futuristic, many quantity surveyors are promoting the view that SMMs, BQs and therefore measurement are no longer key functions of the profession........so has developed the intellectual confusion that equates all measurement with BQs and SMMs and which fails to isolate and identify measurement as a basic core skill fundamental to all areas of the entire practice of contemporary quantity surveying." (McDonagh, 1992).

This research has recognised two distinct subdivisions to the measurement problem. These are found to emanate from the differing demands and problems encountered by two groups of contractor - *specialists* and *non-specialists*. This research; based on a detailed understanding of the underlying issues, provides a rationale behind these diverse views.

In contrast to previous detailed solutions, this research has maintained a conceptual overview and sought to identify, in principal, how the pricing documentation should be presented. On this premise, the research has identified that significant levels of non-specialists require the work to be measured for them. In addition, significant levels of specialists do not require their work to be quantified for them. They have developed their own unique methods of pricing work that are not consistent with the Standard Method.

The research also proposes changes to the position of the specialist contractor within the supply chain (both pre and post-tender) and the abolition of Plan & Specification methods of procurement for non-specialist contractors. Both suggestions are supported by the representative views of estimators.

5.2.5.5 Summary

All of the problems encountered in practice were sourced back to a common theme – a mismatch between the needs of the estimator and the format of pricing documentation supplied to them. The research has revealed that solutions can be formulated to reduce the frequency and extent of the problems identified.

The level of agreement, tested statistically and proven to be significant at the 5% level, suggests that the formulated solutions are acceptable to the industry. The solutions are directed towards the two classifications of contractor (chart 4.62, p.287 & chart 4.63, p.288).

It is proposed that specialist pricing documentation should not be quantified on their behalf but, instead, procured in a consistent *non-quantified* format. The need for consistency is highlighted by the failings of the Elemental Bills (Kodikara, 1990, p.17 & literature review, p.34). They should also play a more active role within the design process and have direct contractual links with the client. As only about 1% of their workload is measured for them, compliance with the proposal not to quantify will not signify a substantial departure from current practice; the standardisation of non-quantified prices, involvement at the tender stage and direct contractual links, will however. Approximately 29% of the total industry workload is procured from specialists and the majority of this is currently in an inconsistent non-quantified format.

The research also proposes that pricing documentation should always be quantified on behalf of the non-specialist contractor. This represents a significant change in current practice equating to approximately 42% of the total industry workload (figure 4.9, p.212). This would also eliminate the duplication of the measurement task that results in the entire project being quantified between an estimated 2.68 to 6.88 times over. It is further proposed that more stringent control measures are implemented to ensure that the quality of bills are maintained – in reality, this will be more difficult to bring about.

Both solutions are recognised to have a substantial impact on reducing the frequency and extent of the problems identified and have gained widespread acceptance from the relevant representative bodies (table 4.38, p.291).

5.2.6 Can revisions to the processes commonly adopted in the preparation of pricing documentation be proposed and evaluated? (research question 6)

5.2.6.1 Results of the research

The proposed solutions generated by the research also indicate what the format of the pricing documentation should be i.e. what the end product should look like (chart 4.62, p.287 & chart 4.63, p.288). The solutions were based upon an understanding of what the current processes were, found to be predominantly of a reactionary nature to counter the affects of insufficient tender documentation, and also what the desired processes were.

A change in the format of the end product, as proposed by the research, would therefore also bring about changes in the processes commonly adopted in the preparation of tender documentation. The need to adopt reactionary processes, as highlighted above, would therefore be eliminated (table 4.5, p.208). The revised processes would correspond with those preferred by the contractor's estimators and in no way need to be enforced (endorsed by table 4.38, p.291).

Quantification of the work for the non-specialists, as proposed, would relieve them of current enforced processes of having to quantify the work themselves. Both the non-specialist subcontractor and the main contractor, particularly the latter, would no longer need to carry out this task. As a result, the consequential affects, and processes to deal with them, would no longer need to be carried out (figure 4.9, p.212).

More specifically, the duplication of the measurement task would be eliminated, as would the need to safeguard against areas of potential post-tender dispute through qualification of the tender etc, measures taken to mitigate against the risk of underpayment and the need to identify and quantify areas of potential risk. Avoiding a duplication of the measurement task would have a significant affect on the industry (table 4.6, p.211).

As a consequence of the above, the processes adopted by others within the pricing chain would also be affected. A reduced level of qualification would reduce the level of risk management typically undertaken by the main contractor. A fall in the overall level of post-tender conflict, variations and claims would additionally reduce the need for processes to be put in place to identify and monitor these. This could have a substantial impact upon the industry (figure 4.6, p.194 & figure 4.7, p.203).

The changes in process may therefore be viewed at two levels – those affected at the tender stage (e.g. risk management and duplication of the measurement task) and those at the post-tender stage (management of variations etc).

The non-quantification of specialist work, as proposed, would relieve the specialist estimator of enforced processes to deal with quantified work (item g, figure 4.7, p.203). As such a low proportion of the specialists workload is actually measured (approximately 3% by value) this would have less of an impact (figure 4.9, p.212). The specialists reported significant problems with inconsistencies in non-quantified information. Standardisation of the format of non-quantified prices from these contractors would therefore reduce these inconsistencies and the processes required to deal with them. The specialists would not have to back-fit their prices to the measured or poorly itemised work, nor deal with post-tender conflict, nor the need to qualify their tenders in as much detail (table 4.5, p.208). The main contractors would also have to contend with less risk and their processes put in place to deal with such (item 2.1, table 4.5, p.208). At the post-tender stage, the specialist would no longer need to establish processes to capture, value and mitigate the affects of post-tender conflicts.

Similarly, the processes put in place by the main contractor and client's representative to deal with the post-tender conflict would be substantially reduced.
A change in the position of the specialist at the tender stage would help the client to create a better value for money design solution (chart 4.44, p.250 & chart 4.46, p.253). Proposals generated from this would inevitably require vetting by an independent professional – a potential role for the engineering consultant or even quantity

surveyor. This in turn, through better communication of the client's needs, would help to ease the pricing process for the specialist contractor.

A change in the contractual relationships post-tender would require direct contracts to be drafted between the client and specialist contractor. The case of Aurum Investments Limited –v- Avonforce and others highlights the duty of care placed upon contractors to warn against design deficiencies if reasonable to do so (Brewer, 2001, p.25).

The interviews revealed that the incidence of nomination was virtually non-existent. However, the financial and performance benefits established within this research provide sufficient grounds to question current practice (table 4.5, p.208; table 4.6, p.211 & figure 4.9, p.212). The main contractor would therefore no longer be required to maintain processes to manage post-tender conflict (table 4.5, p.208).

Responsibility for the design will need to be clearly defined within the contract documentation and indicate how the services of the specialist are being procured (between the two extremes of):-

1) **Performance** – where the specialist contractor provides the overall design solution.
2) **Prescription** – where the solution is dictated by the client and means of achieving left to the specialist contractor (RICS, 2000 c, p.9; Latham, 1994 p.30 & Atkinson, 2001, p.16).

5.2.6.2 Literature review

Table 5.7: Research question 6: Summary of research findings that are supported by the literature

Issue	Reference to literature	Comments
Elimination of reactionary processes (table 4.5, p.208).	-	Previous literature has failed to identify the reactionary processes carried out in practice (e.g. qualifications of tenders, specialists bracketing bill items together and non-specialists refusing to price).
Duplication of measurement.	-	Again, this has not been identified to the same extent by previous research.
Procedures set up to deal with the inherent risks of current practice:		
- Tender stage (e.g. risk management and duplication of measurement).	-	Not recognised by previous research.
- Post-tender (claims management and variations management).	Skinner, 1979, p.214; Langford, Kennnedy & Sommerville, 1992, p.65 & 66.	The occurrence of claims is well documented within the literature. However, the literature has failed to address the extent of these procedures i.e. undertaken by each contractor within the pricing chain (as opposed to just the client).
Need for collateral warranties/ direct contracts to be drawn up between the client and specialist – also consider the main contractor/ specialist relationship.	Supportive cases: Williams v. Fitzmaurice, 1858. (Brewer, 2001, p.25).	-

Inevitably, as the literature has failed to gain an understanding of the reactionary processes encountered in practice no appreciation has been gained about the benefits brought about by a change in how prices are procured.

5.2.6.3 Summary

As the suggested proposals reflect the needs of the contractors' estimators, an enforced change in processes is not required chart (4.62, p.287 & chart 4.63, p.288). The proposals will enable the detrimental affects of current practice to be eliminated (table 4.6, p.211).

Duplication of the measurement task will be eliminated (which will have a significant affect on practice) and reactionary processes will no longer need to be implemented (both at the tender and post-tender stages).

5.2.7 Can revisions to the pricing methods commonly adopted (in light of the above) be proposed and evaluated? (research question 7)

5.2.7.1 Results of the research

Exactly the same rationale will apply to the *methods* of pricing as explained within the processes section. Revisions to the pricing methods will naturally flow from a change in the format of pricing documentation. There will be no need to enforce or bring about a change in the pricing methods adopted, as the tendering contractors will automatically carry these out (chart 4.62, p.287 & chart 4.63, p.288).

The quantification of non-specialist work on behalf of both the main contractor and non-specialist subcontractors will enable them to revert back to pricing quantities by the client-side. The non-specialist estimators' pricing will no longer need to rely on their internally produced data or inconsistent data produced by those requesting a price at a higher level within the hierarchy. It will become an automatic exercise of pricing what is described (figure 4.9, p.212).

The specialist contractors, without the enforced need to price client-supplied quantities will be able to rely on their own methods of pricing. In essence, their actual method of pricing will remain unchanged, however; the need to back-fit this arbitrarily would be eliminated. As the incidence of quantification on the client-side is minimal, this will have less of an affect on practice.

In practice the specialists find that current pricing documentation is typically arranged in a format that loosely follows the Standard Method but is presented as itemised descriptions. A more consistent approach to the procurement of non-quantified prices from specialists would also allow the contractors to standardise their methods of pricing. This would have a substantial impact on current practice. Their method of pricing would no longer involve arbitrarily back-fitting to inconsistent items (Kodikara, 1990, p.17 & literature review, p.34).

Overall, the proposed solutions will allow the industry to price the works in the most appropriate manner. They will no longer be required to apply different pricing methodologies to the differing formats of pricing documentation (table 4.6, p.211 & figure 4.9, p.212).

5.2.7.2 Literature review

A lack of detailed appreciation of current practice and thus how the methods of pricing are altered by current practice is apparent within the literature.

The existing body of knowledge does not therefore address how current methods of pricing may be altered by the proposed solutions (table 5.6, p.342).

5.2.7.3 Summary

In exactly the same vein as the last section, the proposed solutions will reflect the estimators' preferred methods of pricing. As a result, the methods of pricing will alter from those typically undertaken. However, changes in the methods of pricing will not need to be enforced as these will follow naturally.

The non-specialists will be able to revert to a situation where they price client-supplied quantities. The specialists will also no longer need to back-fit their prices in an inconsistent manner. The proposals will enable specialist prices to be procured in a consistent format.

5.3 Summary of findings about the research problem

The overall research problem is to address how the effectiveness of documents used in competitive construction tendering may be improved.

This research has developed a detailed understanding of the processes commonly adopted in the preparation of tender documentation. The findings are summarised below:-

- A review of the estimators' behavioural responses to differing formats of pricing documentation has enabled two separate groups of contractor to be established – *specialists* and *non-specialists*. Each was found to have differing characteristics and to react differently to alternative formats of pricing documentation.
- Specialists stated a preference for their work not to be quantified for them – they preferred the pricing documentation to be non-quantified and for this to be produced in a consistent format. The non-specialists stated a strong need for their work to be quantified on their behalf and were satisfied with the traditional format using SMM7. Far from being of a superficial nature, the needs of both parties were found to be deeply rooted within the wider practices of the industry and founded on issues such as the completeness of design, level of design input by the contractor, quality of training of the professionals involved and post-tender treatment of the pricing documentation etc (figure 4.4, p.190 & figure 4.5, p.191).
- Such a macro level understanding, taking into account the needs of subcontractors and interfaces within the pricing chain, has not previously been attempted (table 5.2, p.307).
- Significant gaps are evident within the existing body of knowledge that are addressed by this research project. An understanding of the typical format of pricing documentation has been obtained by contractor type; this is critical to understanding the frequency that problems occur and the worth of any potential solution (figure 4.9, p.212; charts 5.1 & 5.2, p.306).

- The current format of pricing documentation was found to cause significant problems in practice and to increase the overall level of risk endured (table 4.6, p.211).

An evaluation of the effectiveness of current pricing documentation enabled the problems commonly encountered by constructors to be assessed:-

- Current documentation was found to be ineffective.
- Furthermore, current documentation was found to have a detrimental affect on the industry (table 4.7, p.261).
- Current pricing documentation was found to increase the amount of duplication encountered, increase the overall workload of the industry and resultant cost, increase the likelihood of post-tender dispute and, overall, increase the risk endured by the industry (table 4.7, p.261).
- The extent of duplication was significant and exacerbated the problems highlighted above (table 4.6, p.211).
- Poor quality pricing documentation also meant that the quantity surveyor was less able to accurately value the works or provide added value (items 11d-f, table 4.7, p.261).
- Problems were classified as belonging to one of two groups:-
    - *Matters of principal* – a fundamental mismatch in the need for a particular format of pricing documentation and the format that it is actually supplied in.
    - *Matters of practice* – abuse of the standard conventions in practice (e.g. *non-quantified itemised schedules*) rendering the documentation ineffective.

Of concern was the recent decline in the ability of the quantity surveyor to produce accurate quantified information for the non-specialist (chart 4.30, p.471 & chart 4.31, p.472). This may well impair their ability to add value in the future both in terms of a quality service to the client (e.g. accurate cost reporting, estimating, input in value engineering etc) and to the contractor (e.g. accurate valuations of work, valuation of variations etc).

The frequency and extent of each category of problem and its impact upon the relative accuracy of the pricing process enabled the extent of risk taken by the main contractor to be evaluated:-

- Principal differences in the desired format of information were most apparent on the non-specialist side (figure 4.9, p.212). Approximately 41% of the total industry workload was not in the desired format of the non-specialist contractor. Approximately 15% of this had to be quantified by the non-specialist subcontractors and the balance (of 26%) required to be measured by the main contractor (11% of their own workload and 15% on behalf of the non-specialist subcontractors) – table 4.4, p.197.
- The lack of measurement undertaken by the client-side resulted in the measurement task being duplicated by the non-specialist contractors. In total the extent of duplication endured by the non-specialists was estimated to be the equivalent of the entire project being measured between 2.68 and 6.88 times (table 4.4, p.197).
- Approximately 5% of non-specialist work was also poorly prepared (chart 4.8, p.434 & chart 4.9, p.435).
- About 3% of the specialists' workload was in the undesirable quantified format (chart 4.9, p.435).
- The specialists also encountered substantial problems with the inconsistent format of non-quantified work – this represented 29% of the total industry workload (p.207).
- The results have been tested on representative bodies and found to be statistically significant at the 5% level (table 4.10, p.458 – table 4.16, p.463). Specialist views were negative about the appropriateness of measured work for pricing. Of more concern was the inability of measured work to reimburse the specialist contractor – a problem further exacerbated by substantial post-tender changes. They also considered that bills did not allow their work to be evaluated against competitors on a like-for-like basis (question 11a, chart 4.10, p.437).
- The opposite tendency was confirmed for the non-specialists – they found billed information to be useful for tender preparation, appropriate to

reimburse them financially and also enable their work to be evaluated on a like-for-like basis (table 4.10, p.458).

- The problems identified in practice were found to occur frequently and significantly impair the effectiveness of the tendering process (table 4.7, p.261).
- The above research findings were predominantly overlooked by the literature. Those that had been covered were based on supposition from practitioners (table 5.2, p.307 – table 5.7, p.348).

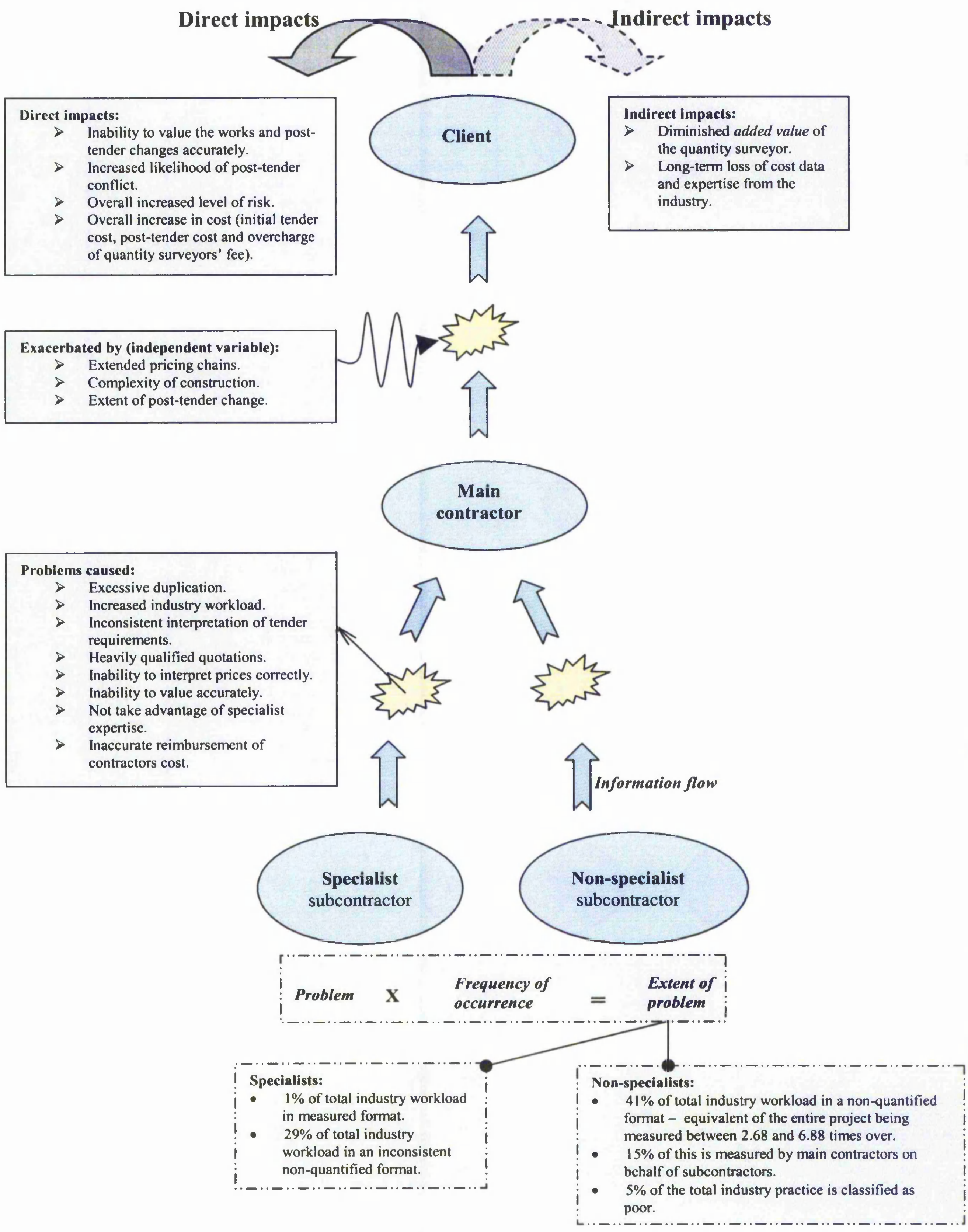
The research revealed that the level of exposure to risk experienced by the constructor has a direct and significant impact upon the client. The findings are summarised as follows:-

- As central coordinator of the pricing process, the main contractor takes on the majority of risk at the pricing stage (table 4.6, p.211).
- Contractors are well adjusted to the management of risk brought about by ineffective pricing documentation and include additional cost within their prices to compensate for such (table 4.5, p.208).
- Ambiguity in pricing brought about by ineffective documentation leaves those further up the pricing chain unsure whether the risks have been priced. Current practice therefore increases the likelihood of priced risk being double-counted (table 4.7, p.261).
- The level of risk was found to impact directly on the client in terms of increased cost. These costs are exacerbated within an extended pricing chain and more complex forms of construction (table 4.7, p.261).
- The presence of client-supplied measured work for the specialist was seen to increase the level of risk and cost to the client (chart 4.45, p.252 & table 4.7, p.261).
- The results also confirmed that the client was not receiving the savings generated from earlier involvement by the specialist contractor – a further impact (chart 4.44, p.250; chart 4.46, p.253).
- The gap in demand for measured work to be prepared on behalf of the non-specialist contractor significantly increased the cost and post-tender

conflict to which the client is exposed. Approximately 41% of practice failed to meet the quantified needs of the non-specialists, multiplied by the extent of duplication; this effectively amounted to the entire project being measured between 2.68 and 6.88 times over (table 5.1, p.301).

- Significant costs were therefore borne by the industry and subsequently by the client. The adoption of a non-quantified form of procurement, although initially cheaper to the client (by saving on bill production fees), contains hidden costs of duplication and priced risk brought about by ambiguity and time constraints in pricing (table 4.7, p.261).
- Poor practice, in the form of non-quantified itemised schedules, represents approximately 5% of the total industry workload and further increases the cost and potential for post-tender conflict (chart 4.6, p.226; chart 4.8, p.434; chart 4.9, p.435).
- An indirect impact, that of a diminishing added value of the quantity surveyor, was also identified through a fall in the incidence of measurement for the non-specialists (p.213).
- Overall, the client incurs significant levels of additional cost and is exposed to greater levels of post-tender conflict as a direct result of current practice (table 4.5, p.208). Furthermore, the client does not maximise the potential of the quantity surveyor or the expertise of the specialist contractor within the decision making process (chart 4.44, p.250; chart 4.46, p.253). Figure 5.1 (p.356) illustrates these points:-

Figure 5.1: Problems caused by current practice and impacts upon the client



The research revealed that solutions can be formulated to reduce the frequency and extent of the problems identified:-

- By meeting the stated needs of the two classifications of contractor (specialists and non-specialists) it was established that current problems could be overcome (chart 4.57, p.280; chart 4.61, p.284).
- The research proposes that specialist work should not be quantified on their behalf in the traditional manner. Instead, their work should be procured in a consistent non-quantified format. The Pricing Schedule contained within Appendix A of the Building Services Procurement Guide is considered to be a suitable replacement (RICS, 2000 c, p.44).
- It is also proposed that the specialist contractor should have a direct involvement in pre-tender decision making and, post-tender, have contractual links with the client. The research reveals that better value for money can be obtained from utilising the specialists' expertise in this manner (chart 4.44, p.250; chart 4.46, p.253). The specialist would still be able to price work in accordance with the aforementioned Pricing Schedule and thus help to create a consistent database of cost (Kodikara, 1990, p.17 & literature review, p.34). In turn, through analysis, the added benefit of the quantity surveyor may be more fully utilised.
- The research also proposes that non-specialist work should always be quantified on their behalf (supported by chart 4.61, p.284). More stringent control measures are required to ensure that bills that are purported to be in accordance with the Standard Method and charged accordingly to the client do in reality comply. The research does not propose any solutions as to how this may be achieved. The former proposal, that of always preparing bills for the non-specialist sector, may have less relevance when the act of bill preparation delays the overall project and costs the client more in the process (i.e. fast-track methods of procurement). However, it is argued that this counter view is often a falsehood. In terms of cost, the client will pay for the increased cost of duplication and encounter an increased level of post-tender dispute when bills are absent – not purely benefit from a reduction in fee and early completion. In terms of time, the contractors still have to quantify the works themselves (amounting to the entire project

being measured between approximately 2.68 and 6.88 times over) – table 5.1, p.301). It therefore seems illogical to suggest that this approach could save time. It is also recognised that many of the delays incurred in construction relate to poor pricing documentation (often resulting in the inability of the contractor to continue the work through insolvency etc) - Moore, 1984, p.31. In accordance with the views from the industry, it is argued that the proposed solution to prepare bills for non-specialists holds firm (chart 4.63, p.288).

- Both proposals (not to quantify specialist work and to quantify non-specialist work) were found to be statistically significant at the 5% level (chart 4.38, p.450).

5.3.1 An overview of other industries

Although it is not the intention of this section to draw detailed comparisons with other industries it is worth noting the main similarities.

Both the industrial engineering and civil engineering sectors of the UK building industry have developed their own standard methods of measurement. A joint document was published in 1984 for the industrial engineering sector - The Standard Method of Measurement for Industrial Engineering Construction published by the RICS and ACE. This covers trades such as Instrumentation, Scaffolding, Ductwork, Pipework, Electrical and Insulation. The civil engineering standard method is also now in its third edition (1991) and, of particular relevance, does not incorporate complex mechanical or electrical works (clause 2.2, p.5). In keeping with the findings of this research the civil engineering standard method advises that such work should be itemised (i.e. not *quantified*) in sufficient detail for the tenderers to price it accurately.

5.3.2 An overview of other countries

In a similar vein this section only intends to highlight areas of interest relevant to the research. Methods of measurement are evident within other countries as tabled below:-

Table 5.8: Examples of standard methods of measurement in existence within other countries

Country	**Standard method of measurement**
Belgium	Code de mesurage.
Finland	Building 80.
France	Mode de métré normalisé – Avant and Métré et devis quantitatif des ouvrages de bâtiment.
Germany	VOB/C – Verdingungsordnung für Bauleistungen – Part C.
Netherlands	Nen 3699 and Standard Measurement of Net Quantities for Material and Activities of Building.

<u>Source:</u> Hore, A.V., Kehoe, J.G., McMullan, R. & Penton, M.R. 1997. Construction 1 – Management, Finance, Measurement. MacMillan Press Ltd. p.123

In particular, a review of tendering procedures in France reveals some key similarities with the proposals of this research.

The predominant procurement method is known as the *Lots séparés* (separate trades) system where each lot is let separately (Pearson, 1994, p.18). The specialist *enterprises* (contractors) are separately employed by the clients and are responsible for the detailed design of the work they execute and quantification thereof – as proposed for specialist contractors by this research. This is an important similarity between this research and current practice in France. They also measure the work to suit their own methods of measurement (their own *bordereau*) – again, in keeping with the findings of this research.

Design input in France tends to be limited to conceptual design providing the client with more flexible arrangements for sharing design responsibilities between consultants and contractors. Responsibilities for organising the work on site are traditionally quite loosely defined.

As a more recent development the large firms have attempted to totally integrate the design function to provide an all-in service to the client. The *démarche ensemblière* (all in or package deal approach) provides more intensive management of the design and poses a threat to the traditional roles of independent consultants.

5.4 Summary

The research problem has been addressed comprehensively by the research process. Proposals have been generated to improve the effectiveness of documents adopted in competitive construction tendering.

Current methods were not only found to be ineffective but also detrimental to the overall pricing process. The two groups of contractor identified, *specialists* and *non-specialists*, both reacted adversely to current methods of procuring prices (table 4.9, p.456 – table 4.16, p.463). The non-specialists endured significant levels of duplication. Inconsistent and inappropriate documentation was also apparent on the specialist side. The overall cost and likelihood of post-tender dispute were significantly increased by the current methods adopted (summarised in figure 5.1, p.356).

As central coordinator of the price, the main contractor was found to take on the majority of this risk. The research revealed that the level of exposure experienced by the main contractor had a direct impact upon the client. Additional costs were included and often duplicated throughout the pricing chain. The potential for post-tender conflict was also significantly increased (table 4.5, p.208 and tables 4.9-4.16, p.456-463). Furthermore, the client was not benefiting from expert advice potentially available from the specialist (chart 4.44, p.250; chart 4.46, p.253).

Proposals were generated by the research and found to be acceptable to the end users of the pricing documentation. Statistically significant results were found at the 5% confidence level to support the suggestions that:-

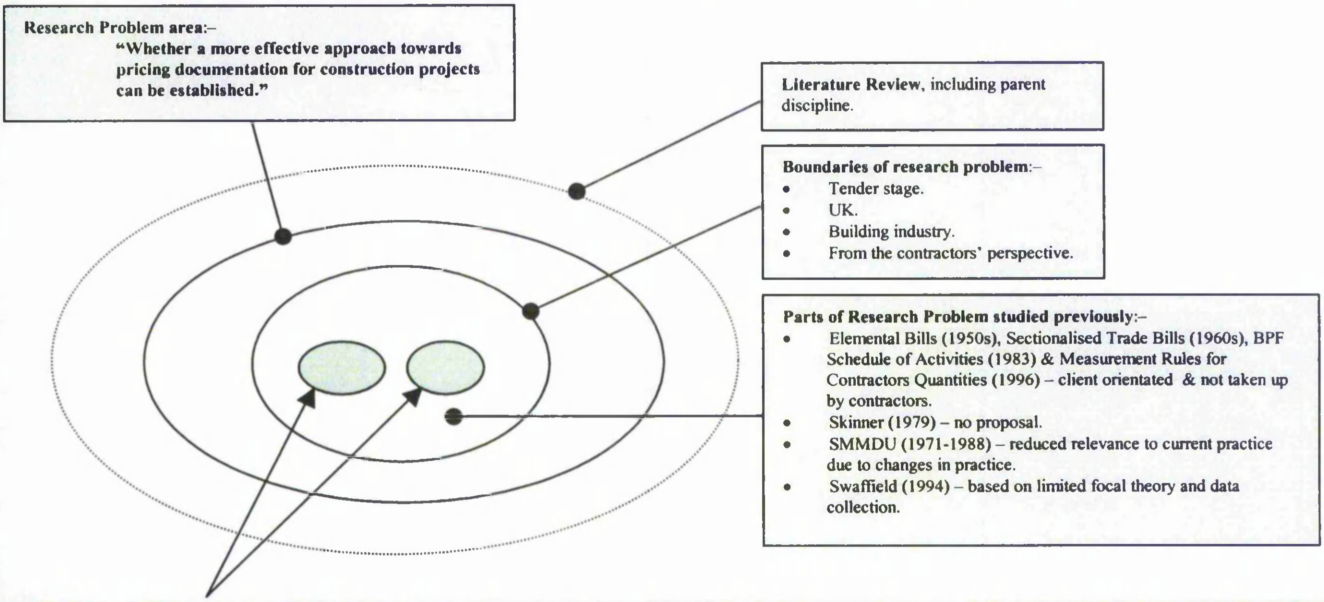
- Specialist work should not be quantified on behalf of the estimator (even when the design is complete) and instead procured in a consistent non-quantified format.
- Specialists should be involved in the pre-tender decision-making process and, post-tender, have direct contractual links with the client.
- Non-specialist work should always be quantified on their behalf signifying the abolition of the Plan & Specification form of tender procurement.

The research also revealed that, such changes in format of the pricing documentation did not require the processes and methods employed by the tendering contractors to be enforced. These would flow naturally – non-specialists would be able to price client-supplied quantities direct, specialists could also apply their own methods and present these in a standard format.

Much of the literature is contradictory on the required methods of procuring tenders from the two groups of contractor. The majority of views in support of the research findings are also based on the opinions of practitioners – not on any substantive data collection or analysis (table 5.2, p.307 – table 5.7, p.348). This research provides a cohesive and logical explanation of the estimators' preferences and how these can be met in practice.

Figure 5.2 (p.363) provides an overall summary of the entire chapter. The results of the research are compared against the original research questions and also against the research problem. This serves to complete the original illustration contained within the literature review chapter (figure 2.4, p.111).

Figure 5.2: Findings of the research compared against the original objectives



Research questions	Summary of findings against each of the research questions	Summary of findings against the research problem
What processes are commonly adopted in the preparation of pricing documentation?	• Processes adopted in practice were found to be complex. • Two groups of contractor were identified based on their behavioural responses and requirements of different formats of pricing documentation, namely; specialists and non-specialists. • The current format of pricing documentation was found to cause significant problems in practice and to increase the overall level of cost and risk endured.	❑ Existing methods of preparing pricing documents were found to be ineffective and detrimental to the overall pricing process. ❑ The overall cost and likelihood of post-tender conflict were significantly increased by the current methods adopted. ❑ Proposals have been generated to improve the effectiveness of documents adopted in competitive construction tendering:- • Specialist work should not be quantified on behalf of the estimator (even if the design is complete) but instead procured in a consistent non-quantified format. • Specialists should be involved in the pre-tender decision-making process and, post-tender, have direct contractual links with the client. • Non-specialist work should always be quantified on behalf of the contractor and use of the Plan & Specification form of tender procurement be abolished.
How effective is current pricing documentation as indicated by those problems commonly encountered by constructors during the pricing of tender documentation?	• Existing methods of preparing pricing documentation were not only found to be ineffective but also detrimental to practice. • Significant levels of duplication were endured by the non-specialists and inconsistent formats of pricing documentation experienced by the specialists. • The overall workload of the industry, subsequent cost, likelihood of post-tender dispute and level of risk were all significantly increased by current practice.	
What is the frequency and extent of each category of problem, its impact upon the relative accuracy of the pricing process and the extent of risk taken by the main contractor?	• A significant proportion of the total industry workload was not in the desired format for non-specialists (approximately 41%). This caused high levels of duplication – estimated to be the equivalent of the entire project being measured between 2.68 and 6.88 times over. • Approximately 5% of the non-specialist workload was also poorly prepared. • The specialists also encountered substantial problems with the inconsistent format of non-quantified work (representing 29% of the total industry workload).	
What is the impact upon the client of the exposure to risk of the constructor in terms of the current pricing documentation?	• The main contractor was found to take on the majority of risk caused by current practice (as central coordinator of the price). • Direct impacts on the client included an overall increase in cost, increased likelihood of post-tender dispute (plus knock-on affects such as contractor insolvency) and inability to maximise value-for-money by not incorporating specialist expertise within the design process. • An indirect impact was recognised as being a fall in the expertise of the quantity surveyor and thus added value derived.	
Can solutions be formulated to reduce the frequency and extent of the problems identified?	• The research revealed that solutions could be formulated to reduce the frequency and extent of problems identified. • By meeting the needs of the contractors, through a change in format of the pricing documentation, it was established that current problems could be overcome. • Proposals centered around the quantification of non-specialist work (and thus abolition of Plan & Spec methods of procurement), a consistent method of procuring non-quantified prices from specialists (and proposal to adopt the Building Services Procurement Guide Pricing Schedule); direct involvement of the specialist contractor at the pre-tender stage and potential for direct contractual ties with the client post-tender.	
Can revisions to the processes commonly adopted in the preparation of pricing documentation be proposed and evaluated?	• Revisions to the processes commonly adopted were recognised to naturally flow from the proposed changes in format of pricing documentation. The process of measurement would be eliminated for the non-specialist. Both groups of contractor would also no longer require to instigate reactionary processes to counter the detrimental affects of current practice (e.g. tender qualifications, claims and risk management).	
Can revisions to the pricing methods commonly adopted (in light of the above) be proposed and evaluated?	• In a similar context to the above, revisions to the methods of pricing would not require to be enforced as these would be naturally adopted by the industry. Non-specialists would be able to price directly from quantified data and the specialists able to apply a standard method of pricing.	

Source: Adapted from - Perry, C. 1995. "A structured approach to presenting PhD theses: notes for candidates and their supervisors." p.17.

CHAPTER 6:

CONCLUSIONS

6.1 Introduction

6.2 Conclusions about each of the research questions

6.3 Conclusions about the research problem

6.4 Contribution

6.5 Implications for theory

6.6 Implications for policy and practice

6.7 Limitations

6.8 Recommendations for further research

6.9 Summary

6.1 Introduction

This chapter concludes the overall thesis of the research and, in so doing, brings together the results of previous chapters.

The initial introductory chapter of the thesis places the research in context and justifies the overall basis for conducting the study. The literature review then serves to provide a detailed analysis of previous research and status of the existing body of knowledge. A number of research questions are seen to emerge from the literature review, these are summarised as an overall research problem – *whether the effectiveness of pricing documentation may be improved for the contractors' estimator.*

Chapter three explains the methodology adopted in order to address these underlying research questions. The results of this stage are then presented in chapter four – initially as raw data and, secondly, in their statistically tested format.

The penultimate chapter, the discussion of results, evaluates how successfully the original research questions have been addressed and the extent to which they address the research problem. A comparison is also made in terms of how the research findings relate to the existing body of knowledge.

This chapter concludes by considering how the effectiveness of pricing documentation may be improved. Consideration is also given to the implications of the findings for theory, policy and for practice. Limitations that apply to the research are taken into account before making recommendations about the potential direction of future research.

6.2 Conclusions about each of the research questions

6.2.1 What processes are commonly adopted in the preparation of pricing documentation? (research question 1)

- The overall processes of preparing pricing documentation have been broken down into three generic stages and the processes involved mapped as:
    1. The interaction between the client and main contractor (p.184),
    2. The main contractors own decision-making process (on how to manage the pricing process, p.193) and;
    3. The interface between the main contractor and subcontractor (p.200).

- High volumes of work are typically subcontracted by the main contractor (equating to approximately 80% of the total industry workload, figure 4.7, p.203).
- A key finding of the research is the discovery that the *format* of pricing documentation alters the behavioural response of the contractors' estimators and the pricing processes they adopt:-
    - Two separate behavioural traits have been identified within the building industry. Each trait is consistently displayed by the two identified types of contracting organisation. They expressed a principal preference for their work to be either quantified or non-quantified (p.201 & table 4.2, p.192).
        - *Specialists* typically include the likes of mechanical and electrical contractors. They prefer to quantify the work themselves rather than have this quantified on their behalf by an external party. The specialist firms also use their own systems of pricing and strongly avoid breaking down their pricing information to a level similar to that of the Standard Method. They find the Standard Method to be too detailed and not reflective of their own cost base. They prefer to provide a higher-level breakdown of pricing information and acknowledge appendix A (of the RICS Building Services

Guide) as an acceptable industry standard. They consider that this level of pricing information enables prices to be evaluated fairly and to be more reflective of their own cost base.

  - The *non-specialists* typically include all other trades. In contrast, they prefer the work to be quantified on their behalf by an external party. They express dissatisfaction if the work is not quantified for them.

- Typical characteristics of each type of contractor are rooted within the customary practices of the industry and, as a result, form the basis of their response e.g. level of completeness of the design, level of understanding of their work by the rest of the industry, extent of design work undertaken by the contractor (table 4.2, p.192).
- The behavioural responses to differing formats of pricing documentation have been mapped for each group (figure 4.7, p.203). This has not been identified by previous research.
- Adverse responses are encountered when their desired format of pricing documentation is not complied with (table 4.5, p.208).
- Only about 1-2% of the specialists workload is received in a pre-quantified format (at odds with their preferred format). The balance is predominantly in non-quantified format – in principal the format they require. However, this is inconsistently prepared and, as a result, does not suit their requirements (item 2.1, table 4.5, p.208).
- Approximately 30% of the non-specialists workload is also purported to be in a pre-quantified format. However, of this, approximately 5% is poorly prepared (e.g. non-quantified itemised schedules). Therefore, only 25% of the non-specialists' workload is actually measured for them and thus complies with their required format (figure 4.9, p.212; chart 4.6, p.226; chart 4.7, p.227).

6.2.2 How effective is current pricing documentation as indicated by those problems commonly encountered by constructors during the pricing of tender documentation? (research question 2)

- The effectiveness of current pricing documentation has been evaluated from the perspective of the end users of the pricing information – contractors' estimators.
- A high proportion of pricing documentation currently prepared is at odds with the identified needs of contractors' estimators. In this respect, current pricing documentation is not effective (figure 4.9, p.212; chart 4.6, p.226; chart 4.7, p.227).
- The extent of non-compliance with the needs of contractors' estimators causes further detrimental affects throughout the pricing chain (table 4.6, p.211; table 4.7, p.261; figure 5.1; p.356):-
    - The measurement of non-specialist work needs to be unnecessarily duplicated by the contractors' estimators.
    - Each of the competing non-specialist main contractors typically find that, in order to obtain competitive quotations, they have to measure the work on behalf of their subcontractors. This causes further confusion as each main contractor will interpret the requirements differently. Competing subcontractors will then be faced with a number of permutations of the same job to price.
    - Poor practice results in the tendering contractor having to qualify their price against potential risks and include priced risk.
    - The cost of the tendering process is increased.
    - The accuracy of the pricing process is reduced.
    - Post-tender variations are more difficult to value.
    - The likelihood of post-tender dispute and level of risk are heightened.

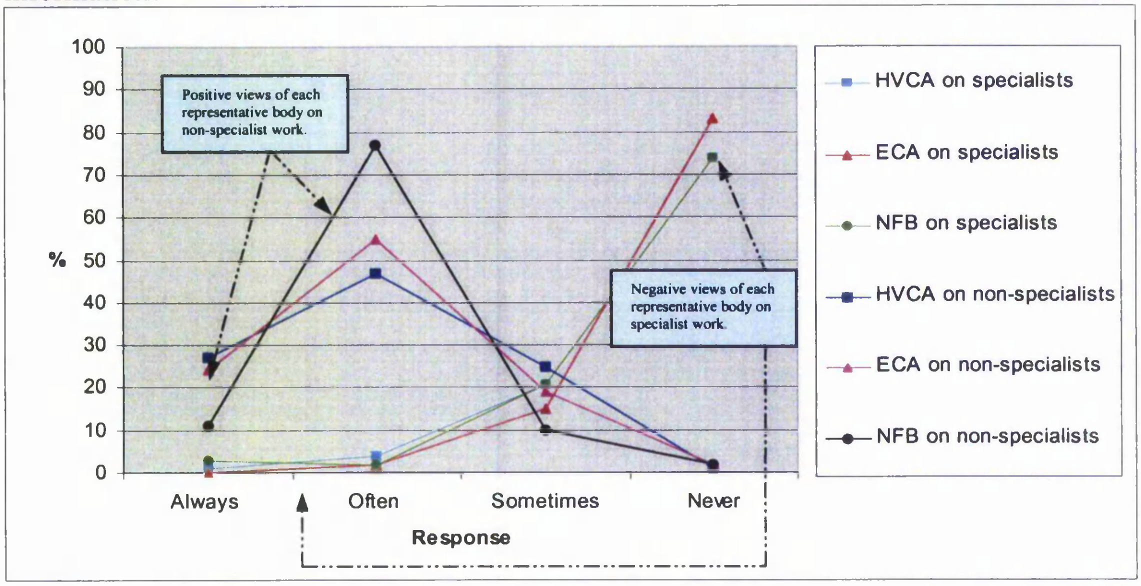
6.2.3 What is the frequency and extent of each category of problem, its impact upon the relative accuracy of the pricing process and the extent of risk taken by the main contractor? (research question 3)

- Overall, 76% of the current pricing documentation does not fully comply with the requirements expressed by the contractors' estimators (figure 6.1, p.385 refers):-
  - 34% is in a semi-compliant format, that is, despite complying in principal with the format required by the contractors' estimators, the information is poorly prepared. Of this, 29% of the total industry workload is prepared in an inconsistent non-quantified format for specialists and 5% is the extent that bills of quantity are poorly prepared for the non-specialists (often as itemised descriptions and not quantified) – chart 4.8, p.434; chart 4.9, p.435.
  - A more fundamental area of concern is the fact that 42% of current practice does not match the principal requirements of contractors' estimators. In contrast to the stated requirements of estimators, 1% of the total industry workload is measured on behalf of specialist contractors and 41% is not measured on behalf of the non-specialist sector. The latter causes unnecessary duplication of the measurement task (figure 4.9, p.212; figure 6.1, p.385; table 4.7, p.261).
- The volume of duplication has been estimated by multiplying the typical number of contractors involved within the pricing chain by the extent of variance (between the required format and that supplied). The extent of duplication is the equivalent of the entire project being measured between 2.68 and 6.88 times over (table 5.1, p.301).
- The quality of bills of quantities typically prepared by quantity surveyors has been evaluated for each type of contracting organisation (from the specialists and non-specialists viewpoint). Views were collated from representative samples of both classifications of contractor. This enabled an assessment to be made of the relative accuracy of the pricing process. Statistically negative (i.e. derogatory) results were recorded by the specialists and positive results recorded by the non-specialists against the following criteria (table 4.7, p.261; tables 4.10-4.16, p.458-463).

- *Accuracy of the descriptions.*
- *Accuracy of the quantities.*
- *How logically the information is presented.*
- *How closely the information relates to what is eventually built.*
- *Additional work required to supplement this information in order to generate a price.*
- *How well this enables prices to be evaluated on a like-for-like basis.*
- *Appropriateness of billed information to value interim valuations, variations and final accounts.*

- The frequency that quantity surveyors accurately measure both specialist and non-specialist work was directly addressed. Chart 6.1 (p.371) illustrates the views of both groups of contractor on their own work and that of the other sector of the industry. Statistically significant results are recorded in terms of a low frequency that specialist work is accurately quantified and high frequency that non-specialist work is accurately quantified (table 4.37, p.286; table 4.38, p.291)

Chart 6.1: All contractors views on specialist and non-specialist work
Based on pricing information typically prepared by consultant quantity surveying firms, do you consider that they are able to accurately prepare quantified pricing information?



- Contractors, as a result of current practice, endure substantial levels of risk. As central coordinator of the pricing process, the main contractor takes on the majority of this risk. Most apparent is the demand placed on the main contractor to take on the responsibility of subcontractors' quantities (either through subcontractor qualifications or their refusal to price unless the main contractor quantifies the work on their behalf) – table 4.6, p.211; figure 4.9, p.212; chart 4.7, p.227; table 4.7, p.261.

6.2.4 What is the impact upon the client of the exposure to risk of the constructor in terms of the current pricing documentation? (research question 4)

- Contractors, particularly the main contractor, are exposed to increased levels of risk as a result of current practice (table 4.6, p.211; figure 4.9, p.212; chart 4.7, p.227; table 4.7, p.261).
- The contractors' exposure to risk has a direct impact upon the client. These impacts may be divided into two main areas – *additional costs of the tendered work* and *an increased likelihood of post-tender dispute* (figure 5.1, p.356).

> *Additional cost* is incurred for the following reasons:

- Duplication of the measurement process increases the amount of time, effort and cost in compiling a price by each of the contractors' estimators (table 5.1, p.301).
- Ambiguities in pricing documentation (brought about by poor practice and differing interpretations by competing contractors) increase the price risk included by the competing contractor. The likelihood that the same items will be priced a number of times therefore increases – ultimately at the expense of the client (table 4.7, p.261).
- Additional price risks are more likely to be included by competing contractors to compensate for (table 4.5, p.208; table 4.7, p.261):-
  - Inaccurate descriptions.
  - Inaccurate quantities.
  - Inaccurate valuations of work.
  - The extent of post-tender change (and consequential affects of the above).
  - Taking on the quantification risk of subcontractors (via tender qualifications and measuring the work on their behalf). This is further exacerbated by the main contractors' lack of awareness of the specific trades (resulting in an increased likelihood of further risks being priced or overlooked).
- The client potentially pays for a service that, in reality, is either not undertaken at all or is poorly undertaken – that of bill production by the quantity surveyor (table 4.7, p.261).

> Secondly, the client encounters an *increased likelihood of post-tender dispute* due to (table 4.6, p.211; table 4.7, p.261):

- Ambiguities within pricing documentation increasing the likelihood of incorrect interpretation.
- Potential underpayment of the work due to a lack of appreciation of the price build-up.

- A lack of appreciation of the price build-up further exposes the client to additional risk of overpayment.

- Indirect impacts have also been identified that impact upon the client:
  - A reduction in the expertise of the quantity surveyor and reduced benefit from professional advice (p.213; figure 5.1, p.356).
  - Less value for money as a result of the specialists' current position within the supply chain. A more proactive involvement of the specialist in design decisions would bring about savings not currently reaped by the client (chart 4.44, p.250; chart 4.46, p.253; chart 4.48, p.257; chart 4.49, p.258).

6.2.5 Can solutions be formulated to reduce the frequency and extent of the problems identified? (research question 5)

Solutions have been formulated to reduce the frequency and extent of the problems identified. These are directed towards the two classifications of contractor and focus on matching the format of pricing documentation with the requirements of the contractors' estimator.

The formulated solutions are acceptable to the industry and are proven to be statistically significant at the 5% confidence level (table 4.38, p.291):-

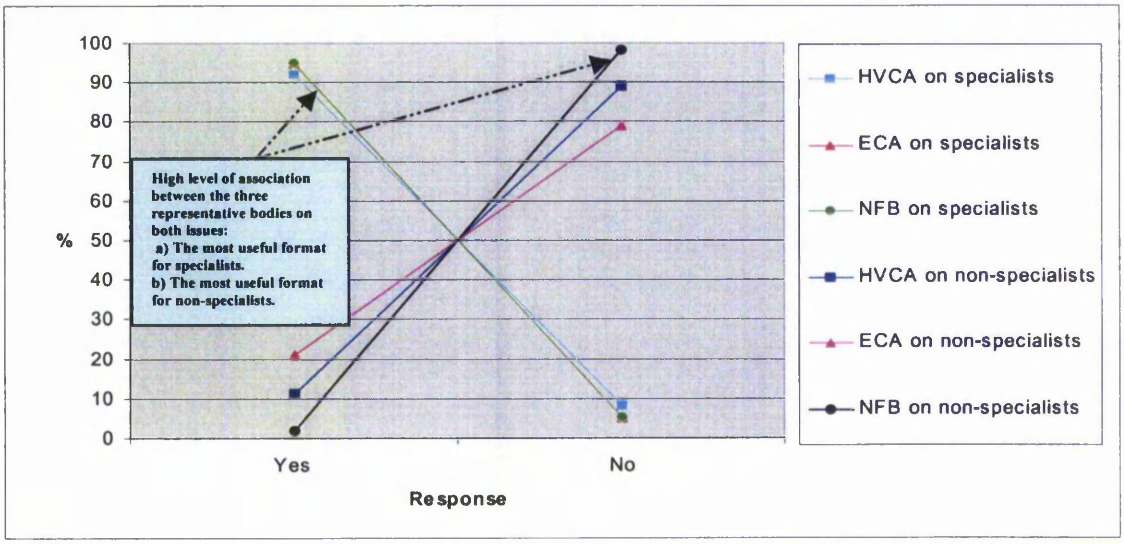
- The quantity surveyor should not quantify specialist work on their behalf (chart 4.57, p.280). Instead, pricing documentation should be presented in a non-quantified format. As only about 1% of their current workload is quantified for them the former will not constitute a significant departure from current practice. However, the consistent production of non-quantified information will have a substantial impact on current practice – representing 29% of the total industry workload (Kodikara, 1990, p.17 & literature review, p.34)
  - The itemised pricing schedule within the Building Services Procurement Guide is considered to be a suitable alternative to the Standard Method of Measurement (Appendix A. RICS, 2000 c, p.42-54).
- The typical position of the specialist contractor within the supply chain should be altered. Specialists should play a more proactive involvement at

the design stage and have direct contractual links with the client post-tender (chart 4.48, p.257; chart 4.49, p.258).

- Pricing documentation should always be quantified for the non-specialist contractor (further supported by Kodikara, 1990, p.263). This represents a substantial change to current practice and would significantly improve approximately 41% of the total industry workload. The Plan & Specification form of procurement should also be abolished (chart 4.6, p.226; chart 4.9, p.435).
- More stringent control measures are required to ensure that the quality of bills of quantities meets the standards required by the Standard Method of Measurement (chart 4.9, p.435; table 4.7, p.261).

Chart 6.2 (below) illustrates the results of the empirical testing stage confirming the differing requirements of the specialists and non-specialists. The chart also illustrates how comparable the results are between the three representative bodies (based on responses from 309 estimators).

Chart 6.2: All contractors views on specialist and non-specialist work:
Would it be more useful to the contractors' estimator if the consultant quantity surveyor did not attempt to quantify the work?



6.2.6 Can revisions to the processes commonly adopted in the preparation of pricing documentation be proposed and evaluated? (research question 6)

Revisions to the processes commonly adopted in the preparation of pricing documentation will naturally flow from the proposed changes in format of tender documentation. The process of measurement will be eliminated for the non-specialist and the need for both groups to establish reactionary processes (to counter detrimental effects) will no longer be required (table 4.5, p.208). There will be no need to enforce any procedural changes.

Consistent non-quantified pricing documentation for the specialist contractors would mean they would no longer be required to back-fit their pricing information to inconsistent tender documentation. They would also no longer need to set up processes to deal with the consequential risks arising from current practice.

A change in the specialists' position within the supply chain would further reduce their need to establish processes to deal with risks brought about by the main contractor.

Quantification of the non-specialists work would relieve them of their enforced need to quantify the work themselves. As an industry this will substantially reduce the number of times the process of measurement is undertaken (figure 4.9, p.212; chart 4.9, p.435). This will also eliminate the need to set up processes to deal with the detrimental affects brought about by the current lack of measured work for these contractors (table 4.5, p.208).

Overall, the proposed solutions will significantly reduce the need to set up processes to deal with inappropriate tender documentation. The affects of such will be experienced at the tender stages (e.g. risk management and duplication of the measurement task) and post-tender (management of variations and conflict) – table 4.7, p.261; table 4.38, p.291.

6.2.7 Can revisions to the pricing methods commonly adopted (in light of the above) be proposed and evaluated? (research question 7)

In a similar vein to the processes, revisions to the pricing methods commonly adopted will naturally flow from the proposed solutions.

The specialists will be able to apply consistent methods of tender preparation and have confidence that the methods adopted will be appropriate to the format of pricing documentation they receive (Kodikara, 1990, p.17 & literature review, p.34).

A substantial impact will be experienced by the non-specialist sector. Their pricing methods will be able to rely on quantities supplied on their behalf. Methods of pricing will therefore be based upon bills of quantities (table 4.7; p.261).

6.3 Conclusions about the research problem

The results of the research have enabled the overall problem to be addressed – *how the effectiveness of pricing documents adopted in competitive construction tendering may be improved for the contractors' estimator.*

A key finding of the research is the identification of two classifications of contractor based on their preferred source of pricing documentation. One group, the *specialist* (i.e. building services contractors) prefers to prepare their own quantities. In contrast to conventional practice, they do not require the work quantifying on their behalf by the quantity surveyor (chart 4.51, p.272). The other group, referred to as the *non-specialists* (i.e. all other contractors), require that pricing documentation is prepared on their behalf by the quantity surveyor (chart 4.61, p.284). The non-specialists expressed dissatisfaction when the work was not quantified for them (table 4.7, p.261).

In practice, pricing documentation is not effective as it rarely complies with the above principal needs of each contractor type (chart 4.9, p.435). Substantial problems are encountered as a result (table 4.7, p.261). The current format of pricing documentation increases the overall cost of the tendering process, the overall level of risk endured and likelihood of post-tender dispute. As central coordinator of the price the main contractor is exposed to the majority of risk. As a key document used within the adjudication process (Pasquire, 1994, p.50) the accuracy of the tendered price is also impaired. The research also reveals that the client encounters consequential affects and the quantity surveyor is less able to provide a valued service (figure 5.1, p.356).

Solutions have been generated by the research and are generally acceptable to the industry. The original proposed solutions (formulated during the interviews) have been further supported by both the results of the industry survey and empirical testing stages – statistically significant results have been obtained at the 5% confidence level (table 4.38, p.291; table 4.8, p.269). The solutions involve the procurement of specialist work in a consistent non-quantified format and that all non-specialist work should be quantified (including the abolition of the Plan & Specification method of procurement). The research further proposes the involvement of the specialist during the design process and direct contractual links with the client post-tender.

Central to the thesis of this research is to define, in *principal*, the demands of pricing documentation by the end users. It is suggested that, for a profession perhaps more acquainted with prescriptive detail (i.e. SMM7), this may not be most comfortable of propositions (Champness, 1996, p.23). The existing literature has tended to view the issue of measurement as a singular problem and, in response, suggested detailed measurement rules. This research has exposed the "*problem*" in far greater depth and in so doing reveals a number of *principals* that should be applied.

6.4 Contribution

A number of areas have been identified where the research complies with the requirements of a Doctor of Philosophy. Table 6.1 (below) provides a summary of the areas where the research provides an independent and original contribution to knowledge.

The categories of contribution (detailed in the columns) are supported by the literature on the subject (National Postgraduate Committee, 1993; Phillips & Pugh, 1994, p.59-62).

Table 6.1: Areas of contribution achieved by the research

Areas of contribution / Outcomes of the research	Setting down a major piece of new information in writing for the first time.	Carrying out empirical work that hasn't been done before.	Making a synthesis that hasn't been done before.	Bringing new evidence to bear on an old issue.	Looking at areas that people in the discipline haven't looked at before.	Adding to knowledge in a way that hasn't been done before.
Identification of the processes commonly adopted in the preparation of tender documentation (as opposed to just within a single contracting firm – Pasquire, 1991 & Kodikara, 1990).		✔			✔	✔
Identifying the type and volume of workload received by the contractors themselves (as opposed to let by Quantity Surveyors, RICS, 2000 b).	✔	✔	✔	✔	✔	
A detailed understanding of the quality (measured against a number of criteria) of pricing information produced by both sides of the industry (i.e. usefulness & existence of abuse in practice).	✔	✔		✔	✔	
Identification and categorisation of the problems encountered by constructors during the pricing of tender documentation.	✔	✔		✔	✔	
The establishment of the frequency and extent of each category of problem, its impact upon the relative accuracy of the pricing process and the extent of risk endured by the main contractor.	✔	✔		✔	✔	

Table 6.1: Areas of contribution achieved by the research (continued)

Areas of contribution / Outcomes of the research	Setting down a major piece of new information in writing for the first time.	Carrying out empirical work that hasn't been done before.	Making a synthesis that hasn't been done before.	Bringing new evidence to bear on an old issue.	Looking at areas that people in the discipline haven't looked at before.	Adding to knowledge in a way that hasn't been done before.
Understanding the needs of industry (from the estimators perspective) at a subcontractor/ trade level (Pasquire, 1991, p.221).	✔	✔			✔	
Understanding the needs of main contractors at the tender stage.	✔	✔			✔	
Identification of *specialist* and *non-specialist* trades (as defined).					✔	✔
Identification of contrasting needs and characteristics of both *specialists* and *non-specialists*.					✔	✔
The formulation of solutions to reduce the frequency and extent of the problems identified e.g. proposals that: • *Non-specialist* work should always be quantified on their behalf. • Plan & Specification methods of procurement should be abolished for these trades (this inevitably excludes circumstances when the contractor takes on design responsibility). • *Specialist* work should not be quantified on their behalf. • *Specialist* work should be prepared in a consistent non-quantified format. • *Specialist* contractors should be brought into the design process earlier within the construction timetable. • The *specialist* has direct contractual links with the client post-tender.			✔		✔	✔

An illustration of the advances made against the existing literature is provided in figure 5.2 (p.363). Many of the recommendations for further research within the subject area have also been addressed by this research (Skinner, 1979, p.214-216; Pasquire, 1991, p.221, item 4)

6.5 Implications for theory

The issue of measurement has been debated at length within the industry over a considerable period of time. The rise in fast-track methods of procurement and reduction in use of bills of quantities have been cited by many commentators as the end of the useful life of bills of quantities. Further changes in the dynamics of the industry, through an increased level of subcontracting and rise in the importance of the specialist, have created a state of confusion as to the requirements of pricing documentation. For example, Burnham's insistence that measurement is a vital requirement to all contractors (1992, p.10) and Coffey's view that measurement is required by the specialist contractor (1992, p.7) versus the counter view of Ardley that bills are of no use to specialists (1992, p.63). This research cuts through this confusion to reveal that the requirements of the industry are split – a lack of appreciation of which has arguably blurred the previous debate (refer to table 2.7, p.101).

Contrary to any new method of measurement (as frequently proposed, p.129), the research confirms that the existing Standard Method is appropriate for non-specialists and, as a further recommendation, suggests the abolition of the Plan & Specification method of procurement for these trades. An overall nett increase in the volume of measurement, based on current practice, is thus proposed for the non-specialist sector. The research confirms those views in favour of the continued adoption of traditional methods. However, contrary to traditional thinking, the research proposes that the Standard Method is no longer appropriate for specialist trades. In its place a standard method of preparing non-quantified prices is proposed. This goes further than advice contained within the Buildings Services Procurement Guide (RICS, 2000 c, p.25) that states that only simple services installations should not be quantified.

The existing state of confusion has resulted in an inconsistent approach to the production of pricing documentation and had a detrimental affect on the industry (chart 4.9, p.435).

Theory about the most appropriate methods of pricing documentation has therefore been altered considerably by the research. By understanding the requirements of individual trades, the end users of the documentation, a profile of the requirements of the industry has been established. Figure 5.2 (p.363) illustrates the implications of research on theory.

Skinners' model of the format, adequacy and independence of pricing information is also altered by the research findings in terms of the appropriateness of current pricing documentation (Skinner, 1979, p.76). Skinner's findings may also be broken down into classifications of contractor at the tender stage (instead of just the main contractor).

In addition to the immediate discipline, the research findings also have wider implications:-

- The proposals and methodology may be transferable to other building industries around the world.
- The proposals may be transferable to other *like* industries where the work is undertaken by a multitude of subcontractors i.e. civil engineering, shipbuilding, the rail industry and where expertise is divided between the client and those delivering. For example, Permanent Way work (the maintenance of the track) is readily understood by most within the rail industry and therefore capable of being prescribed by the client-side. However, signaling work is more complex in nature, requires expert knowledge from the contractor and may be better procured in consultation with the contractor. The analogy reflects the non-specialist/ specialist findings within the research.
- The philosophies established may also be transferable to any instance when the pricing process is outsourced i.e. core understanding of the business that is readily understood by both parties (by those specifying the work and those carrying out or managing the work) should be detailed/ quantified. However, those services delivered by specialist suppliers (whose knowledge is not shared with the specifying party) should not be detailed/ quantified other than in terms of performance criteria.
- Adherence to these principles could bring about substantial savings and reductions in the amount of risk taken.

6.6 Implications for policy and practice

It is evident from the research that changes in policy and practices are required in order to improve the effectiveness of pricing documentation. An assessment has been undertaken to establish what the barriers to successful implementation would be and therefore the implications for policy and practice.

Figure 6.1 (p.385) illustrates the demands of the industry (in terms of required format of pricing documentation) and the extent that practice currently complies with these needs. It also illustrates, post-implementation of the research proposals; how closely the demands of estimators will be met. This shows that the needs of the industry will be met in their entirety if the research proposals are successfully implemented. The illustration also highlights the percentage of practice that is not compliant with the demands of the industry (i.e. in principal = 42%) and the proportion of practice that is semi-compliant with the demands of the industry (e.g. poor practice = 34%). Overall, 76% of current practice does not fully meet the needs of the industry. This represents a substantial proportion of current practice.

Figure 6.2 (p.386) then illustrates what changes need to occur in order that current practice meets the needs of the industry. Also highlighted are the key participants within the pricing chain that would need to bring about such change. The quantity surveyor (or practitioner taking on this role) inevitably has a key role to play in bringing about change but the client is also identified as a key player – particularly in being convinced of the benefits derived and insisting on the proposals being adhered to in light of these.

Finally, figure 6.3 (p.387) identifies the changes in policy and practice required to implement the proposed solutions. A number of barriers have been identified that may impair the successful implementation of the research proposals. These have also been evaluated to assess, based on the anticipated reaction of the industry, the likelihood of these proposals being accepted. It is important to note that the evaluations are based solely on the personal views of the researcher and take into account the logic and commercial pressures most likely to impact upon delivery.

Both the non-quantification of specialist work (which is minimal in practice) and the implementation of a standard method of procuring non-quantified prices from specialists could readily be implemented in full. The pricing schedule contained in the RICS Building Services procurement guide is recognised as a sound basis to prepare consistent non-quantified pricing documentation for the specialist (RICS, 2000 c, p.44). Collectively these represent 30% of the total potential.

Direct contractual links between the specialist and client, earlier involvement of the specialist during the design process and consistent quantification of non-specialist work seem likely to be substantially implemented. A change in position of the specialist within the supply chain and direct contractual links are most likely to meet resistance from those contractors that profit from the current situation. However, by educating the client on the benefits derived, this should be overcome. The consistent quantification of non-specialist work heavily depends on how well the benefits of such an approach are sold to the client and the capacity to do so (in terms of current skill base) within the quantity surveying profession. The skill base within the profession may well be the most restrictive factor. The elimination of poor practice is least likely to be implemented. Such ingrained practices are estimated to represent approximately 5% of the potential total.

Overall, provided that the proposals are presented positively and benefits clearly articulated; the majority of the improvements are considered likely to be readily implemented.

Finally, a point raised during the various presentations of the research findings was that of the continued need to teach the measurement of specialist work (in light of the above proposals). The personal views of the researcher are that any such debate should separate the need to gain knowledge about the technical detail and those measurement skills that will need to be applied in practice. It is suggested that the measurement of specialist work still has a place within education but that the focus should be changed. Practitioners, in today's building industry, need to understand the technology and apply the skill of measurement in other areas e.g. value engineering, project management and cost control etc (Swaffield & Pasquire, 1995, p.2).

Figure 6.1: Illustration of the desired format of pricing documentation, actual format as it is presented in practice and extent of compliance in line with proposed changes

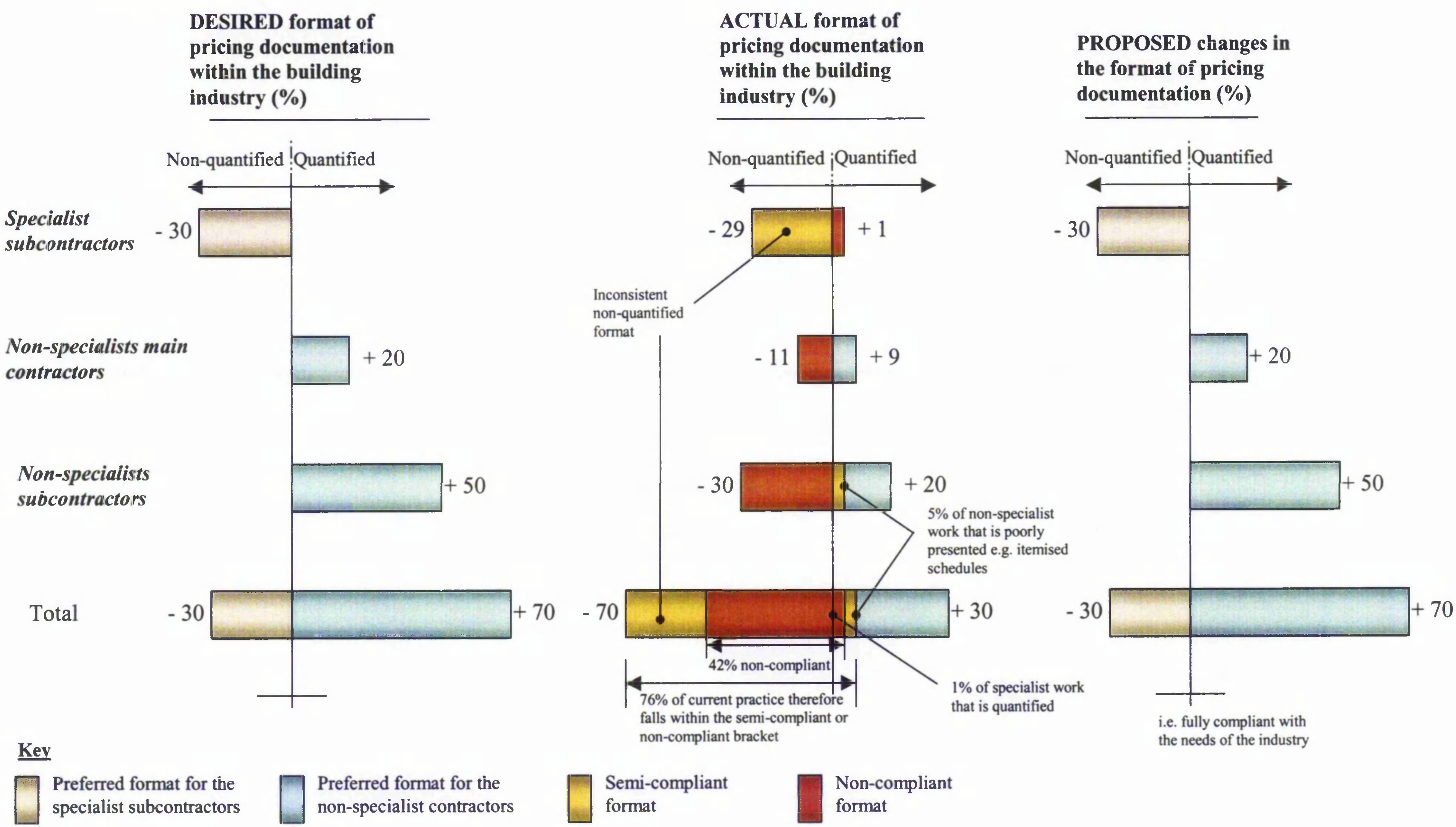


Figure 6.2: Steps to compliance with the needs of the industry (in terms of format of the pricing documentation)

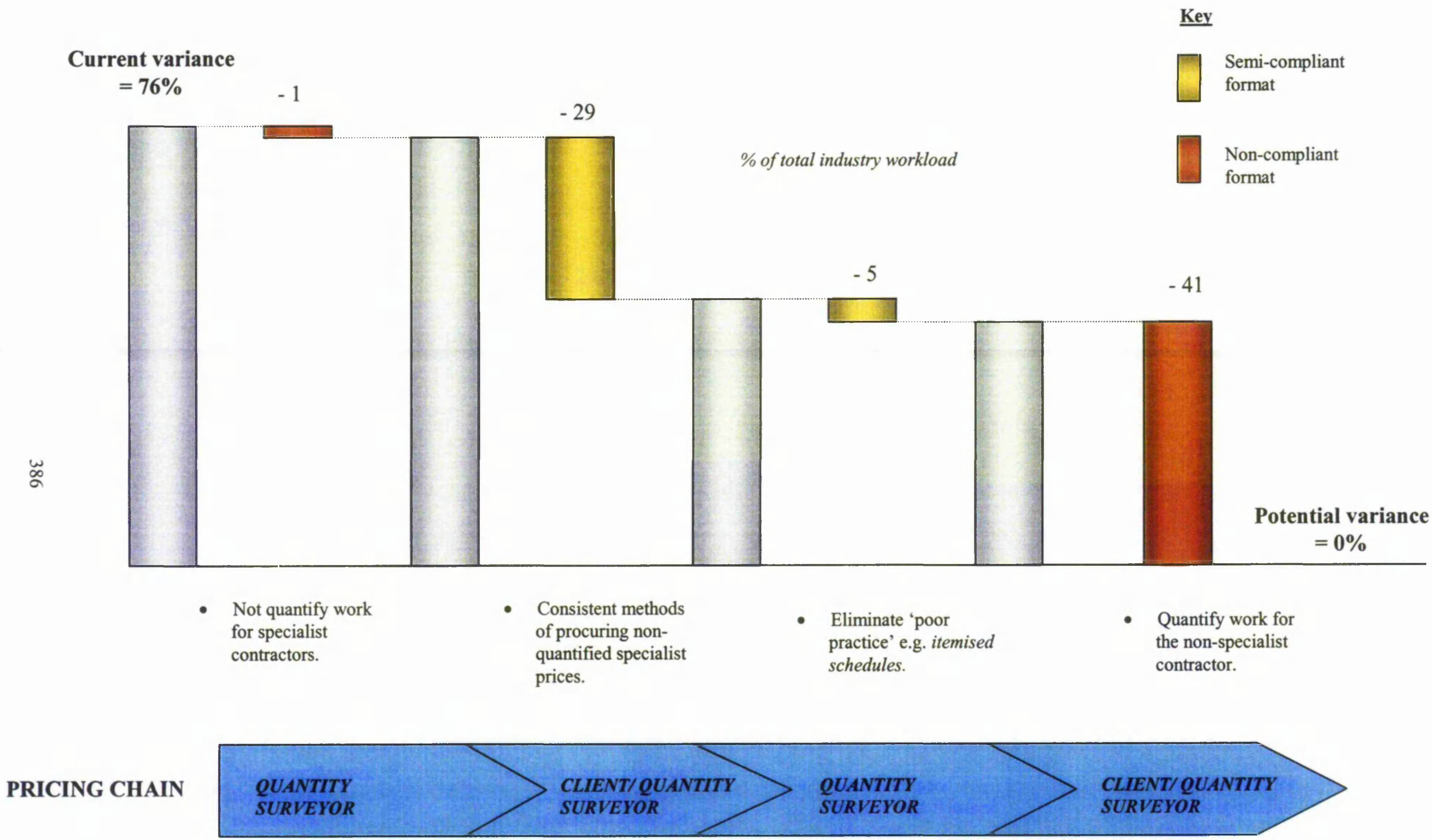


Figure 6.3: Changes in policy and practice required to achieve full compliance with the needs of the industry

CHANGES REQUIRED TO IMPROVE THE EFFECTIVENESS OF PRICING DOCUMENTATION

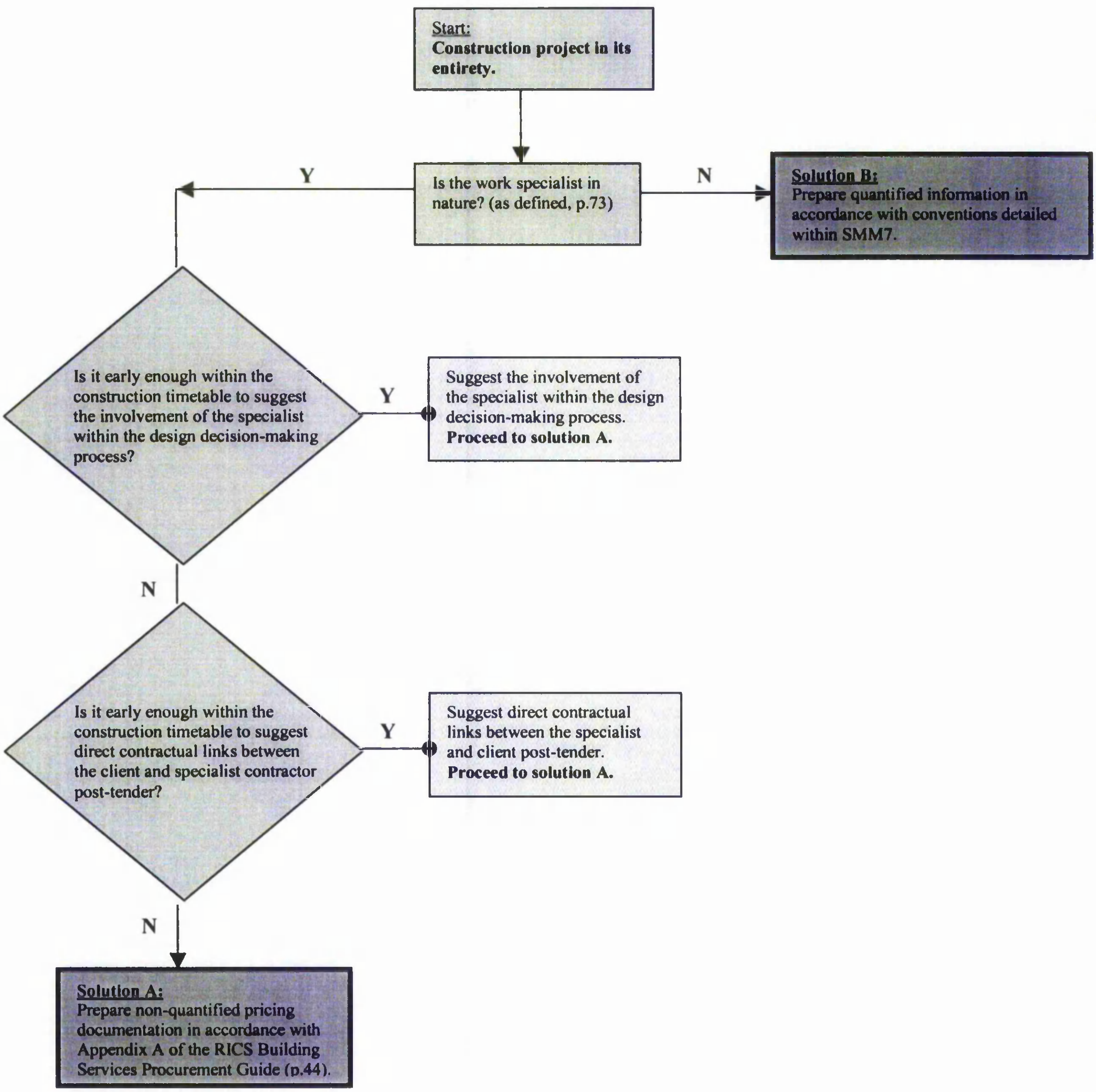
Changes required	Changes in policy and practice	Examples	Likelihood of implementation
NOT QUANTIFY WORK FOR SPECIALIST CONTRACTORS	• Education of the quantity surveying profession that specialist work should no longer be quantified.		●
CONSISTENT METHOD OF PROCURING NON-QUANTIFIED SPECIALIST PRICES	• Development of an industry wide standard format as an alternative to the Standard Method (the Pricing Schedule contained in Appendix A of the Building Services Guide is considered to be an appropriate solution, p.44). • Development of the skill base of the profession through education and continuing professional development.		●
INVOLVE THE SPECIALIST SUBCONTRACTOR EARLIER WITHIN THE CONSTRUCTION PROCESS	• Reluctance to accept this proposal will probably be encountered from the main contractor (and other subcontractors) as this will forfeit their opportunity to profit from the specialist subcontractor. • Contractual arrangements will also need to be amended.	• Post-tender disputes. • Changes in post-tender quantities.	◐
DIRECT CONTRACTUAL LINKS BETWEEN THE SPECIALIST CONTRACTOR & CLIENT	• Reluctance to accept this proposal will probably be encountered from the main contractor (and other subcontractors) as this will forfeit their opportunity to profit from the specialist subcontractor. • Need to educate clients on the benefits of more involved management of specialists. • Contractual arrangements will also need to be amended.	• Post-tender disputes. • Reduced risk.	◐
QUANTIFY WORK FOR THE NON-SPECIALIST CONTRACTOR	• Need to educate clients that the up front cost of quantity production will generate an overall benefit to the project. • Educating the quantity surveying profession on the need to quantify non-specialist work and detrimental affects of not doing so.	• Not interested in the wider good of the industry.	◐
ELIMINATE 'POOR PRACTICE' E.G. *ITEMISED SCHEDULES*	• Difficult to change working practices. • Probably the greatest challenge to the industry.		○

Key:

● – Likely to be fully implemented ◐ - Likely to be partially implemented ○ – Unlikely to be implemented at all

In order to turn the findings of the research into practical advice a simple checklist of questions has been prepared to support the decision making of the quantity surveyor (figure 6.4). This basic checklist incorporates the major findings of the research.

Figure 6.4: Checklist of key decisions for the quantity surveyor under a traditional method of procurement



6.7 Limitations

A number of limitations are evident within the research.

The results are restricted to the UK building industry and based on the views of three representative bodies, the HVCA, ECA and NFB. These membership bodies are however considered to be representative of other like contractors within the industry (methodology chapter, section 3.4.3.1, p.144). Furthermore, the findings are based on a relatively large volume of respondents when compared against previous research within the subject area as illustrated below:-

Table 6.2: Comparison of the volume of results/ participants incorporated within the current research against previous research within the subject area.

Research technique	Skinner (1979)	Pasquire (1991)	Kodikara (1990)	RICS (2000 b) – Contracts in Use Survey	Kings (2002)
Interviews – fact-finding stage (no. undertaken)	1	3	10	n/a	47
Semi-structured questionnaire – testing out results (no. undertaken)	n/a	5 field studies.	10	n/a	172
Structured questionnaire survey - testing the proposals (no. undertaken).	12	8 interviews.	Interviews with 10 contracting firms and professional acceptance survey with 33 external candidates (thus 43).	151	286
Total	**13**	**16**	**63**	**151**	**505**

During the course of the research views were also collated from two additional groups referred to as "other contractors" and "quantity surveyors". However, during a critical analysis of the methodology, these were discounted due to the low number of respondents (methodology, section 3.4.9, p.157). As these have not been included within the results they do not limit the validity of the results.

Further limitations are highlighted in section 3.5.8 of the methodology chapter but are not considered to adversely bias the results (p.166).

Inevitably specialist traits may well be displayed by other contracting organisations (other than the building services contractor). The lack of a definitive list of such firms may be viewed as a shortfall in this research. However, to counter such opinion, the research has defined the common characteristics of such an organisation (figure, 4.5, p.191; table 4.2, p.192) and would suggest the need to apply professional judgement to the decision-making process undertaken. Rather than dictate prescriptive measurement rules it is considered a matter for the quantity surveyor to establish and apply the principals of this research (Champness, 1996, p.23). The lack of such an approach may be considered to be a failing of previous guidance – i.e. that professional judgment was overtaken by detailed measurement rules.

Although an obvious statement, the proposals for non-specialists are limited to occasions when the quantity surveyor is involved in tender preparation (as the research recommends quantification in accordance with the Standard Method). This does however justify an increased role of the quantity surveyor in the traditional sense (or somebody carrying out this role).

6.8 Recommendations for further research

A number of recommendations for further research have emerged during the course of the study:-

1. A consistent method of preparing non-quantified pricing documentation for specialist contractors has been proposed by the research and appendix A of the RICS Building Services Guide identified as an appropriate alternative to SMM7. It is recommended that the use of this is further developed to ensure that a *standard* method of preparing such a schedule is clear and procedural guidelines establish how this can be achieved in practice (supported by the failing of Elemental Bills, p.34).

2. Apply the same methodology to other industries within the UK e.g. civil engineering, shipbuilding etc – identifying the needs of end users, mapping how frequently these needs are met and proposing solutions in light of such.

3. Apply the same methodology to other countries. Australia would be a useful country to test how applicable the findings are as they have similar approaches to the procurement of construction work.

4. Develop a more strategic review of how the effectiveness of pricing documentation should be evaluated and shaped in the future. The last Standard Method was published in 1988 (over 13 years ago) and was based on work undertaken between 1982-4 (17 years ago). Since then the Joint Standing Committee have, assuming the same principals apply, sought to clarify contractual interpretations by issuing amendments to the document.

   Such a time lag, between comparing the needs of the industry (that was limited in scope) with how closely such needs are met, has proved detrimental. It is recommended that the RICS should establish a long term strategic plan incorporating cross-checks and surveys at periodic intervals – say every 5 years or when major changes to the structure of the industry occur. A conceptual framework should be developed from this stating the principal needs of end users.

5. The RICS Contracts in Use Survey is limited to the practices of the quantity surveyor. It is recommended, in order to obtain a more in depth understanding of current practice, that the assessment of current practice is widened. For example, evaluating the quality of bills produced and which elements/trades are actually measured.

6. Information Technology has developed considerably since the last publication of the Standard Method. Despite the development of estimator software packages, few standard packages have been produced for the industry. A significant opportunity exists within the market to develop a fully integrated software system that could be used by all parties, from the quantity surveyor to main contractors and subcontractors. If information was initially populated by the quantity surveyor (quantified for non-specialists and in a non-quantified format for specialists) this could be sent direct to the tendering contractors (via email for example). With compatible software packages (or modules of the same software) the contractors' prices could be then transferred. "Firewalls" will inevitably be required to ensure commercial sensitivity. Retrieval of information in this manner would enable the quantity surveyor to carry out analysis of pricing documentation more readily (e.g. Monte Carlo analysis) and for all parties to use post-tender e.g. submit Applications for Payment in the same format. A coding hierarchy could also be included so that each party obtains the information they require - materials scheduling for contractors and bills for the quantity surveyor. The duplication of effort and cost saved could be significant. It could also act as a database of cost information. The RICS is perhaps best placed to oversee such a development.

7. A suggestion arising from the interviews was the development of a standard pro-forma to manage the pricing process. In practice, this is carried out in an

inconsistent manner and often increases the likelihood of post-tender dispute. A standard pro-forma could detail the Conditions of Contract, drawings included, subcontractors, assumptions and caveats etc. This would alleviate the inconsistent format that pricing documentation is received by subcontractors and similarly how the subcontractors return it to the main contractor. This would perhaps be most appropriately developed by the RICS and included within recommendation 6. This may also be useful for Small and Occasional Clients receiving quotations direct from contractors - enhancing their understanding of what is being offered (Morledge & Sharif, 1998).

6.9 Summary

This chapter concludes the overall thesis of the research. Conclusions about each of the research questions are initially drawn followed by a summary of how well the overall research problem has been addressed. It is concluded that sufficient evidence has been collated to address the research problem and suggest solutions as to how the effectiveness of pricing documentation can be improved.

The contribution made by the research is then presented in tabular format for ease of reference (table 6.1, p.379). Figure 5.2 (p.363) illustrates the implications of the research for theory. Implications for policy are discussed and changes in current practice summarised if the proposals are to be implemented in full. Limitations are evaluated but not considered to bias the results. Finally, a number of diverse recommendations for further research are proposed which could have a substantial impact upon the industry.

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Appendix A

Developing a list of generic work categories

CAWS Page Nr	Group Ref.	Sub-Group Ref.	Work Section Ref.	Potential Subcontract/ Main Contract	Level 1 Categorisation	Final Categorisation
		Number of categories:	**316**	**54**	**46**	**8**
8	B	Complete Buildings	B10	Proprietary Building	Prefabricator	Prefabricator
	C	Demolition/ Alteration/ Renovation	C10	Demolition	Demolition	Demolition
		"	C20	Various	Various	Various
		"	C30	Demolition	Demolition	Demolition
		"	C40	Masonry	Main Contractor	Constructing
		"	C41	Damp Proof	Damp Proof	Constructing
		"	C50	Metalwork	Metalwork	Constructing
		"	C51	Damp Proof	Damp Proof	Constructing
		"	C52	Damp Proof	Damp Proof	Constructing
9	D	Groundwork	D10	Ground Stabilisation	Groundwork	Groundwork
		"	D11	Ground Stabilisation	Groundwork	Groundwork
		"	D12	Ground Stabilisation	Groundwork	Groundwork
		"	D20	Excavation	Groundwork	Groundwork
		"	D30	Piling	Groundwork	Groundwork
		"	D31	Piling	Groundwork	Groundwork
		"	D32	Piling	Groundwork	Groundwork
		"	D40	Piling	Groundwork	Groundwork
		"	D50	Piling	Groundwork	Groundwork
	E	In Situ concrete/ Large precast concrete	E10	Concreting	Main Contractor	Constructing
		"	E11	Concreting	Main Contractor	Constructing
		"	E20	Formwork	Main Contractor	Constructing
		"	E30	Reinforcement	Reinforcement	Assembly
		"	E31	Reinforcement	Reinforcement	Assembly
		"	E40	Main Contractor	Main Contractor	Constructing
		"	E41	Main Contractor	Main Contractor	Constructing
		"	E42	Main Contractor	Main Contractor	Constructing
		"	E50	Precast Concrete	Assembly	Assembly
		"	E60	Precast Concrete	Assembly	Assembly
	F	Masonry	F10	Masonry	Main Contractor	Constructing
		"	F11	Masonry	Main Contractor	Constructing
		"	F20	Stone Masonry	Stone Masonry	Assembly
		"	F21	Stone Masonry	Stone Masonry	Assembly
		"	F22	Precast Concrete	Assembly	Assembly
		"	F30	Precast Concrete	Assembly	Assembly
		"	F31	Specialist Supplier	Prefabricator	Prefabricator
	G	Structural/ Carcassing metal/ timber	G10	Steelwork	Steelwork	Assembly
		"	G11	Steelwork	Steelwork	Assembly
		"	G12	Steelwork	Steelwork	Assembly
		"	G20	Joinery	Joinery	Constructing
		"	G30	Cladding	Cladding	Assembly
		"	G31	Cladding	Cladding	Assembly
		"	G32	Cladding	Cladding	Assembly
10	H	Cladding/ Covering	H10	Glazing	Glazing	Assembly
		"	H11	Curtain Walling	Curtain Walling	Assembly
		"	H12	Curtain Walling	Curtain Walling	Assembly
		"	H13	Glazing	Glazing	Assembly
		"	H14	Precast Concrete	Assembly	Assembly
		"	H20	Cladding	Cladding	Assembly
		"	H21	Joinery	Joinery	Constructing
		"	H30	Cladding	Cladding	Assembly
		"	H31	Cladding	Cladding	Assembly
		"	H32	Cladding	Cladding	Assembly
		"	H33	Cladding	Cladding	Assembly
		"	H40	Cladding	Cladding	Assembly
		"	H41	Cladding	Cladding	Assembly
		"	H50	Precast Concrete	Assembly	Assembly
		"	H51	Stone Masonry	Stone Masonry	Assembly
		"	H52	Precast Concrete	Assembly	Assembly
		"	H60	Roofing	Roofing	Constructing
		"	H61	Roofing	Roofing	Constructing
		"	H62	Roofing	Roofing	Constructing
		"	H63	Roofing	Roofing	Constructing
		"	H64	Roofing	Roofing	Constructing
		"	H70	Metalwork	Metalwork	Constructing
		"	H71	Metalwork	Metalwork	Constructing
		"	H72	Metalwork	Metalwork	Constructing

Appendix A

CAWS Page Nr	Group Ref.	Sub-Group Ref.	Work Section Ref.	Potential Subcontract/ Main Contract	Level 1 Categorisation	Final Categorisation
		"	H73	Metalwork	Metalwork	Constructing
		"	H74	Metalwork	Metalwork	Constructing
		"	H75	Metalwork	Metalwork	Constructing
		"	H76	Cladding	Cladding	Assembly
	J	Waterproofing	J10	Asphalt	Asphalt	Constructing
		"	J20	Asphalt	Asphalt	Constructing
		"	J21	Asphalt	Asphalt	Constructing
		"	J22	Asphalt	Asphalt	Constructing
		"	J30	Asphalt	Asphalt	Constructing
		"	J31	Asphalt	Asphalt	Constructing
		"	J32	Main Contractor	Main Contractor	Constructing
		"	J33	Main Contractor	Main Contractor	Constructing
		"	J40	Main Contractor	Main Contractor	Constructing
		"	J41	Roofing	Roofing	Constructing
		"	J42	Roofing	Roofing	Constructing
		"	J43	Roofing	Roofing	Constructing
11	K	Linings/ Sheathing/ Dry partitioning	K10	Dry Lining	Dry Lining	Assembly
		"	K11	Dry Lining	Dry Lining	Assembly
		"	K12	Dry Lining	Dry Lining	Assembly
		"	K13	Dry Lining	Dry Lining	Assembly
		"	K20	Joinery	Joinery	Constructing
		"	K21	Joinery	Joinery	Constructing
		"	K30	Joinery	Joinery	Constructing
		"	K31	Plasterer	Plasterer	Finishing
		"	K32	Joinery	Joinery	Constructing
		"	K33	Terrazo Flooring	Terrazo Flooring	Constructing
		"	K40	Suspended Ceilings	Suspended Ceilings	Assembly
		"	K41	Raised Access Floors	Raised Access Floors	Assembly
	L	Windows/ Doors/ Stairs	L10	Glazing	Glazing	Assembly
		"	L11	Glazing	Glazing	Assembly
		"	L12	Glazing	Glazing	Assembly
		"	L20	Glazing	Glazing	Assembly
		"	L21	Glazing	Glazing	Assembly
		"	L22	Glazing	Glazing	Assembly
		"	L30	Joinery	Joinery	Constructing
		"	L31	Metalwork	Metalwork	Constructing
		"	L40	Glazing	Glazing	Assembly
		"	L41	Glazing	Glazing	Assembly
		"	L42	Glazing	Glazing	Assembly
	M	Surface finishes	M10	Flooring	Flooring	Finishing
		"	M11	Asphalt	Asphalt	Constructing
		"	M12	Flooring	Flooring	Finishing
		"	M20	Plasterer	Plasterer	Finishing
		"	M21	Plasterer	Plasterer	Finishing
		"	M22	Plasterer	Plasterer	Finishing
		"	M23	Plasterer	Plasterer	Finishing
		"	M30	Plasterer	Plasterer	Finishing
		"	M31	Plasterer	Plasterer	Finishing
		"	M40	Flooring	Flooring	Finishing
		"	M41	Terrazo Flooring	Terrazo Flooring	Constructing
		"	M42	Flooring	Flooring	Finishing
		"	M50	Flooring	Flooring	Finishing
		"	M51	Carpet	Carpet	Assembly
		"	M52	Painter & Decorator	Painter & Decorator	Finishing
		"	M60	Painter & Decorator	Painter & Decorator	Finishing
12	N	Furniture/ Equipment	N10	Furniture	Furniture	Prefabricator
		"	N11	Furniture	Furniture	Prefabricator
		"	N12	Furniture	Furniture	Prefabricator
		"	N13	Plumber	Plumber	Assembly
		"	N14	Furniture	Furniture	Prefabricator
		"	N15	Signwriter	Signwriter	Constructing
		"	N20	Furniture	Furniture	Prefabricator
		"	N21	Furniture	Furniture	Prefabricator
		"	N22	Furniture	Furniture	Prefabricator
		"	N23	Furniture	Furniture	Prefabricator
	P	Building fabric sundries	P10	Insulation	Insulation	Assembly
		"	P11	Insulation	Insulation	Assembly
		"	P20	Joinery	Joinery	Constructing
		"	P21	Joinery	Joinery	Constructing
		"	P22	Mastic Applicator	Mastic Applicator	Constructing
		"	P30	Main Contractor	Main Contractor	Constructing

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CAWS Page Nr	Group Ref.	Sub-Group Ref.	Work Section Ref.	Potential Subcontract/ Main Contract	Level 1 Categorisation	Final Categorisation
		"	P31	Main Contractor	Main Contractor	Constructing
	Q	Paving/ Planting/ Fencing/ Site furniture	Q10	Main Contractor	Main Contractor	Constructing
		"	Q20	Main Contractor	Main Contractor	Constructing
		"	Q21	Main Contractor	Main Contractor	Constructing
		"	Q22	Tarmacadam	Tarmacadam	Constructing
		"	Q23	Paving	Paving	Constructing
		"	Q24	Paving	Paving	Constructing
		"	Q25	Paving	Paving	Constructing
		"	Q26	Sport Surfaces	Sport Surfaces	Specialist
		"	Q30	Landscaper	Landscaper	Constructing
		"	Q31	Landscaper	Landscaper	Constructing
		"	Q40	Joinery	Joinery	Constructing
		"	Q50	Specialist Supplier	Specialist Supplier	Prefabricator
13	R	Disposal systems	R10	Plumber	Plumber	Assembly
		"	R11	Plumber	Plumber	Assembly
		"	R12	Main Contractor	Main Contractor	Constructing
		"	R13	Main Contractor	Main Contractor	Constructing
		"	R14	Main Contractor	Main Contractor	Constructing
		"	R20	Mechanical	Mechanical	Assembly
		"	R21	Mechanical	Mechanical	Assembly
		"	R30	Mechanical	Mechanical	Assembly
		"	R31	Mechanical	Mechanical	Assembly
		"	R32	Mechanical	Mechanical	Assembly
		"	R33	Mechanical	Mechanical	Assembly
	S	Piped supply systems	S10	Plumber	Plumber	Assembly
		"	S11	Plumber	Plumber	Assembly
		"	S12	Plumber	Plumber	Assembly
		"	S13	Plumber	Plumber	Assembly
		"	S14	Mechanical	Mechanical	Assembly
		"	S15	Landscaper	Landscaper	Constructing
		"	S20	Mechanical	Mechanical	Assembly
		"	S21	Mechanical	Mechanical	Assembly
		"	S30	Mechanical	Mechanical	Assembly
		"	S31	Mechanical	Mechanical	Assembly
		"	S32	Gas	Gas	Specialist
		"	S33	Gas	Gas	Specialist
		"	S34	Gas	Gas	Specialist
		"	S40	Mechanical	Mechanical	Assembly
		"	S41	Mechanical	Mechanical	Assembly
		"	S50	Mechanical	Mechanical	Assembly
		"	S51	Mechanical	Mechanical	Assembly
		"	S60	Mechanical	Mechanical	Assembly
		"	S61	Mechanical	Mechanical	Assembly
		"	S62	Mechanical	Mechanical	Assembly
		"	S63	Mechanical	Mechanical	Assembly
		"	S64	Mechanical	Mechanical	Assembly
		"	S65	Mechanical	Mechanical	Assembly
		"	S70	Mechanical	Mechanical	Assembly
		"	S71	Mechanical	Mechanical	Assembly
14	T	Mechanical heating/ Cooling/ Refrigeration systems	T10	Plumber	Plumber	Assembly
		"	T11	Plumber	Plumber	Assembly
		"	T12	Plumber	Plumber	Assembly
		"	T13	Mechanical	Mechanical	Assembly
		"	T14	Mechanical	Mechanical	Assembly
		"	T15	Mechanical	Mechanical	Assembly
		"	T16	Mechanical	Mechanical	Assembly
		"	T20	Mechanical	Mechanical	Assembly
		"	T30	Mechanical	Mechanical	Assembly
		"	T31	Plumber	Plumber	Assembly
		"	T32	Plumber	Plumber	Assembly
		"	T33	Mechanical	Mechanical	Assembly
		"	T40	Mechanical	Mechanical	Assembly
		"	T41	Mechanical	Mechanical	Assembly
		"	T42	Mechanical	Mechanical	Assembly
		"	T50	Mechanical	Mechanical	Assembly
		"	T60	Mechanical	Mechanical	Assembly
		"	T61	Mechanical	Mechanical	Assembly
		"	T70	Mechanical	Mechanical	Assembly
		"	T71	Mechanical	Mechanical	Assembly
		"	T72	Mechanical	Mechanical	Assembly

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CAWS Page Nr	Group Ref.	Sub-Group Ref.	Work Section Ref.	Potential Subcontract/ Main Contract	Level 1 Categorisation	Final Categorisation
	U	Ventilation/ Air conditioning systems	U10	Mechanical	Mechanical	Assembly
		"	U11	Mechanical	Mechanical	Assembly
		"	U12	Mechanical	Mechanical	Assembly
		"	U13	Mechanical	Mechanical	Assembly
		"	U14	Mechanical	Mechanical	Assembly
		"	U15	Mechanical	Mechanical	Assembly
		"	U16	Mechanical	Mechanical	Assembly
		"	U17	Mechanical	Mechanical	Assembly
		"	U20	Mechanical	Mechanical	Assembly
		"	U30	Mechanical	Mechanical	Assembly
		"	U31	Mechanical	Mechanical	Assembly
		"	U32	Mechanical	Mechanical	Assembly
		"	U33	Mechanical	Mechanical	Assembly
		"	U40	Mechanical	Mechanical	Assembly
		"	U41	Mechanical	Mechanical	Assembly
		"	U42	Mechanical	Mechanical	Assembly
		"	U43	Mechanical	Mechanical	Assembly
		"	U50	Mechanical	Mechanical	Assembly
		"	U60	Mechanical	Mechanical	Assembly
		"	U61	Mechanical	Mechanical	Assembly
		"	U70	Mechanical	Mechanical	Assembly
15	V	Electrical supply/ power/ lighting systems	V10	Electrical	Electrical	Assembly
		"	V11	Electrical	Electrical	Assembly
		"	V12	Electrical	Electrical	Assembly
		"	V20	Electrical	Electrical	Assembly
		"	V21	Electrical	Electrical	Assembly
		"	V22	Electrical	Electrical	Assembly
		"	V30	Electrical	Electrical	Assembly
		"	V31	Electrical	Electrical	Assembly
		"	V32	Electrical	Electrical	Assembly
		"	V40	Electrical	Electrical	Assembly
		"	V41	Electrical	Electrical	Assembly
		"	V42	Electrical	Electrical	Assembly
		"	V50	Electrical	Electrical	Assembly
		"	V51	Electrical	Electrical	Assembly
		"	V90	Electrical	Electrical	Assembly
	W	Communications/ Security/ Control systems	W10	Communications	Communications	Assembly
		"	W11	Communications	Communications	Assembly
		"	W12	Communications	Communications	Assembly
		"	W13	Communications	Communications	Assembly
		"	W20	Communications	Communications	Assembly
		"	W21	Communications	Communications	Assembly
		"	W22	Communications	Communications	Assembly
		"	W23	Communications	Communications	Assembly
		"	W30	Communications	Communications	Assembly
		"	W40	Security	Security	Assembly
		"	W41	Security	Security	Assembly
		"	W50	Electrical	Electrical	Assembly
		"	W51	Electrical	Electrical	Assembly
		"	W52	Electrical	Electrical	Assembly
		"	W53	Electrical	Electrical	Assembly
		"	W60	Electrical	Electrical	Assembly
		"	W61	Electrical	Electrical	Assembly
		"	W62	Electrical	Electrical	Assembly
	X	Transport systems	X10	Lifts	Lifts	Assembly
		"	X11	Escalators	Escalators	Assembly
		"	X12	Escalators	Escalators	Assembly
		"	X20	Machinery	Machinery	Assembly
		"	X21	Machinery	Machinery	Assembly
		"	X22	Machinery	Machinery	Assembly
		"	X23	Machinery	Machinery	Assembly
		"	X30	Machinery	Machinery	Assembly
		"	X31	Machinery	Machinery	Assembly
		"	X32	Machinery	Machinery	Assembly
16	Y	Services reference specification	Y10	Mechanical	Mechanical	Assembly
		"	Y11	Mechanical	Mechanical	Assembly
		"	Y20	Mechanical	Mechanical	Assembly
		"	Y21	Mechanical	Mechanical	Assembly
		"	Y22	Mechanical	Mechanical	Assembly
		"	Y23	Mechanical	Mechanical	Assembly

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CAWS Page Nr	Group Ref.	Sub-Group Ref.	Work Section Ref.	Potential Subcontract/ Main Contract	Level 1 Categorisation	Final Categorisation
		"	Y24	Mechanical	Mechanical	Assembly
		"	Y25	Mechanical	Mechanical	Assembly
		"	Y30	Mechanical	Mechanical	Assembly
		"	Y31	Mechanical	Mechanical	Assembly
		"	Y40	Mechanical	Mechanical	Assembly
		"	Y41	Mechanical	Mechanical	Assembly
		"	Y42	Mechanical	Mechanical	Assembly
		"	Y43	Mechanical	Mechanical	Assembly
		"	Y44	Mechanical	Mechanical	Assembly
		"	Y45	Mechanical	Mechanical	Assembly
		"	Y46	Mechanical	Mechanical	Assembly
		"	Y50	Mechanical	Mechanical	Assembly
		"	Y51	Mechanical	Mechanical	Assembly
		"	Y52	Mechanical	Mechanical	Assembly
		"	Y53	Mechanical	Mechanical	Assembly
		"	Y54	Mechanical	Mechanical	Assembly
		"	Y59	Mechanical	Mechanical	Assembly
		"	Y60	Electrical	Electrical	Assembly
		"	Y61	Electrical	Electrical	Assembly
		"	Y62	Electrical	Electrical	Assembly
		"	Y63	Electrical	Electrical	Assembly
		"	Y70	Electrical	Electrical	Assembly
		"	Y71	Electrical	Electrical	Assembly
		"	Y72	Electrical	Electrical	Assembly
		"	Y73	Electrical	Electrical	Assembly
		"	Y74	Electrical	Electrical	Assembly
		"	Y80	Electrical	Electrical	Assembly
		"	Y81	Electrical	Electrical	Assembly
		"	Y82	Electrical	Electrical	Assembly
		"	Y89	Electrical	Electrical	Assembly
		"	Y90	Electrical	Electrical	Assembly
		"	Y91	Painter & Decorator	Painter & Decorator	Finishing
		"	Y92	Electrical	Electrical	Assembly
	Z	Building fabric reference specification	Z10	Joinery Fabricator	Prefabricator	Prefabricator
		"	Z11	Metalwork Fabricator	Prefabricator	Prefabricator
		"	Z20	Main Contractor	Main Contractor	Constructing
		"	Z21	Main Contractor	Main Contractor	Constructing
		"	Z22	Mastic Applicator	Mastic Applicator	Constructing
		"	Z30	Painter & Decorator	Painter & Decorator	Finishing

Appendix B

Interview selection process

Setting

- Numerous types of contractors.
- All carry out different types of work & manage differently.
- *But* probable that generic pricing techniques exist based on contractor/ job characteristics.
- By identifying these = potential to maximise results for given research resources.

Methodology in developing a generic list of contractor types

- Start with a comprehensive list i.e. The Common Arrangement of Work Sections (CAWS).
- Consider the types of contractors that may undertake such work.
- Develop a list of generic types.

Results of generic list

Category	Characteristics	e.g.
Demolition	• large scale & small scale demolition	demolition contractor
Groundwork	• involved in substructure working, structural & non-structural works	piling/ excavation/ ground stabilisation
Assembly	• contractors responsible for 'assembling' products on site (& usually their prefabrication) • assembly process usually relatively quick using bolting/ welding techniques etc • pre-site assembly may be quite extensive • these products receive their final shape before being built into the building (formed) • usually involves considerable amount of contractor design input and, thus, expertise.	steelwork/ M&E/ cladding/ glazing/ precast concrete
Constructing	• greater degree of 'constructing' the end product in-situ than assembly trades • usually involves the use of bonding materials e.g. mortar • involves the use of both formed (e.g. brickwork) and formless materials (e.g. concrete) • these trades usually construct to a design rather than creating their own	typical main contract work/ joinery/ roofing/ paving/ landscaping/ concreting
Prefabricator	• usually 'suppliers-only' of prefabricated units - not usually involved in assembly stage	proprietary buildings/ suppliers of furniture/ prefabricated joinery e.g. trusses

Appendix B

Results of generic list (continued)

Category	Characteristics	e.g.
Finishing	• involves (mainly) the application of formless products (these are naturally volumes & take their final shape in position) • also assembly of prefabricated units e.g. plasterboard & coving • both are undertaken at latter stages of construction process to produce a finished surface.	floor screeding/ plastering/ painting/ decorating/ plasterboarding
Specialist	• outright specialists that do not easily fall into any of the above	gas installers/ sports surfaces

Practical issues

- Initially approach contractors from Yellow Pages.

Commentary

- Generic groupings suspect.
- Will become less of a problem as more data is collated & knowledge gained.
- **Just bear these in mind @ analysis stage & review in light of results.**

Interviews: Data Collection

1. GENERAL DETAILS?	2. PROCESSES?	3. PROBLEMS?		
Backgound information	**Processes involved in establishing a price?**	**What problems are encountered? (can these be categorised?)**	**What's the underlying problem?**	**How frequently do these occur?**
Contractor:	**Separate into: BQ/ Plan & Spec/ D&B**	Conceptualise the problems!	Not reflect how work is priced? - wrong kind of info?	Note: refer back to the identified stages
Type:	- what steps are involved?			
Date:	- flag up bill?		- time related?	
Location & time:	- exact details		- just poor info? - project not adequately defined?	
Interviewee& position:	- actually sketch the process			
Number of personnel:	- how do you calculate/ build up the price? - e.g. do you build up a unit rate, then multiply by a quantity?			
Turnover:				
Time in business:	- or work out a price then divide by a quantity?			
Number of jobs priced per year/ day?	- is the quantity useful?			
	- is drawn info a necessity?			
	- locational info. important?			
Conditions of Contract?	- double check quants against drawings?			
What are the specifications referred to as?	- which info is used?			
Values of job types:- BQ/ Plan & Spec/ D&B etc	- which info is not used? - specification not too much of a problem as using v. similar products time & time again?			
	- just walk into room & price?			

4. CONSEQUENCES?			5. PROPOSALS?		6. COMMENTS?
How does this effect the accuracy of the price?	**Price risk endured by:-**		**How can this be overcome/ how can pricing info be improved?**		**Comments/ non-directed discussion**
	Client?	**Constructor?**	**Alter processes**	**Alter methods**	
	How does risk shift? - is this equitable i.e. risk & control together? - how does this risk differ at the various stages of construction? - Who retains risk of:- - design? - quantities? - (how sub/c'd - D&B, Plan & Spec, BQ)	- Ditto	Note: refer back to the identified stages - reduce frequency? - reduce extent?		Note other factors:- e.g. proportion of labour/ material value? - level of subcontractor design input? - do these factors effect preferred methods of pricing? - formed v. formless - buying/ pricing? - differences in m/c, sub/c, sub/sub/c pricing?

Appendix D

Industry survey sampling methodology

The sampling process seeks to obtain a representative sample of two different groups of contractor to test-out differences in their pricing behaviour.

Perhaps the best way to achieve this will be to directly compare the results of **separate samples** - one of **specialists** (as defined) and another of **non-specialists**. This will provide a clear division within the results and make comparison simpler.

To avoid small number statistics a minimum of 32 responses is required per sample. The attached calculation attempts to account for anticipated non-response and in so doing increases each sample to 182.

The issue of *a minimum acceptable response rate* can be avoided by initially making contact with each estimator, employing follow-up tactics and collecting information on the non-respondents.[1] An assessment can then be made of whether the non-respondents represent a different unknown body of opinion.

A **secondary sample** is proposed to compare the results. If differences are found to be insignificant we could assume that other representative bodies within the same group are also likely to hold similar views. Due to limited resources I suggest that only a secondary *specialist* sample is taken. If these results are comparable we could then further assume that similar relationships exist between different groups of *non-specialists*.

To test the theory it is probably better to use contractors that frequently display one or other of these behavioural characteristics.

With this in mind I propose the **ECA** (Electrical Contractors Association) and **HVCA** (Heating & Ventilating Contractors' Association) for the *specialists* and the **NFB** (National Federation of Builders) for the *non-specialists*. Having trawled through all the available sampling frames these are considered to the most representative for the task in hand. Access to all three has also been granted. By adding this third sample the total number of questionnaires to be sent out now equates to (rounded up to) 546 (3 x 182).

The proposed technique may be defined as a **non-probability, non-proportional quota sampling technique** and is a recognised method of obtaining views from targeted groups[2] (Fellows & Liu define this as non-probability stratified sampling p.121). It is *non-proportional* as no attempt is made to proportionally represent each group as they appear in the total population (even if we knew what these were). By establishing a quota we ensure that each of these groups is adequately represented.

The method also possesses an element of judgement sampling in that we're seeking the views of subjects with a particular knowledge. These could be selected randomly once membership listings are obtained.

---

[1] Nachmias, C.F. & Nachmias, D. (1992) "Research Methods in The Social Sciences." 4th Edition. Edward Arnold: London. p. 191.

[2] Sekaran, U. (1992) "Research Methods for Business - A Skill Building Approach." 2nd Edition. John Wiley & Sons. p. 236.

Appendix D

Calculation of sample size

Assumptions:

1. basic requirement of 32 responses for each sample drawn.
2. typical return rate of around 30%.
3. time constraints of estimators may reduce this further.
4. however, as the topic is particularly relevant to estimators they may be encouraged to respond.
5. the questionnaire has been well piloted (& re-piloted) to remove any threatening questions and ensure it's not too long or complex (14 sent out & 10 returned).

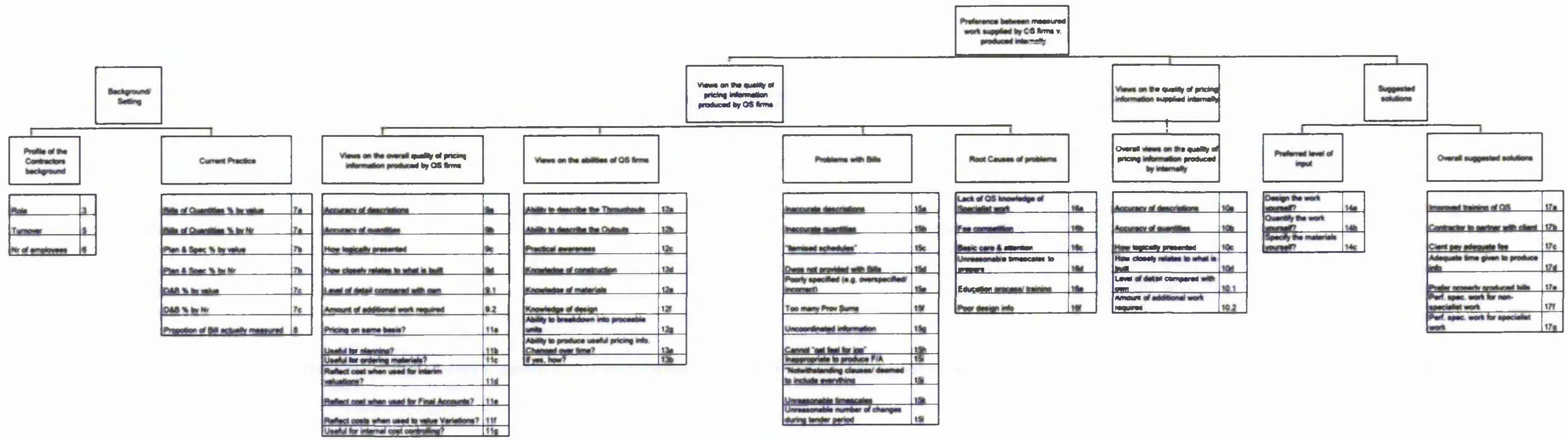
Response rate:

- taking the above factors into account it is anticipated that the response rate may be around 18%.

Sample size for each representative body:

- base figure 32
- assumed response level 18%
- $\therefore$ **sample size** $(32 \div 0.18)$ = **182**

Industry survey: Illustrated question hierarchy



SECTION 1: ABOUT YOURSELF

Please fill out the following details in the spaces provided:-

1. Job title : ....

2. Location: ....

Please tick the most appropriate response:-

3. Typical role:

☐ Main Contractor ☐ Subcontractor ☐ Other, please specify ....

4. Type of work undertaken: ....

(e.g. plastering, steelwork, mechanical, groundwork etc)

Please tick the most appropriate response:-

5. Approximate annual turnover of the company:-

(if part of a larger group of companies, please restrict your response to the immediate division or sector)

less than or equal to £100,000:	☐	greater than £1m & less than or equal to £25m:	☐
greater than £100,000 & less than or equal to £500,000:	☐	greater than £25m & less than or equal to £100m:	☐
greater than £500,000 & less than or equal to £1m:	☐	over £100m:	☐

6. Approximate number of employees within the company:-

(inclusive of site operatives)

0:	☐	50 - 99 :	☐
1 - 4:	☐	100 - 199:	☐
5 - 9:	☐	200 - 249:	☐
10 - 19:	☐	250 - 499:	☐
20 - 49:	☐	500 + :	☐

SECTION 2: ABOUT THE INFORMATION YOU RECEIVE FROM THE CLIENT

7. Described below are three different ways in which a client may obtain a price from you. Please indicate the approximate percentage (by value & number) of your pricing workload that represents how you initially receive the information from the client:-

Please note: totals should equal 100:-

FORMAT OF THE INFORMATION YOU RECEIVE FROM THE CLIENT:-	PRICED PER ANNUM:-	
	% BY VALUE	% BY NUMBER
a) BILLS OF QUANTITIES PRODUCED BY THE CLIENT (i.e. the work is pre-designed & quantified by the client side)....		
b) PLAN & SPECIFICATION (i.e. the work is pre-designed but unquantified by the client side)..		
c) DESIGN & BUILD (i.e. the work is neither designed nor quantified by the client side)..		
Totals	= 100	= 100

Please tick the most appropriate response:-

8. Referring to Bills of Quantities typically supplied by the client, what proportion of their value is actually measured?

(i.e. once you subtract the Preliminaries, Prime Cost Sums, Provisional Sums, itemised descriptions and contractor design elements etc.):-

- 0 - 10%: ☐
- 11 - 25%: ☐
- 26 - 50%: ☐
- 51 - 75%: ☐
- 76 - 100%: ☐
- Not applicable : ☐

SECTION 3: YOUR VIEWS ON QUANTIFIED INFORMATION PRODUCED BY *CONSULTANT QUANTITY SURVEYING FIRMS*

Please circle the most appropriate response:-

9. Which response best describes the measured work when it is supplied by a *Consultant Quantity Surveying firm*:-

a) how accurately the descriptions specify the quality of the works to be carried out:.....	very good	good	poor	very poor
b) accuracy of the quantities:..........................	very good	good	poor	very poor
c) how logically the information is presented:..	very good	good	poor	very poor
d) how closely the information relates to what is eventually built:...............................	very good	good	poor	very poor

Please tick the most appropriate response:-

9.1 When you compare the <u>level of detail</u> of measured work typically supplied by *Consultant Quantity Surveying firms* with your own estimating cost data, the measured work supplied by *Consultant Quantity Surveying firms* is:-

far more detailed	more detailed	less detailed	far less detailed
☐	☐	☐	☐

9.2 How much additional work is required to supplement the measured work supplied by *Consultant Quantity Surveying firms* in order that a price may be calculated?:-

none	a little	a lot	It's not used at all
☐	☐	☐	☐

SECTION 4: YOUR VIEWS ON QUANTIFIED INFORMATION PRODUCED *WITHIN* YOUR OWN ORGANISATION

Please circle the most appropriate response:-

10. Which response best describes the measured work when it is supplied by someone *within your own organisation*:-

(i.e. either by yourself or a colleague)

a) how accurately the descriptions specify the quality of the works to be carried out:.....	very good	good	poor	very poor
b) accuracy of the quantities:..........................	very good	good	poor	very poor
c) how logically the information is presented:..	very good	good	poor	very poor
d) how closely the information relates to what is eventually built:..............................	very good	good	poor	very poor

Please tick the most appropriate response:-

10.1 When you compare the <u>level of detail</u> of the *internally supplied measured work* with your own estimating cost data, the *internally supplied measured work* is:-

far more <u>detailed</u>	more <u>detailed</u>	less <u>detailed</u>	far less <u>detailed</u>
☐	☐	☐	☐

10.2 How much additional work is required to supplement the *internally supplied measured work* in order that a price may be calculated?:-

<u>none</u>	<u>a little</u>	<u>a lot</u>	<u>It's not used at all</u>
☐	☐	☐	☐

SECTION 5: FURTHER VIEWS ON QUANTIFIED INFORMATION PRODUCED BY *CONSULTANT QUANTITY SURVEYING FIRMS*

Please circle the most appropriate response:-

11. Based on the typical measured work that is supplied by *Consultant Quantity Surveying firms*, which of following advantages do you agree with?

a) all pricing on the same basis (i.e. levels the playing field):......................	strongly agree	agree	disagree	strongly disagree
b) useful for planning the works:....................	strongly agree	agree	disagree	strongly disagree
c) useful for ordering materials:.....................	strongly agree	agree	disagree	strongly disagree
d) accurately reflects the cost of the works when used to prepare interim valuations:....................................	strongly agree	agree	disagree	strongly disagree
e) accurately reflects the cost of the works when used to prepare the Final Account:....................................	strongly agree	agree	disagree	strongly disagree
f) can be used to accurately value the actual cost of variations:......................	strongly agree	agree	disagree	strongly disagree
g) useful for internal cost controlling by the contractor (i.e. comparing actual costs incurred against the individual items as they are measured):................................	strongly agree	agree	disagree	strongly disagree
h) other, please specify:...............................	strongly agree	agree	disagree	strongly disagree

----

Please circle the most appropriate response:-

12. In relation to your own area of work, how do you rate the ability of *Consultant Quantity Surveying firms* in terms of their:-

a) ability to describe the processes involved in constructing the works and resources required to achieve this (i.e. the **THROUGHPUTS**):..................	very good	good	poor	very poor
b) ability to describe the performance requirements of the finished product/ the function it is required to serve (i.e. the **OUTPUTS**)........................	very good	good	poor	very poor
c) practical awareness:..	very good	good	poor	very poor
d) knowledge of construction:.......................................	very good	good	poor	very poor
e) knowledge of materials:..	very good	good	poor	very poor
f) knowledge of design:..	very good	good	poor	very poor
g) ability to break down the construction into priceable units:...............................	very good	good	poor	very poor
h) other, please specify:..	very good	good	poor	very poor

Please tick the most appropriate response:-

13. Do you believe that the ability of *Consultant Quantity Surveying firms* to produce useful quantified information has changed over time?:-

- yes, their ability to produce useful quantified information has **improved** over time ☐
- yes, their ability to produce useful quantified information has **deteriorated** over time ☐
- no, their ability to produce useful quantified information has **remained constant** over time ☐

13.1 If yes, over what time period has this shift in ability been most noticeable?

- within the last 5 years: ☐
- 6 to 10 years: ☐
- 11 to 15 years: ☐
- 16 to 20 years: ☐
- more than 20 years: ☐

SECTION 6: YOUR PREFERRED LEVEL OF INPUT

14. Please consider how your price for two identical projects may be affected by the following scenarios:-

Scenario 1:

you are required to base your price upon the kind of typical measured work you receive from *Consultant Quantity Surveying firms*.

Scenario 2:

at the outset of an identical project you're given all 3 options:-

1) design the work yourself
2) quantify the work yourself
3) specify the materials yourself

the only condition being that you comply with the same overall performance specification.

Question: How would your price for the second scenario differ to that of the first?:-

Please tick the most appropriate response:-

If given the freedom to:-

then, the overall price would be affected in the following direction:-

	reduce greatly – –	reduce –	remain the same 0	Increase +	increase greatly + +
a) design the work yourself:........................	☐	☐	☐	☐	☐
b) quantify the work yourself:.......................	☐	☐	☐	☐	☐
c) specify the materials used:......................	☐	☐	☐	☐	☐
d) other, please specify:.............................	☐	☐	☐	☐	☐

SECTION 7: YOUR COMMENTS

15. In your opinion, what is the main problem encountered when pricing measured work supplied by *Consultant Quantity Surveying firms*?

16. Based on the above, what do you consider to be best method(s) of overcoming this?

SECTION 7: YOUR COMMENTS (CONTINUED)

17. **Do you have anything else to add? Please feel free to state your views on how the source of the measured work affects how you price (i.e. when it is supplied by a *Consultant Quantity Surveying firm* as opposed to being supplied *internally*):-**

Appendix G: Reply to RICS M&E presentation

Stuart Kings
5 Gladstone Street
Hessle
Hull
HU13 OSD

Mr J L N Martin
Executive Director
Building Cost Information Service Ltd
12 Great George Street
Parliament Square
London
SW1P 3AD

27th September 2000

Dear Mr Martin

Re: RICS Presentation 03/08/2000 – "*Improving the Effectiveness of Pricing Documentation*"

Many thanks for your letter dated 04/08/2000 commenting on the presented findings of the above research project. Your observations are very helpful and have each been addressed below:-

Observation 1:
"The results on BQ's relating to non-specialist trades are really helpful. It would seem that contractors see BQ's as part of the "solution" not part of the "problem". This is a result that would be worth publicising."

Response:
Yes, the Non-Specialist trades (e.g. Main Contractors, plasterers & excavation contractors) prefer good quality Bills to be produced for them. They are satisfied with the industry's established principles for preparing pricing documentation i.e. SMM7.

Their work is (usually) comparatively simple in nature, substantially designed and well understood by those producing the pricing information. As a consequence, high quality pricing information can be produced. The level of dissatisfaction often expressed relates purely to the quality of the end product not the principles employed in producing Bills.

I would agree that this fact is worth publishing. In essence we already have the *"solution"* for Non-Specialist trades, we just need to ensure that standards are maintained and the rules of measurement set out in SMM7 are followed. No need to reinvent the wheel here!

Appendix G: Reply to RICS M&E presentation

Observation 2:
"The comments on BQ's relating to specialist trades are less relevant given the low number of bills available."

Response:
Accepted, the survey results illustrate that Specialist trades (e.g. M&E & Structural Steelwork contractors) only receive about 6% of their total workload in Bill format and that only about 1% of their total workload is actually measured. As a consequence, views specifically related to Bills (e.g. how useful they are for ordering materials) are sensitive to a small number of respondents and may well be distorted.

The detailed responses on Bills are less relevant, however, I consider the following *general* findings to be worthy of circulation to a wider audience:-

1. Only about 6% of their workload is presented in Bill of Quantities format.
2. Only about 1% of their total workload is actually measured.
3. The overwhelming preference to produce their own quantities and not to have this prescribed to them in Bills of Quantities format.

Such a low usage of Bills may be explained by earlier findings within the research project. Interviews identified that Specialist work is (usually) complex in nature, not substantially designed and poorly understood by those producing the pricing information. As a consequence, it becomes difficult for an outsider to articulate and, as expected, virtually impossible in cases where the progression of the design rests with the Contractor.

Observation 3:
"The massive vote in favour of Performance Specification is interesting. Does your research identify exactly what they mean by Performance Specification?"

Response:
To some extent. The research identifies, in principle, where the responsibility to quantify the work should reside – either with the client or contractor. Performance Specified work, in the context of this research, refers to pricing documentation supplied by the client which merely specifies the requirements of the end product (its functionality), it does not prescribe the individual quantities that require pricing. Essentially, the contractor has complete freedom to price the work in whichever way they see fit. With Performance Specified work, the responsibility to quantify resides with the Contractor.

The survey results indicate that, in principle:-

a) Non-Specialist trades prefer pricing information to be produced for them in Bills of Quantities format (i.e. they do not prefer Performance Specified work), and;

b) Specialist trades prefer to produce their own pricing information (i.e. they prefer Performance Specified work).

Appendix G: Reply to RICS M&E presentation

Observation 4:
"Research into how Performance Specification could be structured as the design develops would be interesting."

Response:
Yes, having now identified the preference for Performance Specified work by Specialist trades, more detailed research in this area would certainly be of benefit.

However, I consider that the Building Services Guidance Notes already provide an excellent basis for clarifying the responsibilities of a tendering contractor. For example, the Allocation of Design Responsibilities (p.10) read in conjunction with the Pricing Schedule (p.44).

Observation 5:
"Presumably, at some stage in the procurement process, measurement is necessary even if it is only for planning and ordering purposes. Who does this and what level of detail do they do it."

Response:
Yes, at all stages within the procurement process, measurement is a necessity.

Non-Specialist trades tend to base their price on the externally quantified information then remeasure against this for ordering purposes and for Payment Applications/ Final Account.

In contrast, Specialist trades undertake all measurement themselves at all stages of construction even if external quantities are produced for them. Interviews with Specialist trades identified that, even when supplied with externally quantified information, they would discard this, quantify themselves and then submit a lump sum price. Effort is therefore wasted in attempting to quantify the work on their behalf.

Furthermore, although a certain amount of consistency exists within the industry, the manner in which this is undertaken by Specialist trades is often unique to the contracting organisation.

Appendix G: Reply to RICS M&E presentation

In addition to commenting on the observations made, I feel that it is important to draw on the similarities between my own research findings and advice contained within the Building Services Procurement Guide. These are listed below:-

⇨ Accepted that services cost & procurement advice requires input from technically trained specialist QSs (p.7)

⇨ A small skill base exists within the QS profession to measure M&E services (p.37)

⇨ Recommendation that the building services designer should be brought in to the design at the same time as the Architect and Structural Engineer (p.26)

⇨ Specific problems relating to building services installations:-
- The contractors wish to propose alternative items of plant & equipment
- High level of design co-ordination within their own area of work (p.18)

⇨ Bills of Quantities:-
- May not reflect how the work is priced (p.23)
- Allowing the contractor the discretion to choose plant and equipment will most likely result in a lower overall price (p.37)
- Services contractors have traditionally had a closer relationship with Services Engineers than with QSs because the Engineer usually relies on the expertise of the contractor to carry out some of the design work. This results in areas of the design being described only in terms of its performance and the contractor offers a design solution to meet the performance criteria. QSs are unable to produce Bills from this (p.37)
- Should not be used unless the design is fully co-ordinated and specified. If the work is only partially designed and detail design is required of the contractor then Bills should not be used (p.36)
- Bill production is limited by two main factors:-
  - Information available for billing is limited due to the fact that much of the design responsibility resides with the Contractor.
  - History has dictated that the design is not far enough advanced within the procurement timetable to provide the QS with sufficient information for billing.
- Overall recommendation – Bills are most appropriate when the project is small, the building elements are not complex and the services contractor is not required to have any design input (p.25). In reality this situation is rare.
- In other cases, Pricing Schedules (effectively a Performance Specification – allowing the Contractor to quantify themselves) are recommended in lieu of Bills of Quantities (p.40)

Finally, I would like to take this opportunity to thank you again for your invaluable attendance on the day and, in advance, for any further direction/ advice you are able to give based on the above.

Yours sincerely

Stuart Kings

Cc Roger Winfield
John Sparkes
David Nicholl

SECTION 1: INTRODUCTION

The overall aim of the research is to improve the usefulness of pricing information prepared for contractors estimators.

So far the research has successfully identified two main classifications of contractor:-

1. **"SPECIALISTS", &**
2. **"NON-SPECIALISTS"**

These definitions are specific to the research so we've provided an explanation of their characteristics below.

Having read this, we'd then like to get your opinion on the best way to obtain prices from each of the two types of contractor (as we've defined them). In other words, how to improve the usefulness of pricing information prepared for estimators within **Specialist** and **Non-Specialist** contracting companies.

SECTION 2: "SPECIALIST" & "NON-SPECIALIST" CONTRACTORS EXPLAINED

To expand on these definitions we've tabulated some of their common traits. Whilst it is accepted that an individual contractor will not always display all these characteristics at any one point in time, they will usually fall broadly into one or other of the following two categories.

1. Type of contractor (as defined by the research)	**2. Typical examples of trades/ types of work**	**3. Level of complexity** (of the type of work)	**4. Level of understanding of the type of work** (by those producing the pricing documentation)	**5. State of the design** (i.e. whether it is complete or not)
"SPECIALISTS"	• mechanical • electrical • structural steelwork	• **high**, very complex requiring an in depth knowledge of unique trades.	• **low**, only a limited number within the industry posses an in depth knowledge of these trades.	• usually incomplete. • further design is usually required by the tendering contractor (either when pricing or during construction).
"<u>NON</u> - SPECIALISTS"	• excavation • drainage • brickwork • flooring • roof tiling • plastering • floor tiling • painting • suspended ceilings	• **low**, the work involved is relatively straight forward.	• **high**, this type of work usually forms the core training received by most within the industry. • as a consequence, the majority within the industry are well versed in the terminology and details of construction.	• generally substantially complete. • very little further design needs to carried out by the tendering contractor (either when pricing or during construction).

SECTION 3: YOUR VIEWS ON "SPECIALIST" WORK

(Examples:- Mechanical & Electrical contractors, structural steelwork)

Please tick the most appropriate response:-

3.1) Based on the pricing information typically prepared by Consultant Quantity Surveying firms, do you consider that they are able* to *accurately prepare quantified pricing information for* "SPECIALIST" work?

*(**Please note**: Lack of *ability* may relate to factors such as - design information not being complete or available, lack of knowledge by the Consultant Quantity Surveyor or because the work includes an element of contractor design and cannot yet be quantified etc).

Always	Often	Sometimes	Never
☐	☐	☐	☐

3.2) Would it be more useful to the contractors estimator if the Consultant Quantity Surveyor did not attempt to quantify the work?

Yes	No
☐	☐

SECTION 4: YOUR VIEWS ON "NON-SPECIALIST" WORK

(Examples:- excavation, drainage, brickwork, flooring, roof tiling, plastering, tiling, painting, suspended ceilings)

Please tick the most appropriate response:-

4.1) Based on the pricing information typically prepared by Consultant Quantity Surveying firms, do you consider that they are able* to *accurately prepare quantified pricing information for* "NON-SPECIALIST" work?

*(**Please note**: Lack of *ability* may relate to factors such as - design information not being complete or available, lack of knowledge by the Consultant Quantity Surveyor or because the work includes an element of contractor design and cannot yet be quantified etc).

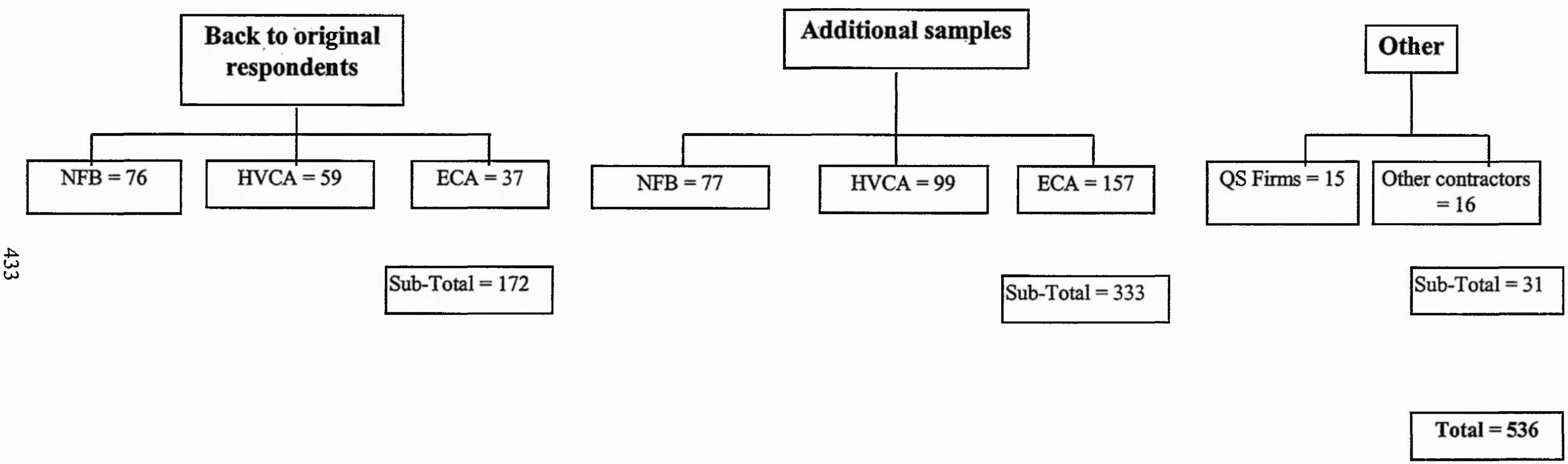
Always	Often	Sometimes	Never
☐	☐	☐	☐

4.2) Would it be more useful to the contractors estimator if the Consultant Quantity Surveyor did not attempt to quantify the work?

Yes	No
☐	☐

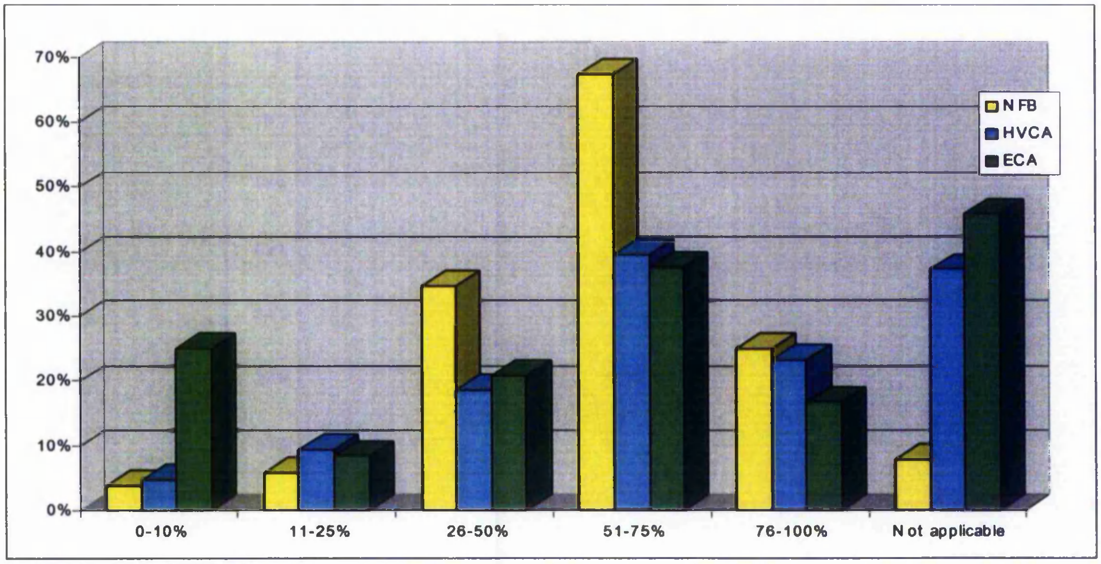
Appendix I

Illustration of the empirical testing sampling decisions



Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.8: Referring to bills of quantities typically supplied by the client, what proportion of their value is actually measured? (question 8)



Source: Analysis of survey data (Industry Survey)

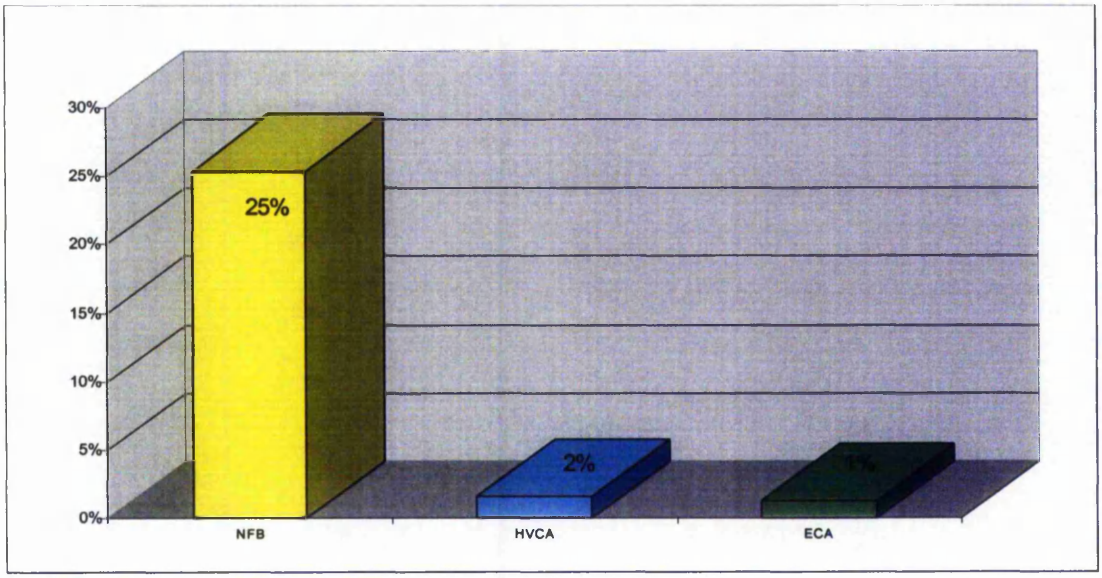
The NFB results reveal that, when bills are received, 26-50% of the value of work is actually measured on 35% of occasions, 51-75% on 67% of occasions and 76-100% on 25% of occasions. The results of the HVCA and ECA broadly follow this pattern with 51-75% of the value measured on 40% and 38% of occasions respectively. However, the results of the ECA for the 0-10% category depart from this trend with a response of 25% of occasions.

Overall, when bills are received, the percentage of work actually measured most frequently falls into the 51-75% of value category. The 'not applicable' category relates to those estimators that do not receive bills at all. As anticipated the higher responses relate to the specialist firms 37% for the HVCA and 46% for ECA.

Appendix J: Industry survey results – Objective 2.1

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.9: Overall percentage of the workload that is actually measured by the client (by value)?



Source: Analysis of survey data (Industry Survey)

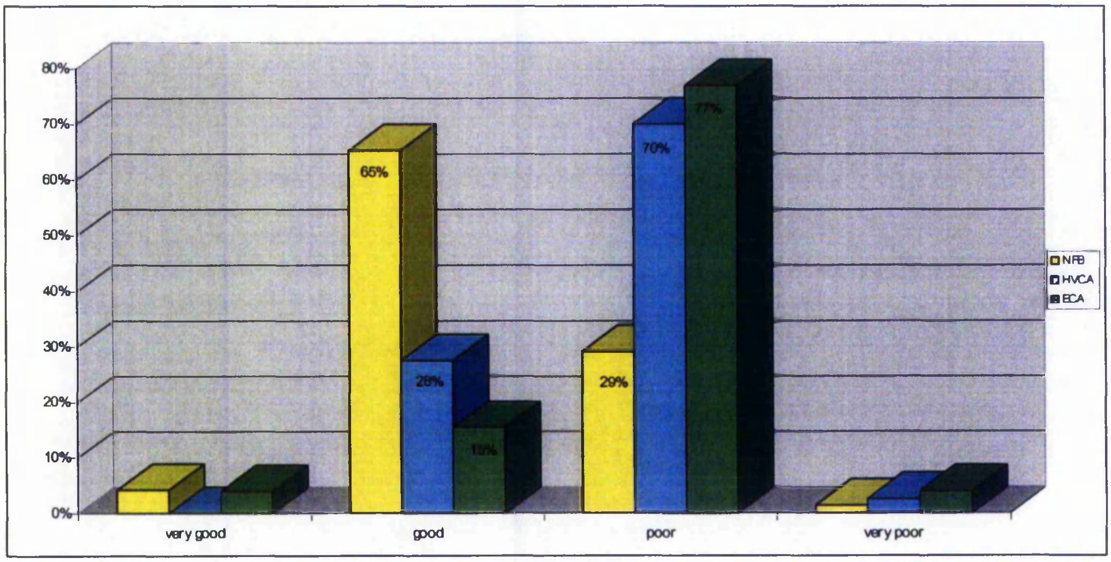
The above graph displays the *actual* value of work received in measured form. This has been calculated by analysing the results of chart 4.6 (p.226) and chart 4.8 (p.434) i.e. percentage by value of work received in bill format and percentage by value actually measured for each respondent.

The results reveal that, overall, 25% of the NFB contractors' workload is *actually* measured by the client. In calculating the above, the highest figure in each category has been used. For example, if the respondent stated that 50% of their workload was in bill format and that between 51-75% of this was actually measured then the actual percentage has been calculated thus: 50 x 0.75 = 37.5%.

The responses from the specialist contractors reveal that only 2% of the HVCA contractors workload is actually measured compared against 1% for the ECA. The actual value of work received in measured form is therefore negligible for specialist trades. Further, based on the above calculation this assumes the highest possible value within each category. If a more sensitive banding had been used this may well have revealed lower percentages of work actually measured.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.10: When measured work is supplied by a *consultant quantity surveying firm*, which response best describes how accurately the descriptions specify the quality of the works to be carried out? (question 9a)



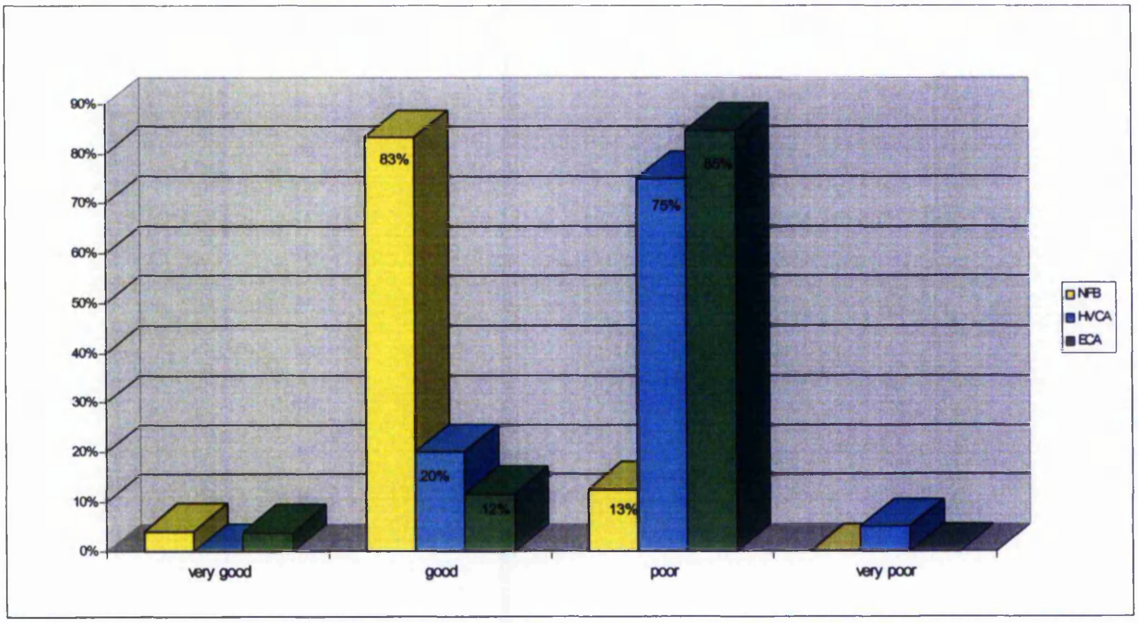
Source: Analysis of survey data (Industry Survey)

Overall, the response from the non-specialists is seen to be more positive than that of the specialists. 65% of non-specialists consider that the quality of measured work supplied by consultant quantity surveying firms, in terms of how accurately the descriptions specify the quality of the works to be carried out, is 'good'. Only 29% of non-specialists considered this to be 'poor'.

In contrast, the HVCA considered the accuracy of the information to be 70% 'poor' and 28% 'good'. Similarly the ECA considered this to be 77% 'poor' and only 15% 'good'. The results of the two specialist groups are comparable.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.11: When measured work is supplied by a *consultant quantity surveying firm*, which response best describes the accuracy of the quantities? (question 9b)

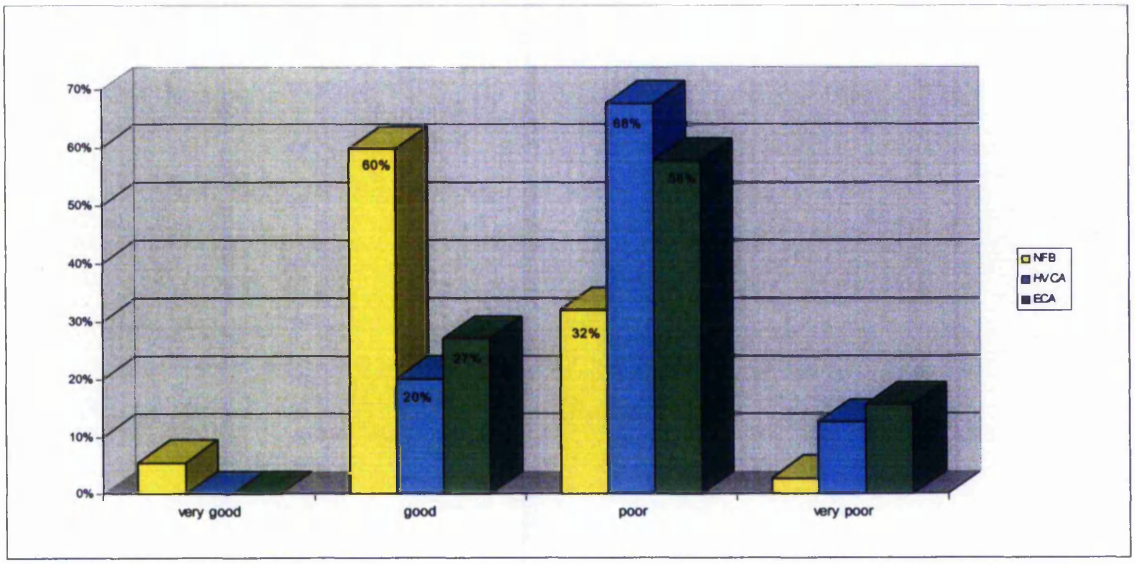


<u>Source:</u> Analysis of survey data (Industry Survey)

In terms of the accuracy of the quantities, the views of the specialists and non-specialists are seen to differ considerably. The specialists respond with 83% 'good' and 13% 'poor'. This compares with 75% 'poor' and 20% 'good' from the HVCA and 85% 'poor' and 12% 'good' from the ECA. The views of the two specialist groups follow a similar trend.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.12: When measured work is supplied by a *consultant quantity surveying firm*, which response best describes how logically the information is presented? (question 9c)



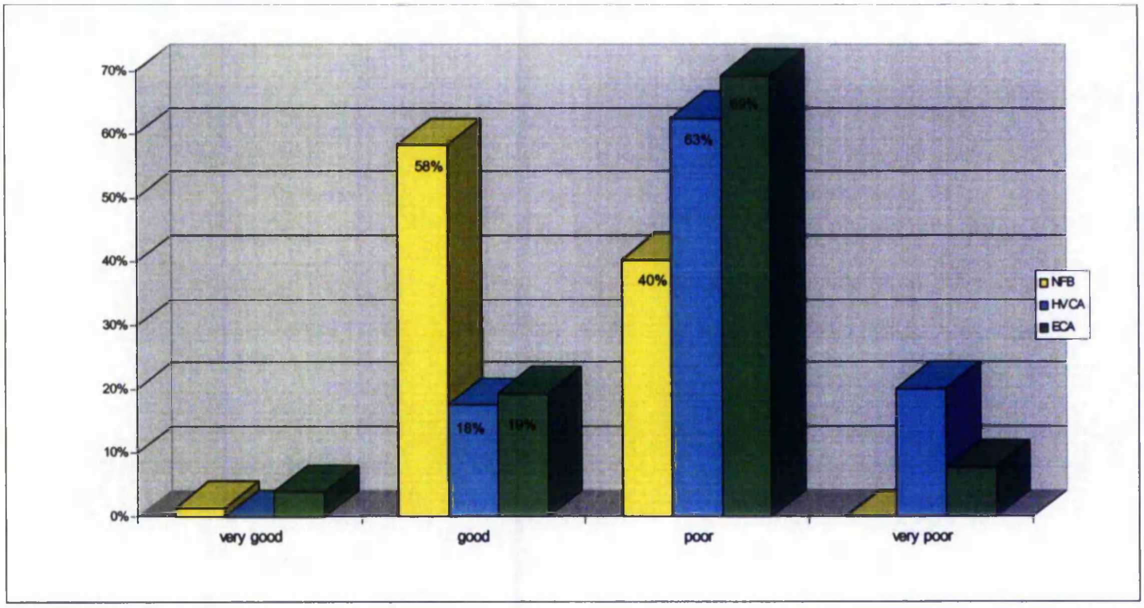
Source: Analysis of survey data (Industry Survey)

This question evaluates how logically the information is presented. The views of the specialists and non-specialists are seen to differ from one another and the two specialist groups to be comparable.

The response from the NFB is noticeably more positive than that of the specialist firms – NFB 60% 'good' and only 32% 'poor'. This compares with 68% 'poor' and 20% 'good' for the HVCA and 58% 'poor' and 27% 'good' for the ECA. Additional responses include 6% 'very good' for the NFB (none for either specialist group) and 15% 'very poor' for the ECA, 12% for the HVCA and only 2% for the NFB.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.13: When measured work is supplied by a *consultant quantity surveying firm*, which response best describes how closely the information relates to what is eventually built? (question 9d)



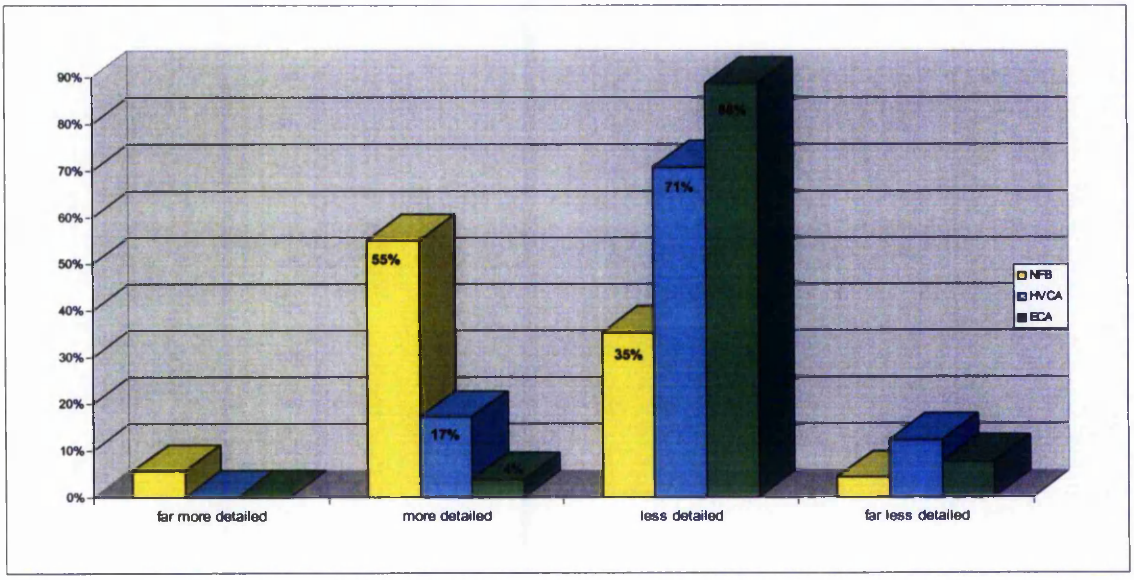
Source: Analysis of survey data (Industry Survey)

The above graph displays how closely the contractors' estimators consider that the original pricing information relates to what is eventually built. The non-specialists view is noticeably more positive than that of the specialists. 58% of non-specialists described the quality of measured work in this respect to be 'good' and 40% 'poor'. 63% of the HVCA responded with 'poor' and only 18% with 'good'. Similarly 69% of the ECA responded with 'poor' and 19% with 'good'.

It is important to appreciate that a number of factors may be attributable for such a divergence between the original documentation and what is eventually built e.g. quality of design information, level of post-tender changes or quality of measured work. However, the question reveals the overall reliability of the data between the two groups of contractor.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.14: When you compare the two sources of measured work (i.e. that typically supplied by a *consultant quantity surveying firm* and that supplied *internally*), the level of detail of measured work supplied by a *consultant quantity surveying firm* is? (question 9.1)



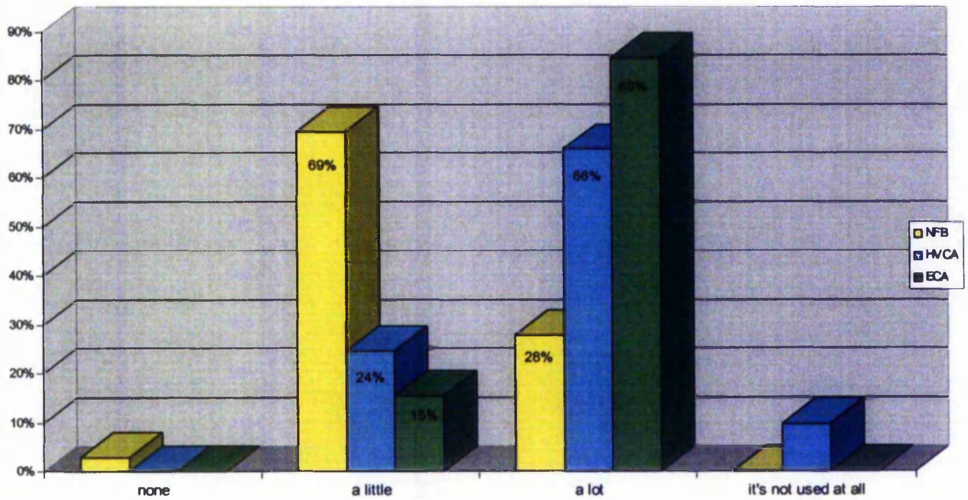
Source: Analysis of survey data (Industry Survey)

This question evaluates quality in terms of how the level of detail of the measured work (supplied externally) compares with measured work that is supplied internally.

The specialist views differ considerably to those of the non-specialist estimators. 55% of NFB estimators describe the information supplied by consultant quantity surveying firms to be 'more detailed' than information supplied internally and 35% to be 'less detailed'. Conversely only 17% of HVCA estimators consider this to be 'more detailed' and 71% 'less detailed'. Similarly, only 4% of ECA estimators consider the externally supplied information to be 'more detailed' and 88% 'less detailed'.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.15: How much additional work is required to supplement the measured work typically supplied by *consultant quantity surveying firms* in order that a price may be calculated? (question 9.2)



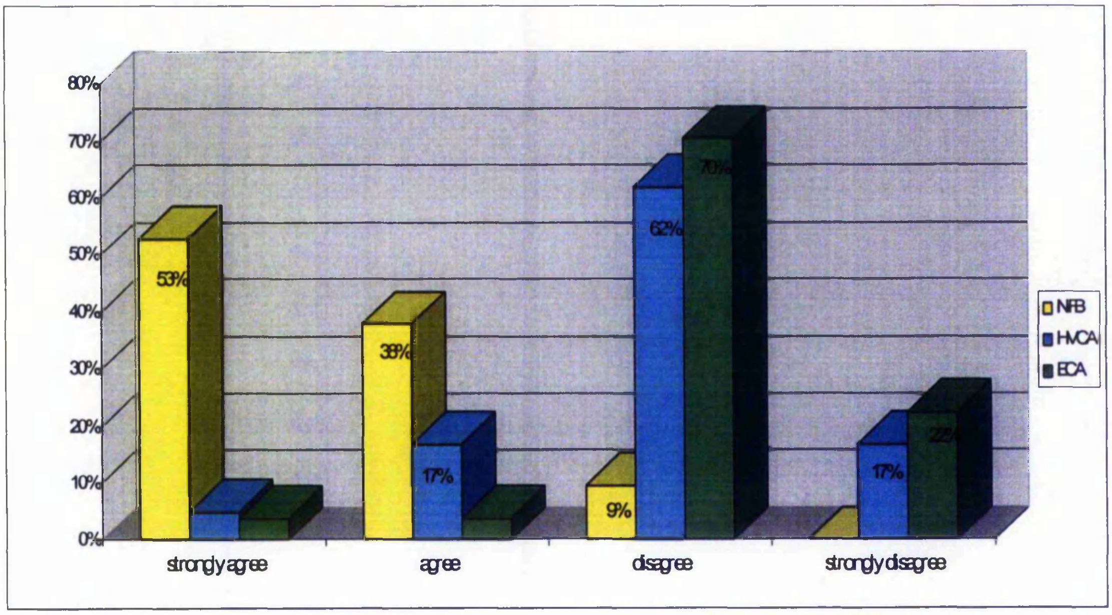
Source: Analysis of survey data (Industry Survey)

This graph illustrates the level of additional work that is required to support externally produced measured work in order to produce a price.

The views of the specialists and non-specialists are seen to differ considerably. 69% of NFB estimators consider that only 'a little' additional work is required to support externally supplied measured work in order to produce a price and 28% 'a lot'. In contrast the majority of specialists consider that 'a lot' of additional work is required (HVCA 66% and ECA 85%) and the minority, that 'a little' is required (HVCA 14% and ECA 15%). The views of the two specialist groups are comparable.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.16: Based on the typical measured work supplied by *consultant quantity surveying firms*, do you consider that this allows all contractors to price on the same basis i.e. it levels the playing field? (question 11a)



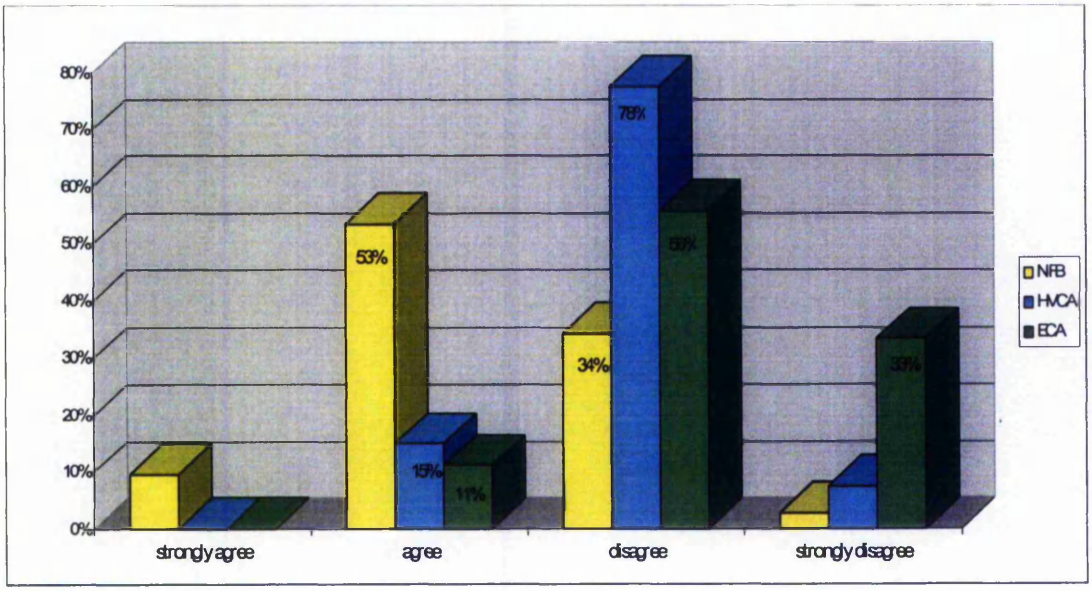
Source: Analysis of survey data (Industry Survey)

The views from the specialists and non-specialists differ considerably about the effectiveness of measured work supplied by consultant quantity surveying firms in terms of whether this enables their bids to be evaluated on a like for like basis i.e. 'on a level playing field'.

53% of the NFB estimators 'strongly agree' that the information provided allows the contractors to price on the same basis, 38% 'agree' and only 9% 'disagree'. In contrast, 22% of the ECA and 17% of the HVCA 'strongly disagree'; 70% of the ECA and 62% of the HVCA 'disagree' and only 4% of the ECA and 17% of the HVCA 'agree'. The views of the HVCA and ECA are similar.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.17: Based on the typical measured work supplied by *consultant quantity surveying firms*, do you consider this to be useful for planning? (question 11b)



<u>Source:</u> Analysis of survey data (Industry Survey)

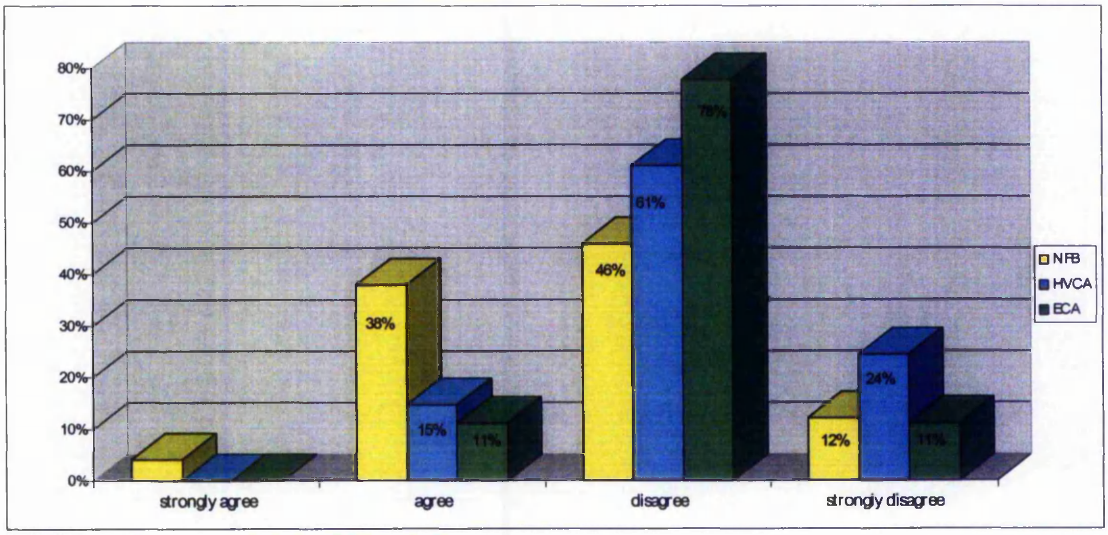
This question reviews how useful the measured work supplied by consultant quantity surveying firms is for planning.

The views from specialist firms are less positive only 15% of the HVCA and 11% of the ECA 'agree', 78% of the HVCA and 56% of the ECA 'disagree'. Furthermore, 7% of the HVCA and 33% of the ECA 'strongly disagree'. In contrast, 53% of non-specialists 'agree', 34% 'disagree' and 10% 'strongly agree.'

Overall, the non-specialist contractors consider the information to be more useful for planning than the specialist firms.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.18: Based on the typical measured work supplied by *consultant quantity surveying firms*, do you consider this to be useful for ordering materials? (question 11c)

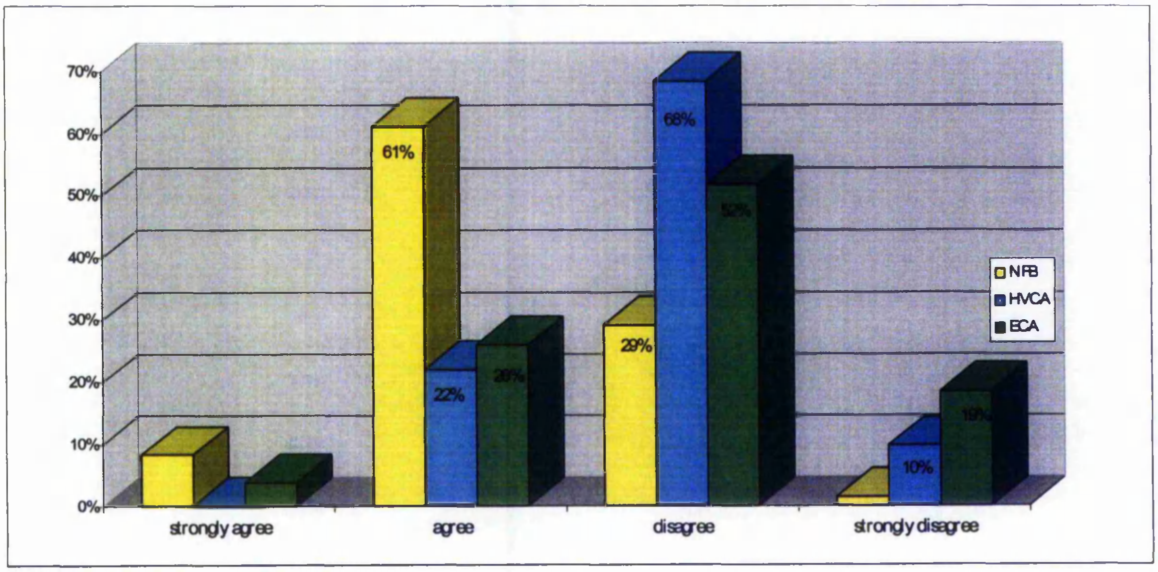


Source: Analysis of survey data (Industry Survey)

The majority of all groups consider that the information is not useful for ordering materials. 11% of ECA estimators 'strongly disagree' with this concept, 78% 'disagree' and 11% 'agree'. Similarly, 24% of the HVCA 'strongly disagree', 61% 'disagree' and 15% 'agree'. The NFB are slightly more positive, 12% 'strongly disagree', 46% 'disagree', 38% 'agree' and 4% 'strongly disagree'.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.19: Based on the typical measured work supplied by *consultant quantity surveying firms*, do you consider that this accurately reflects the cost of the work when used to prepare interim valuations? (question 11d)



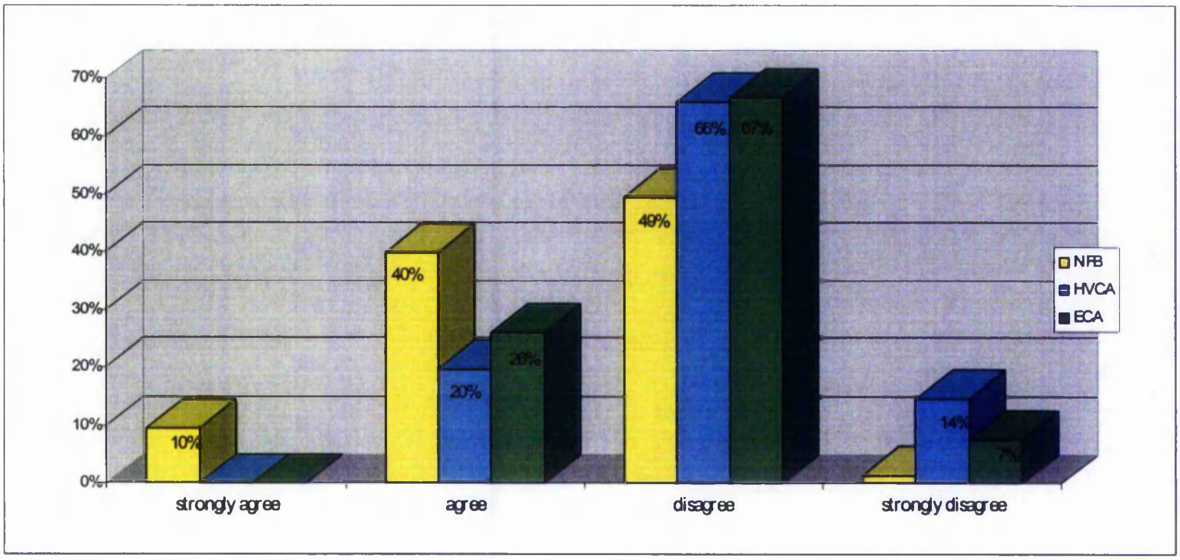
Source: Analysis of survey data (Industry Survey)

The views from the specialists and non-specialists differ in terms of how accurately the measured work supplied by consultant quantity surveying firms reflects the cost of the work when used to prepare interim valuations.

61% of the NFB 'agree' that an accurate valuation can be made and 29% 'disagree'. This compares with a lower number of specialist firms agreeing with the statement (22% of the HVCA and 26% of the ECA) and the majority disagreeing (68% of the HVCA and 52% of the ECA). A number of specialists also 'strongly disagree' – HVCA 10% and ECA 19%.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.20: Based on the typical measured work supplied by *consultant quantity surveying firms*, do you consider that this accurately reflects the cost of the works when used to prepare the Final Account? (question 11e)



Source: Analysis of survey data (Industry Survey)

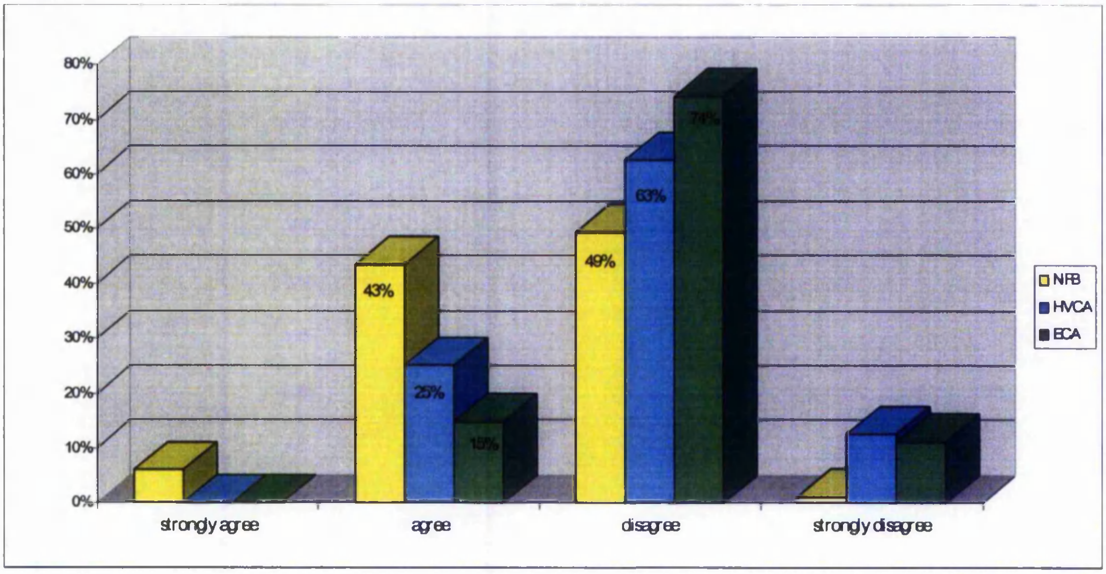
The non-specialists are more favourable than both groups of specialists in terms of how accurately the measured work supplied by consultant quantity surveying firms reflects cost when used to prepare the final account.

10% of the NFB estimators 'strongly agree' that it accurately reflects cost, 40% 'agree' and 49% 'disagree'. In terms of the specialists, only 20% of the HVCA and 26% of the ECA 'agree'. 66% of the HVCA and 67% of the ECA 'disagree' and 14% of the HVCA and 7% of the ECA 'strongly disagree'.

Appendix J: Industry survey results – Objective 2.1

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.21: Based on the typical measured work supplied by *consultant quantity surveying firms*, do you consider that this can be used to accurately value the actual cost of variations? (question 11f)



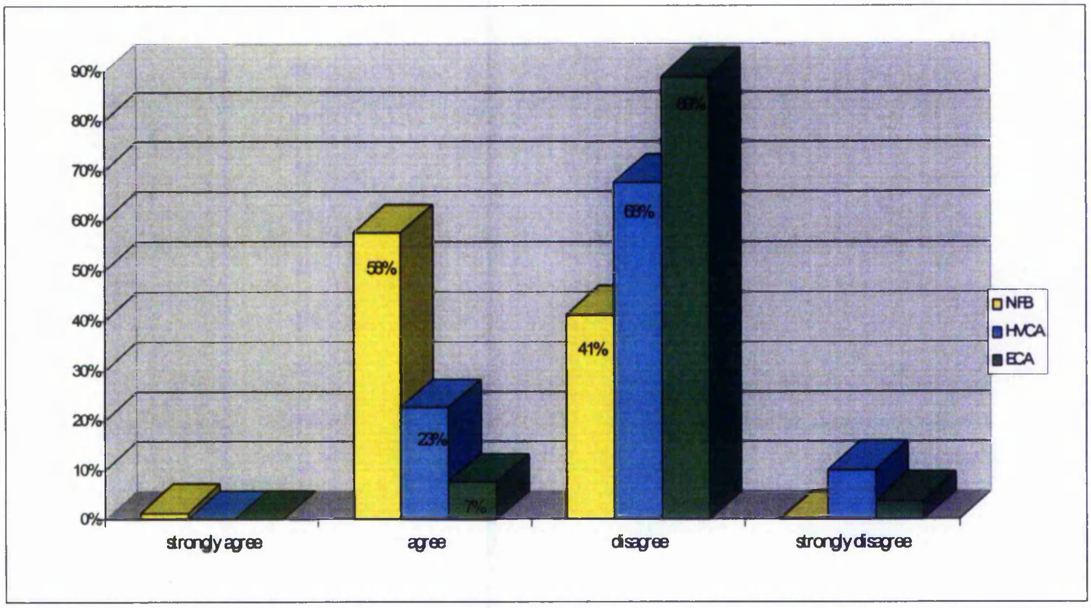
Source: Analysis of survey data (Industry Survey)

This graph evaluates how accurately the measured work can be used to value the actual cost of variations. The response from the non-specialists is seen to be more positive about the information supplied by consultant quantity surveying firms than the specialist contractors.

7% of the NFB estimators 'strongly agree' with the statement, 43% 'agree' and 49%'disagree'. This contrasts with the views of the specialists - 25% of the HVCA and 15% of the ECA 'agree', 63% of the HVCA and 74% of the ECA 'disagree' and 12% of the HVCA and 11% of the ECA 'strongly disagree'. The views of the specialist firms are comparable.

Objective 2.1 (continued): The overall quality of pricing information produced by quantity surveying firms

Chart 4.22: Based on the typical measured work supplied by *consultant quantity surveying firms*, do you consider that this is useful for internal cost controlling i.e. comparing actual costs incurred against the individual items as they are measured? (question 11g)



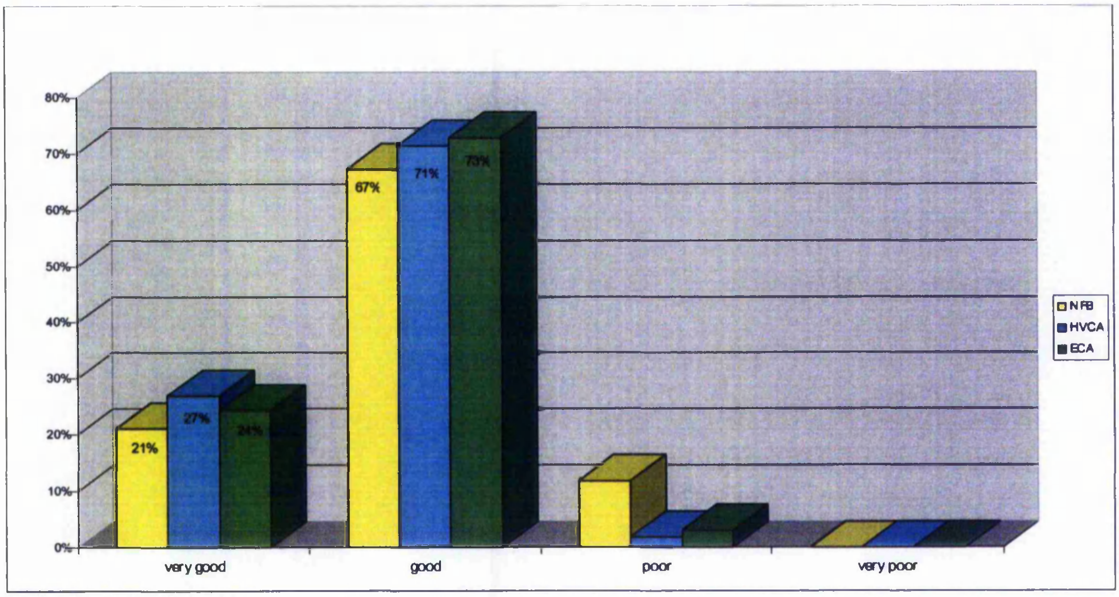
<u>Source:</u> Analysis of survey data (Industry Survey)

This graph illustrates estimators' views on the usefulness of measured work supplied by consultant quantity surveying firms for internal cost controlling. The specialists are less positive about its usefulness than the non-specialists in this respect.

58% of NFB respondents 'agree' with the comment that the information is useful for internal cost controlling and 41% 'disagree'. In terms of the specialists, 23% of the HVCA and 7% of the ECA 'agree'. However, 68% of the HVCA and 89% of the ECA 'disagree' with the comment.

Objective 2.5: Overall quality of the pricing information produced by contracting firms

Chart 4.38: When measured work is supplied by *someone within your own organisation*, which response best describes how accurately the descriptions specify the quality of the works to be carried out? (question 10a)

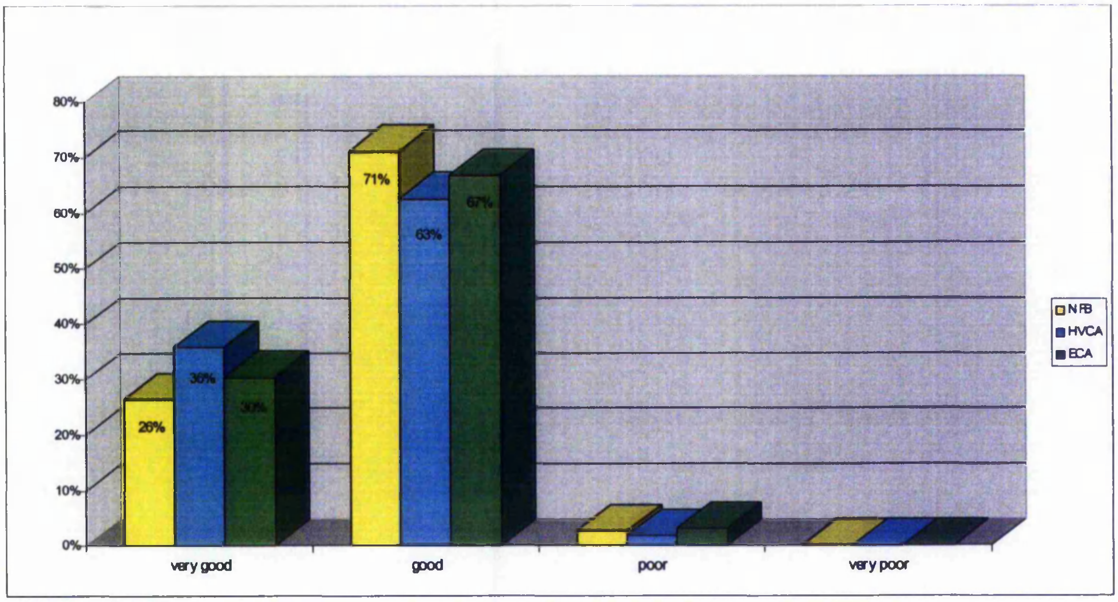


Source: Analysis of survey data (Industry Survey)

The results show a definite improvement in the quality of work in terms of how accurately the descriptions specify the quality of works to be carried out. No distinguishable differences are apparent between the NFB, HVCA or ECA. The highest response level falls within the 'good' category (NFB, 67%; HVCA, 71% and ECA, 73%). Approximately one quarter of all responses is also recorded in the 'very good' category (NFB, 21%; HVCA, 27% and ECA, 24%).

Objective 2.5 (continued): Overall quality of the pricing information produced by contracting firms

Chart 4.39: When measured work is supplied by *someone within your own organisation*, which response best describes the accuracy of the quantities? (question 10b)

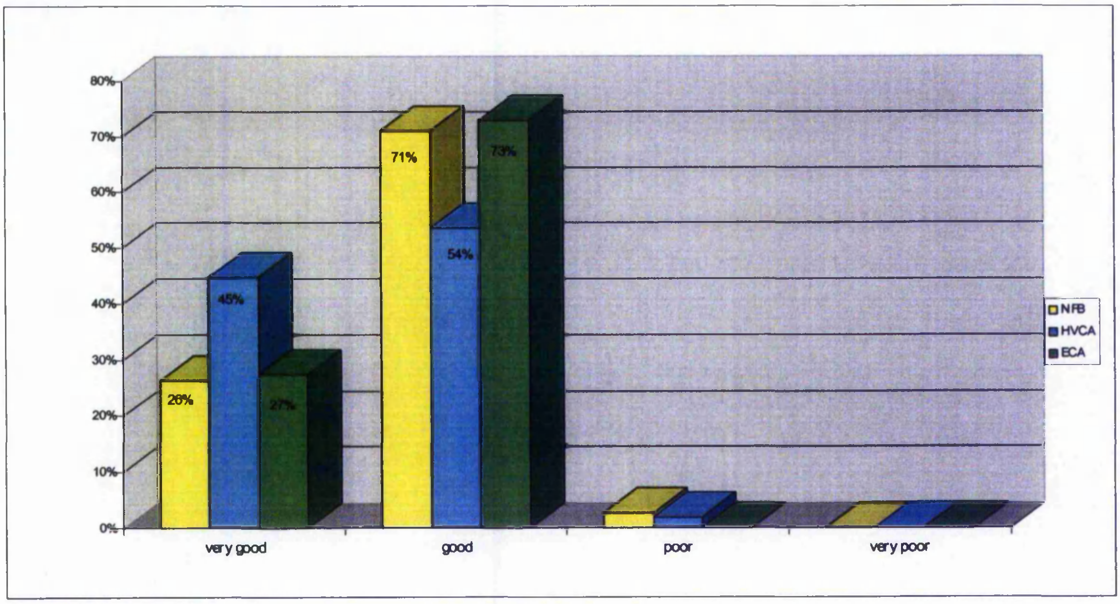


<u>Source:</u> Analysis of survey data (Industry Survey)

A similar trend is depicted when quality is evaluated in terms of the accuracy of the quantities. No distinguishable differences are evident between the three representative bodies. The majority of responses fall within the 'good' category (NFB, 71%; HVCA, 63% and ECA 67%). Approximately one quarter to a third of responses are recorded in the 'very good' category (NFB, 26%; HVCA, 36% and ECA 30%).

Objective 2.5 (continued): Overall quality of the pricing information produced by contracting firms

Chart 4.40: When measured work is supplied by *someone within your own organisation*, which response best describes how logically the information is presented? (question 10c)

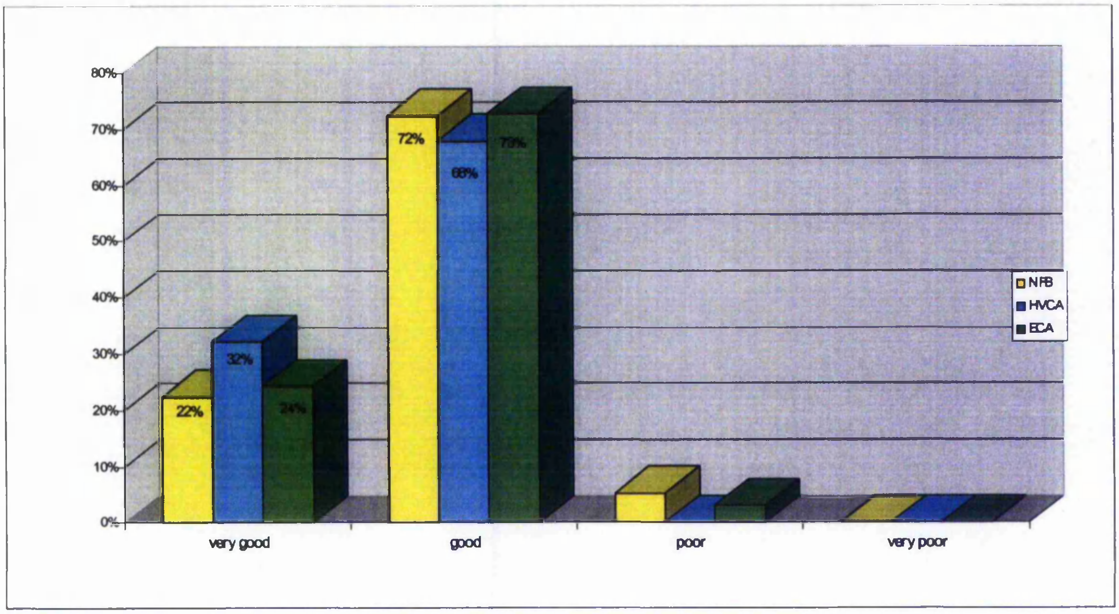


Source: Analysis of survey data (Industry Survey)

A favourable response is also depicted in terms of how logically the information is provided when measured work is supplied by someone within their own organisation. The majority of the responses are recorded within the 'good' category – NFB, 71%; HVCA, 54% and ECA 73%). A high proportion of the HVCA responses (45%) are also recorded in the 'very good' category compared with 26% for the NFB and 27% for the ECA.

Objective 2.5 (continued): Overall quality of the pricing information produced by contracting firms

Chart 4.41: When measured work is supplied by *someone within your own organisation*, which response best describes how closely the information relates to what is eventually built? (question 10d)

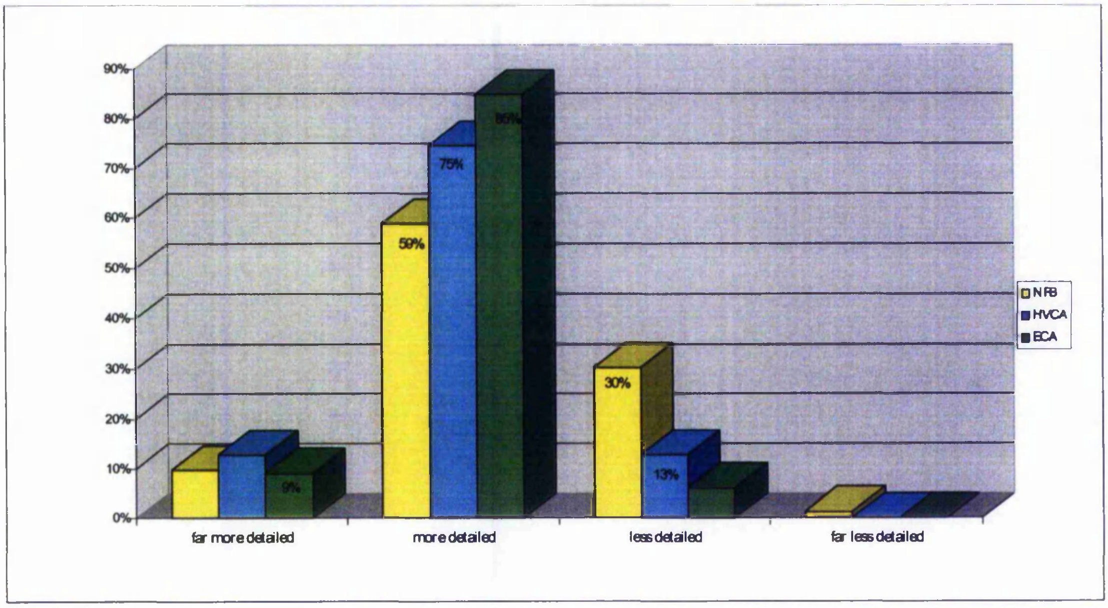


Source: Analysis of survey data (Industry Survey)

Similarly, how well the measured work relates to what is eventually built reveals no distinguishable differences between each of the three representative bodies. The majority of responses fall in the 'good' category (NFB, 72%; HVCA, 68% and ECA, 73%) and approximately one quarter to a third within the 'very good' category (NFB, 22%; HVCA, 32% and ECA, 24%).

Objective 2.5 (continued): Overall quality of the pricing information produced by contracting firms

Chart 4.42: When you compare the two sources of measured work (i.e. that typically supplied by a *consultant quantity surveying firm* and that supplied *internally*), the level of detail of measured work supplied *within your own organisation* is? (question 10.1)

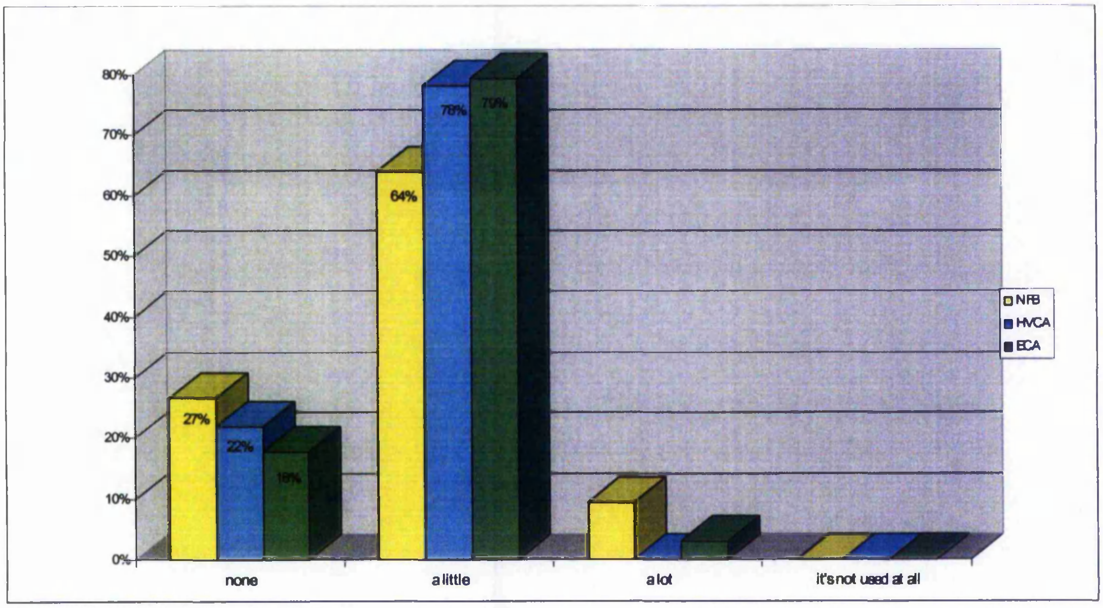


Source: Analysis of survey data (Industry Survey)

The graph illustrates that the level of detail of the internally prepared pricing information is predominantly 'more detailed' than that produced by a consultant quantity surveying firm – NFB, 59%; HVCA, 75% and ECA, 85%. A minority of responses from the NFB are seen to oppose these results – 30% within the 'less detailed' category.

Objective 2.5 (continued): Overall quality of the pricing information produced by contracting firms

Chart 4.43: How much additional work is required to supplement the measured work typically supplied *within your own organisation* in order that a price may be calculated? (question 10.2)



Source: Analysis of survey data (Industry Survey)

The level of additional work required to supplement internally supplied pricing information is minimal. The majority or responses suggest that 'a little' is required – NFB, 64%; HVCA, 78% and ECA, 79%. A comparatively high level of responses are also evident within the 'none' category – NFB, 27%; HVCA, 22% and ECA, 18%.

Table 4.9: Significance test of objective 1.2 - Current practice in terms of the type of work received by contractors

Obj.	Ref	Research questions	Group	%	Other formats	Z Crirical	Z	Result
1.2	7a	Proportion of workload received in Bill format – % by value	NFB	29.66	70.34	1.64	-4.07	Conclude Ho
			HVCA	6.58	93.42	1.64	-8.68	Conclude Ho
			ECA	6.00	94.00	1.64	-8.80	Conclude Ho
		Proportion of workload received in Bill format – % by number	NFB	24.12	75.88	1.64	-5.18	Conclude Ho
			HVCA	5.55	94.45	1.64	-8.89	Conclude Ho
			ECA	5.08	94.92	1.64	-8.98	Conclude Ho
	7b	Proportion of workload received in Plan & Spec format – % by value	NFB	42.96	57.04	1.64	-1.41	Conclude Ho
			HVCA	53.23	46.77	1.64	0.65	Conclude Ho
			ECA	60.43	39.57	1.64	2.09	Conclude H1
		Proportion of workload received in Plan & Spec format – % by number	NFB	50.70	49.30	1.64	0.14	Conclude Ho
			HVCA	56.59	43.41	1.64	1.32	Conclude Ho
			ECA	61.95	38.05	1.64	2.39	Conclude H1
	7c	Proportion of workload received in Design & Build format – % by value	NFB	27.38	72.62	1.64	-4.52	Conclude Ho
			HVCA	40.19	59.81	1.64	-1.96	Conclude Ho
			ECA	33.57	66.43	1.64	-3.29	Conclude Ho
		Proportion of workload received in Design & Build format – % by number	NFB	25.18	74.82	1.64	-4.96	Conclude Ho
			HVCA	37.86	62.14	1.64	-2.43	Conclude Ho
			ECA	32.97	67.03	1.64	-3.41	Conclude Ho

The only significant result, in terms of format of pricing documentation, is recorded by the ECA. They report a significant proportion of their workload in Plan & Specification format - both in terms of % by value (7b) and % by number (7c). None of the other formats of tender documentation feature significantly.

A further two columns have been added to the following tables (p.458 onwards). The initial '+ve or –ve' column indicates whether the response is either in a positive or negative in direction. A positive response denotes a complementary view about the question posed and vice versa for the negative e.g. question 9a with respect to the accuracy of the description.

The second column then displays two further characteristics of the results. Firstly, to confirm its direction and secondly, whether the result is of statistical significance. A blue (upwards ⬆) arrow indicates that the result is both in a positive direction and is statistically significant, a red (downwards ⬇) arrow, that the result is significant but in a negative direction and yellow (sideways ⇨) arrow, that the result is not *significant*.

By way of example, question 9.1 (p.458) shows that despite being in a positive direction, the non-specialists view on the level of detail of information supplied by the quantity surveyor is not a statistically significant result (hence the yellow horizontal arrow).

These points are summarised in the table below:-

Key	Description
+ve	Indicates results is in a positive direction (i.e. giving a complementary response)
-ve	Indicates results is in a negative direction (i.e. not giving a complementary response)
⬆	Indicates a statistically significant result in a positive direction (i.e. giving a significant complementary response)
⬇	Indicates a statistically significant result in a negative direction (i.e. giving a significant response that is not complementary)
⇨	Not a significant result (irrespective of direction)

Table 4.10: Significance test of objective 2.1 - Overall quality of pricing information produced by quantity surveying firms

Obj.	Ref	Research questions	Group	+ or -	+ or -	Z Crirical	Z	Result	+ve or -ve	Overall Signific.
2.1	8	Actual %value of workload measured	NFB	29.66	25.39	1.64	0.57	Conclude Ho		
			HVCA	6.58	1.59	1.64	1.74	Conclude H1		
			ECA	6.00	1.22	1.64	1.78	Conclude H1		
	9a	How accurately the descriptions specify the quality of works to be carried out when supplied by a consultant Quantity Surveyor	NFB	50	22	1.64	3.30	Conclude H1	+ve	⬆
			HVCA	29	11	1.64	2.85	Conclude H1	-ve	⬇
			ECA	21	5	1.64	3.14	Conclude H1	-ve	⬇
	9b	Accuracy of the quantities when supplied by a consultant Quantity Surveyor	NFB	63	9	1.64	6.36	Conclude H1	+ve	⬆
			HVCA	32	8	1.64	3.79	Conclude H1	-ve	⬇
			ECA	22	4	1.64	3.53	Conclude H1	-ve	⬇
	9c	How logically the information is presented when supplied by a consultant Quantity Surveyor	NFB	47	25	1.64	2.59	Conclude H1	+ve	⬆
			HVCA	32	8	1.64	3.79	Conclude H1	-ve	⬇
			ECA	19	7	1.64	2.35	Conclude H1	-ve	⬇
	9d	How closely the information relates to what is eventually built when supplied by a consultant Quantity Surveyor	NFB	43	29	1.64	1.65	Conclude H1	+ve	⬆
			HVCA	33	7	1.64	4.11	Conclude H1	-ve	⬇
			ECA	20	6	1.64	2.75	Conclude H1	-ve	⬇
	9.1	Level of detail of measured work supplied by a consultant Quantity Surveyor when compared with your own estimating data	NFB	43	34	1.64	1.03	Conclude Ho	+ve	⇨
			HVCA	34	7	1.64	4.22	Conclude H1	-ve	⬇
			ECA	25	1	1.64	4.71	Conclude H1	-ve	⬇
	9.2	Additional work required to supplement the measured work supplied by a consultant Quantity Surveyor in order that a price may be calculated	NFB	52	20	1.64	3.77	Conclude H1	+ve	⬆
			HVCA	31	10	1.64	3.28	Conclude H1	-ve	⬇
			ECA	22	4	1.64	3.53	Conclude H1	-ve	⬇

Although not indicated in the manner just explained, the response to question 8 reveals that the value of work actually measured is significantly low for both specialist representative bodies. However, the result of the non-specialist group is not significant.

Questions 9a to 9d are then seen to follow a similar pattern. The non-specialists response against all measures of *quality* is statistically positive and, conversely, the specialist firms' response is statistically negative. Question 9.2 also depicts this trend in terms of the additional work required.

Table 4.10: Significance test of objective 2.1 - Overall quality of pricing information produced by quantity surveying firms (continued)

Obj.	Ref	Research questions	Group	+ or -	+ or -	Z Crirical	Z	Result	+ve or -ve	Overall Signific.
2.1	11a	Based on typical information supplied by consultant Quantity Surveying firms do you consider that this allows pricing on the same basis	NFB	67	7	1.64	6.97	Conclude H1	+ve	↑
			HVCA	33	9	1.64	3.70	Conclude H1	-ve	↓
			ECA	25	2	1.64	4.43	Conclude H1	-ve	↓
	11b	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for planning the works	NFB	46	27	1.64	2.22	Conclude H1	+ve	↑
			HVCA	34	6	1.64	4.43	Conclude H1	-ve	↓
			ECA	24	3	1.64	4.04	Conclude H1	-ve	↓
	11c	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for ordering materials	NFB	43	31	1.64	1.39	Conclude Ho	-ve	⇨
			HVCA	35	6	1.64	4.53	Conclude H1	-ve	↓
			ECA	24	3	1.64	4.04	Conclude H1	-ve	↓
	11d	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare interim valuations	NFB	50	22	1.64	3.30	Conclude H1	+ve	↑
			HVCA	32	9	1.64	3.59	Conclude H1	-ve	↓
			ECA	19	8	1.64	2.12	Conclude H1	-ve	↓
	11e	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare the Final Account	NFB	37	36	1.64	0.12	Conclude Ho	-ve	⇨
			HVCA	33	8	1.64	3.90	Conclude H1	-ve	↓
			ECA	20	7	1.64	2.50	Conclude H1	-ve	↓
	11f	Based on typical information supplied by consultant Quantity Surveying firms do you consider this can be used to accurately value the actual cost of variations	NFB	42	41	1.64	0.11	Conclude Ho	-ve	⇨
			HVCA	30	10	1.64	3.16	Conclude H1	-ve	↓
			ECA	23	4	1.64	3.66	Conclude H1	-ve	↓
	11g	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for internal cost controlling by the contractor	NFB	43	30	1.64	1.52	Conclude Ho	+ve	⇨
			HVCA	31	9	1.64	3.48	Conclude H1	-ve	↓
			ECA	25	2	1.64	4.43	Conclude H1	-ve	↓

All of the specialist responses are significantly negative. The non-specialists only provide significantly positive responses against allowing the prices to be evaluated on a similar basis, planning the works and preparing interim variations. The results of the remaining questions are not significantly positive or negative.

Table 4.11: Significance test of objective 2.2 - Abilities of consultant quantity surveying firms to produce useful pricing information

Obj.	Ref	Research questions	Group	+ or -	+ or -	Z Crirical	Z	Result	+ve or -ve	Overall Signific.
2.2	12a	How do you rate the ability of the consultant Quantity Surveyor in terms of describing the processes involved in constructing the works	NFB	38	36	1.64	0.23	Conclude Ho	+ve	⇨
			HVCA	33	6	1.64	4.32	Conclude H1	-ve	↓
			ECA	25	2	1.64	4.43	Conclude H1	-ve	↓
	12b	How do you rate the ability of the consultant Quantity Surveyor to describe the performance requirements of the finished product	NFB	45	29	1.64	1.86	Conclude H1	+ve	↑
			HVCA	26	15	1.64	1.72	Conclude H1	+ve	↑
			ECA	20	7	1.64	2.50	Conclude H1	+ve	↑
	12c	How do you rate the ability of the consultant Quantity Surveyor in terms of practical awareness	NFB	41	31	1.64	1.18	Conclude Ho	-ve	⇨
			HVCA	35	8	1.64	4.12	Conclude H1	-ve	↓
			ECA	20	7	1.64	2.50	Conclude H1	-ve	↓
	12d	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of construction	NFB	45	29	1.64	1.86	Conclude H1	+ve	↑
			HVCA	33	10	1.64	3.51	Conclude H1	-ve	↓
			ECA	24	3	1.64	4.04	Conclude H1	-ve	↓
	12e	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of materials	NFB	47	27	1.64	2.32	Conclude H1	+ve	↑
			HVCA	37	6	1.64	4.73	Conclude H1	-ve	↓
			ECA	24	3	1.64	4.04	Conclude H1	-ve	↓
	12f	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of design	NFB	42	32	1.64	1.16	Conclude Ho	+ve	⇨
			HVCA	37	6	1.64	4.73	Conclude H1	-ve	↓
			ECA	22	5	1.64	3.27	Conclude H1	-ve	↓
	12g	How do you rate the ability of the consultant Quantity Surveyor to break down the construction into price-able units	NFB	51	23	1.64	3.25	Conclude H1	+ve	↑
			HVCA	37	6	1.64	4.73	Conclude H1	-ve	↓
			ECA	24	3	1.64	4.04	Conclude H1	-ve	↓
	13	Do you believe that the ability of the consultant Quantity Surveyor has changed over time	NFB	39	12	1.64	3.78	Conclude H1	-ve	↓
			HVCA	12	6	1.64	1.41	Conclude Ho	-ve	⇨
			ECA	14	4	1.64	2.36	Conclude H1	-ve	↓

With little exception, the specialist views are significantly negative. However, a significantly positive response is provided in terms of the ability of the quantity surveyor to specify the performance requirements of the finished product and a non-significant response given by the HVCA about the change in ability of the quantity surveyor over time. Although this response is in a negative direction, concurring with the ECA, it is not statistically significant. The non-specialists provide statistically positive responses in terms of the ability of the quantity surveyor to describe the performance requirements, knowledge of construction, knowledge of materials and ability to break down the construction into price-able units.

Table 4.12: Significance test of objective 2.3 - Problems encountered with bills of quantities

Obj.	Ref	Research questions	Group	+ or -	+ or -	Z Crirical	Z	Result	+ve or -ve	Overall Signific.
2.3	15	Problems with Bills								
		Unccordinated information	NFB	16	54	1.64	-4.54	Conclude Ho	-ve	⇨
		Inacurate descriptions	HVCA	13	46	1.64	-4.30	Conclude Ho	-ve	⇨
		Inaccurate descriptions & quantities (joint)	ECA	12	28	1.64	-2.53	Conclude Ho	-ve	⇨

None of the problems cited by either the specialists or non-specialists are statistically significant.

Table 4.13: Significance test of objective 2.4 - Root causes of the problems encountered with bills of quantities

Obj.	Ref	Research questions	Group	+ or -	+ or -	Z Crirical	Z	Result	+ve or -ve	Overall Signific.
2.4	16	Root causes								
		Basic care and attention	NFB	9	20	1.64	-2.04	Conclude Ho	-ve	⇨
		Lack of QS knowledge of specialist work	HVCA	13	11	1.64	0.41	Conclude Ho	-ve	⇨
		Lack of QS knowledge of specialist work	ECA	10	9	1.64	0.23	Conclude Ho	-ve	⇨

In a similar vein, none of the root causes of these problems are found to be statistically significant.

Table 4.14: Significance test of objective 2.5 - Overall quality of the pricing information produced by contracting organisations

Obj.	Ref	Research questions	Group	+ or -	+ or -	Z Crirical	Z	Result	+ve or -ve	Overall Signific.
2.5	10a	How accurately the descriptions specify the quality of works to be carried out when supplied by someone within your own organisation	NFB	67	9	1.64	6.65	Conclude H1	+ve	↑
			HVCA	55	1	1.64	7.22	Conclude H1	+ve	↑
			ECA	32	1	1.64	5.40	Conclude H1	+ve	↑
	10b	Accuracy of the quantities when supplied by someone within your own organisation	NFB	74	2	1.64	8.26	Conclude H1	+ve	↑
			HVCA	55	1	1.64	7.22	Conclude H1	+ve	↑
			ECA	32	1	1.64	5.40	Conclude H1	+ve	↑
	10c	How logically the information is presented when supplied by someone within your own organisation	NFB	74	2	1.64	8.26	Conclude H1	+ve	↑
			HVCA	55	1	1.64	7.22	Conclude H1	+ve	↑
			ECA	33	0	1.64	5.74	Conclude H1	+ve	↑
	10d	How closely the information relates to what is eventually built when supplied by someone within your own organisation	NFB	72	4	1.64	7.80	Conclude H1	+ve	↑
			HVCA	56	0	1.64	7.48	Conclude H1	+ve	↑
			ECA	32	1	1.64	5.40	Conclude H1	+ve	↑
	10	How does the level of detail of internally supplied measured work compare with your own estimating data	NFB	50	23	1.64	3.16	Conclude H1	+ve	↑
			HVCA	48	7	1.64	5.53	Conclude H1	+ve	↑
			ECA	31	2	1.64	5.05	Conclude H1	+ve	↑
	10	Additional work required to supplement the measured work supplied by someone within your own organisation in order that a price may be calculated	NFB	68	7	1.64	7.04	Conclude H1	+ve	↑
			HVCA	55	0	1.64	7.42	Conclude H1	+ve	↑
			ECA	33	1	1.64	5.49	Conclude H1	+ve	↑

Without exception, all of the representative bodies report a statistically significant positive response when the pricing information is prepared internally.

Table 4.15: Significance test of objective 3.1 - Suggested solutions in terms of the contractor's preferred level of input during the tendering process

Obj.	Ref	Research questions	Group	+ or -	+ or -	Z Crirical	Z	Result	+ve or -ve	Overall Signific.
3.1	14a	How would your price alter if you were given the freedom to design the work yourself	NFB	54	16	1.64	4.54	Conclude H1	+ve	⬆
			HVCA	50	0	1.64	7.07	Conclude H1	+ve	⬆
			ECA	33	0	1.64	5.74	Conclude H1	+ve	⬆
	14b	How would your price alter if you were given the freedom to quantify the work yourself	NFB	32	9	1.64	3.59	Conclude H1	-ve	⬇
			HVCA	49	0	1.64	7.00	Conclude H1	+ve	⬆
			ECA	33	0	1.64	5.74	Conclude H1	+ve	⬆
	14c	How would your price alter if you were given the freedom to specify the materials yourself	NFB	49	0	1.64	7.00	Conclude H1	+ve	⬆
			HVCA	49	0	1.64	7.00	Conclude H1	+ve	⬆
			ECA	34	0	1.64	5.83	Conclude H1	+ve	⬆

All of the results are statistically significant in a positive direction with the exception of a single response from the NFB. A statistically significant negative response is given by the NFB when forced into quantifying the work themselves.

Table 4.16: Significance test of objective 3.2 - Contractor's suggested solutions to overcome the stated problems

Obj.	Ref	Research questions	Group	+ or -	+ or -	Z Crirical	Z	Result	+ve or -ve	Overall Signific.
3.2	17	Suggested solutions								
		Properly prepared PQS Bills	NFB	19	33	1.64	-1.94	Conclude Ho	+ve	⇨
		Performance specified work for specialist trades	HVCA	33	7	1.64	4.11	Conclude H1	+ve	⬆
		Performance specified work for specialist trades	ECA	19	9	1.64	1.89	Conclude H1	+ve	⬆

The specialists both give statistically significant positive results to the notion of providing performance specified work for specialist trades. The desire for properly prepared bills by the non-specialists, despite being in a positive direction, is not statistically significant.

Table 4.17: Comparative analysis of NFB and HVCA views on objective 1.2 (i.e. specialists and non-specialists) - Current practice in terms of the type of work received by contractors

Object.	Question	Description	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
1.2	7a	Proportion of workload received in Bill format – % by value	298.000	1159.000	-6.893	.000
	7a	Proportion of workload received in Bill format – % by number	519.000	1465.000	-5.415	.000
	7b	Proportion of workload received in Plan & Spec format – % by value	1539.000	3954.000	-1.955	.051
	7b	Proportion of workload received in Plan & Spec format – % by number	1736.500	3752.500	-.470	.638
	7c	Proportion of workload received in Design & Build format – % by value	1284.000	3237.000	-2.304	.021
	7c	Proportion of workload received in Design & Build format – % by number	1205.500	2801.500	-2.115	.034

Significant differences are recorded against questions 7a and 7b in terms of the proportion of work received in bill format (i.e. < 0.01).

Table 4.18: Comparative analysis of NFB and HVCA views on objective 2.1 (i.e. specialists and non-specialists) - Overall quality of pricing information produced by quantity surveying firms

Object.	Question	Description	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.1	8	Actual % value of workload measured	1643.500	4493.500	-2.213	.027
	9a	How accurately the descriptions specify the quality of works to be carried out when supplied by a consultant Quantity Surveyor	823.000	3451.000	-4.249	.000
	9b	Accuracy of the quantities when supplied by a consultant Quantity Surveyor	447.000	3075.000	-7.038	.000
	9c	How logically the information is presented when supplied by a consultant Quantity Surveyor	741.500	3369.500	-4.694	.000
	9d	How closely the information relates to what is eventually built when supplied by a consultant Quantity Surveyor	712.500	3340.500	-4.927	.000
	9.1	Level of detail of measured work supplied by a consultant Quantity Surveyor when compared with your own estimating data	789.500	3345.500	-4.447	.000
	9.2	Additional work required to supplement the measured work supplied by a consultant Quantity Surveyor in order that a price may be calculated	720.000	3348.000	-5.117	.000
	11a	Based on typical information supplied by consultant Quantity Surveying firms do you consider that this allows pricing on the same basis	347.000	3122.000	-7.288	.000
	11b	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for planning the works	731.500	3432.500	-4.845	.000
	11c	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for ordering materials	1089.500	3864.500	-2.735	.006
	11d	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare interim valuations	720.000	3348.000	-5.000	.000
	11e	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare the Final Account	928.000	3629.000	-3.761	.000
	11f	Based on typical information supplied by consultant Quantity Surveying firms do you consider this can be used to accurately value the actual cost of variations	915.000	3616.000	-3.634	.000
	11g	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for internal cost controlling by the contractor	864.000	3565.000	-4.052	.000

Significant differences are recorded against all questions except question 8 - the % value of workload actually measured.

Table 4.19: Comparative analysis of NFB and HVCA views on objective 2.2 (i.e. specialists and non-specialists) - Abilities of consultant quantity surveying firms to produce useful pricing information

Object.	Question	Description	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.2	12a	How do you rate the ability of the consultant Quantity Surveyor in terms of describing the processes involved in constructing the works	953.500	3728.500	-3.837	.000
	12b	How do you rate the ability of the consultant Quantity Surveyor to describe the performance requirements of the finished product	1480.500	2341.500	-.246	.805
	12c	How do you rate the ability of the consultant Quantity Surveyor in terms of practical awareness	1125.500	3900.500	-3.080	.002
	12d	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of construction	989.500	3764.500	-3.808	.000
	12e	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of materials	760.000	3535.000	-5.218	.000
	12f	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of design	858.500	3633.500	-4.702	.000
	12g	How do you rate the ability of the consultant Quantity Surveyor to break down the construction into price-able units	658.000	3433.000	-5.793	.000
	13	Do you believe that the ability of the consultant Quantity Surveyor has changed over time	1176.000	3804.000	-2.883	.004
	13.1	If yes, over what time period has this been most noticeable	418.000	589.000	-.208	.835

Significant differences in the results are recorded against all questions except 12b and 13.1 - the ability of quantity surveyors to describe the requirements of the finished product and the timescale over which changes in the ability of quantity surveying firms has occurred.

Table 4.20: Comparative analysis of NFB and HVCA views on objective 2.5 (i.e. specialists and non-specialists) - Overall quality of the pricing information produced by contracting organisations

Object.	Question	Description	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.5	10a	How accurately the descriptions specify the quality of works to be carried out when supplied by someone within your own organisation	1851.500	3447.500	-1.568	.117
	10b	Accuracy of the quantities when supplied by someone within your own organization	1920.000	3516.000	-1.174	.240
	10c	How logically the information is presented when supplied by someone within your own organization	1707.500	3303.500	-2.321	.020
	10d	How closely the information relates to what is eventually built when supplied by someone within your own organization	1844.000	3440.000	-1.645	.100
	10.1	How does the level of detail of internally supplied measured work compare with your own estimating data	1620.000	3160.000	-2.222	.026
	10.2	Additional work required to supplement the measured work supplied by someone within your own organisation in order that a price may be calculated	2012.000	3552.000	-.297	.766

As anticipated, no significant differences are recorded between the NFB and HVCA in terms of the quality of information produced within their own company.

Table 4.21: Comparative analysis of NFB and HVCA views on objective 3.1 (i.e. specialists and non-specialists) - Suggested solutions in terms of the contractor's preferred level of input during the tendering process

Object.	Question	Description	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
3.1	14a	How would your price alter if you were given the freedom to design the work yourself	1425.000	2803.000	-3.204	.001
	14b	How would your price alter if you were given the freedom to quantify the work yourself	258.000	1584.000	-8.715	.000
	14c	How would your price alter if you were given the freedom to specify the materials yourself	1295.000	2621.000	-3.507	.000

Significant differences are calculated between the NFB and HVCA in terms of their suggested solutions to overcome frequently encountered problems.

Table 4.22: Comparative analysis of HVCA and ECA views on objective 1.2 (i.e. specialists) - Current practice in terms of the type of work received by contractors

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
1.2	7a	Proportion of workload received in Bill format – % by value	498.000	823.000	-.198	.843
	7a	Proportion of workload received in Bill format – % by number	492.500	1438.500	-.589	.556
	7b	Proportion of workload received in Plan & Spec format – % by value	879.000	2475.000	-1.236	.217
	7b	Proportion of workload received in Plan & Spec format – % by number	967.500	2678.500	-.807	.420
	7c	Proportion of workload received in Design & Build format – % by value	831.000	1497.000	-1.294	.196
	7c	Proportion of workload received in Design & Build format – % by number	929.000	1595.000	-.634	.526

As the HVCA and ECA both belong to the specialist group of contractors significant differences in the results are not anticipated. The above results reveal no significant differences in type of work they receive in practice.

Table 4.23: Comparative analysis of HVCA and ECA views on objective 2.1 (i.e. specialists) - Overall quality of pricing information produced by quantity surveying firms

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.1	8	Actual % value of workload measured	944.000	1647.000	-.741	.459
	9a	How accurately the descriptions specify the quality of works to be carried out when supplied by a consultant Quantity Surveyor	478.500	1298.500	-.701	.483
	9b	Accuracy of the quantities when supplied by a consultant Quantity Surveyor	518.000	869.000	-.037	.971
	9c	How logically the information is presented when supplied by a consultant Quantity Surveyor	500.500	851.500	-.300	.764
	9d	How closely the information relates to what is eventually built when supplied by a consultant Quantity Surveyor	440.500	791.500	-1.235	.217
	9.1	Level of detail of measured work supplied by a consultant Quantity Surveyor when compared with your own estimating data	491.000	1352.000	-.742	.458
	9.2	Additional work required to supplement the measured work supplied by a consultant Quantity Surveyor in order that a price may be calculated	529.000	1390.000	-.066	.947
	11a	Based on typical information supplied by consultant Quantity Surveying firms do you consider that this allows pricing on the same basis	478.500	1381.500	-1.287	.198
	11b	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for planning the works	402.000	1222.000	-2.158	.031
	11c	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for ordering materials	529.500	907.500	-.364	.716
	11d	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare interim valuations	548.500	926.500	-.072	.942
	11e	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare the Final Account	491.000	869.000	-.938	.348
	11f	Based on typical information supplied by consultant Quantity Surveying firms do you consider this can be used to accurately value the actual cost of variations	497.500	1317.500	-.656	.512
	11g	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for internal cost controlling by the contractor	493.000	1313.000	-.807	.420

Similarly, no significant differences are recorded between the quality of work received from quantity surveying firms by the two groups of specialist contractor.

Appendix L: Industry survey analysis

Table 4.24: Comparative analysis of HVCA and ECA views on objective 2.2 (i.e. specialists) - Abilities of consultant quantity surveying firms to produce useful pricing information

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.2	12a	How do you rate the ability of the consultant Quantity Surveyor in terms of describing the processes involved in constructing the works	508.500	1369.500	-.918	.359
	12b	How do you rate the ability of the consultant Quantity Surveyor to describe the performance requirements of the finished product	501.000	879.000	-.797	.425
	12c	How do you rate the ability of the consultant Quantity Surveyor in terms of practical awareness	525.500	903.500	-.854	.393
	12d	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of construction	496.500	1442.500	-1.302	.193
	12e	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of materials	476.000	1422.000	-1.541	.123
	12f	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of design	503.000	1449.000	-1.127	.260
	12g	How do you rate the ability of the consultant Quantity Surveyor to break down the construction into price-able units	568.500	946.500	-.186	.853
	13	Do you believe that the ability of the consultant Quantity Surveyor has changed over time	628.000	1156.000	-1.223	.221
	13.1	If yes, over what time period has this been most noticeable	150.500	321.500	-.085	.932

No significant differences in opinion are reported by the two groups of specialist contractor in terms of the ability of quantity surveying firms to produce useful pricing information.

Table 4.25: Comparative analysis of HVCA and ECA views on objective 2.5 (i.e. specialists and non-specialists) - Overall quality of the pricing information produced by contracting organisations

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.5	10a	How accurately the descriptions specify the quality of works to be carried out when supplied by someone within your own organisation	892.500	2488.500	-.342	.732
	10b	Accuracy of the quantities when supplied by someone within your own organization	867.500	2463.500	-.574	.566
	10c	How logically the information is presented when supplied by someone within your own organization	775.500	2371.500	-1.486	.137
	10d	How closely the information relates to what is eventually built when supplied by someone within your own organization	832.000	2428.000	-.979	.328
	10.1	How does the level of detail of internally supplied measured work compare with your own estimating data	883.500	1444.500	-.288	.773
	10.2	Additional work required to supplement the measured work supplied by someone within your own organisation in order that a price may be calculated	874.500	2414.500	-.719	.472

The quality of internally supplied information is of a similar standard from both groups of contractor as no significant differences in the results are recorded.

Table 4.26: Comparative analysis of HVCA and ECA views on objective 3.1 (i.e. specialists) - Suggested solutions in terms of the contractor's preferred level of input during the tendering process

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
3.1	14a	How would your price alter if you were given the freedom to design the work yourself	850.000	1445.000	-.468	.640
	14b	How would your price alter if you were given the freedom to quantify the work yourself	637.500	1198.500	-2.888	.004
	14c	How would your price alter if you were given the freedom to specify the materials yourself	692.000	1287.000	-2.032	.042

No significant differences are recorded against the level of freedom that each representative body would like to design and specify the materials used. A significant difference is reported against their desired freedom to quantify the work themselves. However, reference to chart 4.45 (p.252) reveals that both agree that their prices will be reduced – the ECA just give a stronger opinion in this direction. Table 4.36 (p.475) confirms that the collective views of the specialists are significantly opposed to the non-specialists on this issue.

Table 4.27: Comparative analysis of ECA and NFB views on objective 1.2 (i.e. specialists and non-specialists) - Current practice in terms of the type of work received by contractors

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
1.2	7a	Proportion of workload received in Bill format – % by value	171.000	496.000	-5.916	.000
	7a	Proportion of workload received in Bill format – % by number	322.500	647.500	-4.330	.000
	7b	Proportion of workload received in Plan & Spec format – % by value	825.500	3240.500	-2.996	.003
	7b	Proportion of workload received in Plan & Spec format – % by number	1005.000	3021.000	-1.148	.251
	7c	Proportion of workload received in Design & Build format – % by value	965.500	2918.500	-1.113	.266
	7c	Proportion of workload received in Design & Build format – % by number	813.000	2409.000	-1.567	.117

The final set of analysis focuses on the differences in opinion between the ECA and NFB.

Significant differences are recorded against the volume of work received in bill format. In contrast, no significant differences are recorded against the volume of work received in Plan & Spec and Design & Build format.

Table 4.28: Comparative analysis of ECA and NFB views on objective 2.1 (i.e. specialists and non-specialists) - Overall quality of pricing information produced by quantity surveying firms

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.1	8	Actual % value of workload measured	1266.500	4116.500	-.779	.436
	9a	How accurately the descriptions specify the quality of works to be carried out when supplied by a consultant Quantity Surveyor	483.000	3111.000	-4.112	.000
	9b	Accuracy of the quantities when supplied by a consultant Quantity Surveyor	286.500	2914.500	-6.235	.000
	9c	How logically the information is presented when supplied by a consultant Quantity Surveyor	532.000	3160.000	-3.615	.000
	9d	How closely the information relates to what is eventually built when supplied by a consultant Quantity Surveyor	582.500	3210.500	-3.222	.001
	9.1	Level of detail of measured work supplied by a consultant Quantity Surveyor when compared with your own estimating data	407.000	2963.000	-4.674	.000
	9.2	Additional work required to supplement the measured work supplied by a consultant Quantity Surveyor in order that a price may be calculated	400.000	3028.000	-4.967	.000
	11a	Based on typical information supplied by consultant Quantity Surveying firms do you consider that this allows pricing on the same basis	142.000	2917.000	-6.943	.000
	11b	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for planning the works	366.000	3067.000	-5.186	.000
	11c	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for ordering materials	730.500	3505.500	-2.292	.022
	11d	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare interim valuations	540.500	3168.500	-3.747	.000
	11e	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare the Final Account	703.500	3404.500	-2.455	.014
	11f	Based on typical information supplied by consultant Quantity Surveying firms do you consider this can be used to accurately value the actual cost of variations	531.500	3232.500	-3.933	.000
	11g	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for internal cost controlling by the contractor	462.000	3163.000	-4.670	.000

As expected, significant differences in the results are recorded against most of the questions relating to the quality of work received from quantity surveying firms.

However, no significant differences are recorded against the % value of the workload that is measured (question 8) and whether the information is useful for ordering materials (question 11c) or preparing the Final Account (question 11e).

Table 4.29: Comparative analysis of ECA and NFB views on objective 2.2 (i.e. specialists and non-specialists) - Abilities of consultant quantity surveying firms to produce useful pricing information

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.2	12a	How do you rate the ability of the consultant Quantity Surveyor in terms of describing the processes involved in constructing the works	552.500	3327.500	-3.963	.000
	12b	How do you rate the ability of the consultant Quantity Surveyor to describe the performance requirements of the finished product	879.500	1257.500	-1.081	.280
	12c	How do you rate the ability of the consultant Quantity Surveyor in terms of practical awareness	795.000	3570.000	-1.811	.070
	12d	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of construction	492.000	3267.000	-4.337	.000
	12e	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of materials	385.500	3160.500	-5.144	.000
	12f	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of design	495.000	3270.000	-4.264	.000
	12g	How do you rate the ability of the consultant Quantity Surveyor to break down the construction into price-able units	403.500	3178.500	-5.066	.000
	13	Do you believe that the ability of the consultant Quantity Surveyor has changed over time	978.000	3606.000	-1.348	.178
	13.1	If yes, over what time period has this been most noticeable	403.500	556.500	-.069	.945

Significant differences are recorded against five questions – the quantity surveyors' ability to describe the processes involved in constructing the works, knowledge of construction, knowledge of materials, knowledge of design and ability to break down the construction into price-able units. No significant differences are recorded against the other questions.

Table 4.30: Comparative analysis of ECA and NFB views on objective 2.5 (i.e. specialists and non-specialists) - Overall quality of the pricing information produced by contracting organisations

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.5	10a	How accurately the descriptions specify the quality of works to be carried out when supplied by someone within your own organization	1131.500	1692.500	-.992	.321
	10b	Accuracy of the quantities when supplied by someone within your own organization	1209.000	1770.000	-.371	.711
	10c	How logically the information is presented when supplied by someone within your own organization	1201.500	1762.500	-.446	.656
	10d	How closely the information relates to what is eventually built when supplied by someone within your own organization	1210.000	1771.000	-.372	.710
	10.1	How does the level of detail of internally supplied measured work compare with your own estimating data	930.500	1491.500	-2.255	.024
	10.2	Additional work required to supplement the measured work supplied by someone within your own organisation in order that a price may be calculated	1230.500	4080.500	-.358	.720

No significant differences were recorded by the ECA and NFB in terms of the quality of information supplied within their own contracting organisations.

Table 4.31: Comparative analysis of ECA and NFB views on objective 3.1 (i.e. specialists and non-specialists) - Suggested solutions in terms of the contractor's preferred level of input during the tendering process

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
3.1	14a	How would your price alter if you were given the freedom to design the work yourself	894.500	1489.500	-3.018	.003
	14b	How would your price alter if you were given the freedom to quantify the work yourself	108.000	669.000	-7.815	.000
	14c	How would your price alter if you were given the freedom to specify the materials yourself	675.000	1270.000	-4.345	.000

Significant differences were recorded between the ECA and NFB in terms of the solutions they put forward.

Table 4.32: Comparative analysis of specialist and non-specialist views on objective 1.2 (i.e. collective views of the HVCA and ECA compared against the NFB) - Current practice in terms of the type of work received by contractors

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
1.2	7a	Proportion of workload received in Bill format – % by value	469.000	2680.000	-7.965	.000
	7a	Proportion of workload received in Bill format – % by number	841.500	3187.500	-6.052	.000
	7b	Proportion of workload received in Plan & Spec format – % by value	2364.500	4779.500	-2.865	.004
	7b	Proportion of workload received in Plan & Spec format – % by number	2741.500	4757.500	-.893	.372
	7c	Proportion of workload received in Design & Build format – % by value	2249.500	4202.500	-2.129	.033
	7c	Proportion of workload received in Design & Build format – % by number	2018.500	3614.500	-2.211	.027

This section of the analysis compares the collective views of the specialist representative contractors against those of the non-specialists. That is, the collective views of the ECA and HVCA (as representatives of the specialists) against those of the NFB (as a representative of the non-specialists).

As anticipated, significant differences are recorded against the proportion of work supplied in bill format and value of work in Plan & Specification format. Conversely, no significant differences are recorded against the other formats of tender documentation.

Table 4.33: Comparative analysis of specialist and non-specialist views on objective 2.1 (i.e. collective views of the HVCA and ECA compared against the NFB) - Overall quality of pricing information produced by quantity surveying firms

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.1	8	Actual % value of workload measured	2910.000	5760.000	-1.905	.057
	9a	How accurately the descriptions specify the quality of works to be carried out when supplied by a consultant Quantity Surveyor	1306.000	3934.000	-5.150	.000
	9b	Accuracy of the quantities when supplied by a consultant Quantity Surveyor	733.500	3361.500	-7.940	.000
	9c	How logically the information is presented when supplied by a consultant Quantity Surveyor	1273.500	3901.500	-5.187	.000
	9d	How closely the information relates to what is eventually built when supplied by a consultant Quantity Surveyor	1295.000	3923.000	-5.159	.000
	9.1	Level of detail of measured work supplied by a consultant Quantity Surveyor when compared with your own estimating data	1196.500	3752.500	-5.678	.000
	9.2	Additional work required to supplement the measured work supplied by a consultant Quantity Surveyor in order that a price may be calculated	1120.000	3748.000	-6.166	.000
	11a	Based on typical information supplied by consultant Quantity Surveying firms do you consider that this allows pricing on the same basis	489.000	3264.000	-8.741	.000
	11b	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for planning the works	1097.500	3798.500	-6.179	.000
	11c	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for ordering materials	1820.000	4595.000	-3.180	.001
	11d	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare interim valuations	1260.500	3888.500	-5.435	.000
	11e	Based on typical information supplied by consultant Quantity Surveying firms do you consider this accurately reflects the cost of the works when used to prepare the Final Account	1631.500	4332.500	-3.974	.000
	11f	Based on typical information supplied by consultant Quantity Surveying firms do you consider this can be used to accurately value the actual cost of variations	1446.500	4147.500	-4.676	.000
	11g	Based on typical information supplied by consultant Quantity Surveying firms do you consider this is useful for internal cost controlling by the contractor	1326.000	4027.000	-5.385	.000

The above table reveals significant differences in the quality of pricing documentation received by the specialist and non-specialist firms. This is an important set of results within the overall research project. A significant result is not recorded against the percentage of work actually measured. Although the differences in current practice are high (between 23-24%), the result is not statistically significant.

Table 4.34: Comparative analysis of specialist and non-specialist views on objective 2.2 (i.e. collective views of the HVCA and ECA compared against the NFB) - Abilities of consultant quantity surveying firms to produce useful pricing information

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.2	12a	How do you rate the ability of the consultant Quantity Surveyor in terms of describing the processes involved in constructing the works	1506.000	4281.000	-4.968	.000
	12b	How do you rate the ability of the consultant Quantity Surveyor to describe the performance requirements of the finished product	2360.000	4706.000	-.749	.454
	12c	How do you rate the ability of the consultant Quantity Surveyor in terms of practical awareness	1920.500	4695.500	-3.165	.002
	12d	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of construction	1481.500	4256.500	-4.991	.000
	12e	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of materials	1145.500	3920.500	-6.370	.000
	12f	How do you rate the ability of the consultant Quantity Surveyor in terms of knowledge of design	1353.500	4128.500	-5.540	.000
	12g	How do you rate the ability of the consultant Quantity Surveyor to break down the construction into price-able units	1061.500	3836.500	-6.752	.000
	13	Do you believe that the ability of the consultant Quantity Surveyor has changed over time	2154.000	4782.000	-2.682	.007
	13.1	If yes, over what time period has this been most noticeable	821.500	1451.500	-.176	.861

Again, significant differences are recorded between the specialists and non-specialists in terms of the perceived ability of quantity surveying firms to measure their own type of work. Despite this, no significant results are recorded against the time period that changes in quality are most noticeable. Both classifications of contractor are in agreement that quantity surveyors have the ability to describe the performance requirements of the finished product.

Table 4.35: Comparative analysis of specialist and non-specialist views on objective 2.5 (i.e. collective views of the HVCA and ECA compared against the NFB) - Overall quality of the pricing information produced by contracting organisations

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
2.5	10a	How accurately the descriptions specify the quality of works to be carried out when supplied by someone within your own organisation	2983.000	6988.000	-1.620	.105
	10b	Accuracy of the quantities when supplied by someone within your own organisation	3129.000	7134.000	-1.012	.311
	10c	How logically the information is presented when supplied by someone within your own organisation	2909.000	6914.000	-1.877	.061
	10d	How closely the information relates to what is eventually built when supplied by someone within your own organisation	3054.000	7059.000	-1.356	.175
	10.1	How does the level of detail of internally supplied measured work compare with your own estimating data	2550.500	6466.500	-2.775	.006
	10.2	Additional work required to supplement the measured work supplied by someone within your own organisation in order that a price may be calculated	3331.500	7336.500	-.025	.980

Other than question 10.1 – the *level of detail of the measured work*, no significant differences are recorded against the quality of pricing documentation supplied within contracting organisations.

Table 4.36: Comparative analysis of specialist and non-specialist views on objective 3.1 (i.e. collective views of the HVCA and ECA compared against the NFB) - Suggested solutions in terms of the contractor's preferred level of input during the tendering process

Object.	Question	Question	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
3.1	14a	How would your price alter if you were given the freedom to design the work yourself	2319.500	6060.500	-3.924	.000
	14b	How would your price alter if you were given the freedom to quantify the work yourself	366.000	3936.000	-10.314	.000
	14c	How would your price alter if you were given the freedom to specify the materials yourself	1970.000	5625.000	-4.785	.000

Finally, the analysis reveals significant differences in opinion between the views of the specialists and those of the non-specialists if given the freedom to input into the design process or specify the materials.