

# **DESIGN AND BUILD PROCUREMENT METHOD IN PRACTICE: KEY CHALLENGES AND PRACTICE BASED ENABLERS**

**Anywhere MURIRO**

School of the Built Environment  
College of Science & Technology  
University of Salford, Salford, UK

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## **ABBREVIATIONS**

<b>BPF</b>	British Property Federation
<b>CECA</b>	Civil Engineering Construction Association
<b>CIRC</b>	Construction Industry Review Committee
<b>CIT</b>	Construct IT centre for Excellence
<b>D&amp;B</b>	Design and Build procurement method
<b>DOI</b>	Degree of involvement
<b>DoE</b>	Department of the Environment
<b>FIEC</b>	European Construction Industry Federation
<b>GDP</b>	Gross Domestic Product
<b>ICE</b>	Institute of Civil Engineers
<b>IT</b>	Information Technology
<b>MC</b>	Middle level manager role – Client Organisation
<b>MCN</b>	Middle level manager role – Contractor Organisation
<b>MD</b>	Middle level manager role – Designer Organisation
<b>NAO</b>	National Audit Office
<b>NEC</b>	The New Engineering Contract
<b>NEDO</b>	National Economic Development Office
<b>RIBA</b>	Royal Institute of British Architects
<b>RICS</b>	Royal Institution of Chartered Surveyors
<b>SC</b>	Strategic level manager role – Client Organisation
<b>SCN</b>	Strategic level manager role – Contractor Organisation
<b>SD</b>	Strategic level manager role – Designer Organisation
<b>SPSS</b>	Statistical Package for Social Science
<b>TC</b>	Top level manager role – Client Organisation
<b>TCN</b>	Top level manager role – Contractor Organisation
<b>TD</b>	Top level manager role – Designer Organisation
<b>UK</b>	United Kingdom

## **ABSTRACT**

Over the recent years the UK construction industry has seen an increasing level of interest in the use of design and build (D&B) as a construction procurement method. This appears to be mainly driven by an attempt by the industry to increase the level of integration in what is generally viewed as a fragmented industry. The main advantages associated with this procurement method that have been cited in reviewed literature have been numerous. Key advantages appear to be the following: single point responsibility for the whole project delivery encompassing design and construction, early contractor involvement resulting in potential cost savings and earlier completion, easy constructability and minimisation of design and construction risk to clients.

Despite its perceived increase in adoption over the last decade as supported by the relatively recent Contracts in use survey in 2010 by the RICS, the construction industry is still experiencing problems associated with D&B procurement. This highlights the need to explore further how this procurement method is being used in practice. The exploration adopted in this research involves identification and evaluation of challenges encountered by key participants (clients, contractors and designers). In addition such an exploration is buttressed by the identification and evaluation of practice based enablers that key participants have used/proposed to use in order to manage better the challenges they have encountered with this procurement method.

The nature of the problem investigated in this research is characteristically exploratory, fluid and flexible, data driven and context-sensitive. As a result a combination of in-depth review of related literature, semi-structured interviews and a questionnaire survey were used as main research techniques. The questionnaire survey was targeted at a wider and a different audience to the one

used in semi-structured interviews. This approach was adopted in order to gain a holistic insight into this multi-faceted problem.

The research shows that adopting D&B procurement method does not necessarily result in integration of design and construction processes. Significant time and effort will need to be spent in creating and facilitating integrative processes and systems to ensure that the gap between the theory and practice of D&B procurement is covered. D&B is not a one size fit all procurement method and each project characteristics and requirements needs to be methodically reviewed and understood to ensure that this fits with the unique features of D&B procurement method.

The research implications mainly relate to the D&B procurement practice. Given the practice based enablers that it generates this has direct implications on how practitioners go about applying the processes and methods that facilitate integration of design and construction in a D&B procurement method set up. This, therefore, goes a long way to bridge the gap between the theory and practice of D&B procurement method. This potentially leads to unlocking this integrative procurement method's benefits that were not previously realised.

The output of this research is a framework for facilitating better integration of design and construction processes. Additionally the framework can also be used as a tool kit for effective use and for acting as an enabler for the flow and realization of potential benefits associated with D&B procurement method. It is expected that this framework will help in providing the much needed guidance to users (in particular infrequent/inexperienced users) of the D&B procurement method.

## **PREFACE**

### **Introduction**

The research reported in this thesis commenced in October 2008 in the School of the Built Environment at the University of Salford. The researcher was and is still employed in the construction sector when this research was commenced. The research model and methodology developed throughout the period 2008 and 2013. As a practitioner actively involved with the construction sector the researcher's interest in construction procurement was perhaps no surprise as the whole project development process hinges upon a procurement strategy and method upon which all the other activities in connection with design and construction of the built environment are based.

Being a chartered quantity surveyor by profession with more than 20 years of experience in both the contracting and cost consultancy sectors of the construction industry the researcher has been fortunate to have acquired a lot of experience in the field of procurement and contract management. Over the years, in the researcher's experience, there have been questions asked by clients and other stakeholders if construction projects were not delivered according to the intended plan e.g. if there were cost and/or time overruns; if there were protracted contractual disputes; if there were defects identified during and after the construction phase and a host of other problems emanating from the delivery of construction projects procured through the design and build procurement method (D&B). In most cases project close out meetings that ensued after the event tended to capture the symptoms of the problem without going into the root cause of the problems impacting the D&B procurement method.

It is against the backdrop of this that the researcher, using reflection as a tool, as well literature relating to D&B procurement method, formulated the research

problem which is the subject of this research. In addition to the professional practice gained at the work place the researcher was greatly assisted and guided by the professional doctorate cohort of 2008 and gained lots of support through the workshop sessions that were held periodically at the University of Salford over the years from 2008 to 2012. The following sections provides a critical review of the relevant aspects of the researcher's professional practice with a view of setting out the process by which the researcher's own reflection has contributed to the researcher's particular choice of research focus.

### **Reflective practice**

The theory of reflective practice is said to be hinged on such concepts as critical thinking, technical rationality, reflection-in-action, reflection-in-practice, reflective research, action learning and positivist epistemology of practice. It is the intention of the researcher to go through each of these concepts in turn in order to show how these reflective practice concepts have provided the ingredients and focus of this research. Moon (1999) supports this view by stating that reflective practice is a process of looking back in a critical way at what has occurred and using the results of this process together with professional knowledge to tackle new situations.

The concept of critical thinking, with its notion of continual questioning of assumptions, has aided the researcher in developing the research area. In a way this concept has managed to develop what is generally referred to as reflective scepticism (Brookfield, 1987) enabling the researcher to generate intellectual arguments that underpin and foster the research problem and the associated intellectual puzzles in the form of research questions. This enabled the researcher to question the perceived theoretical advantages of D&B procurement method and from this to develop further intellectual arguments that guided the research from the initial articulation of the problem, review of related literature, data collection and analysis and development of the final output of the research –

the framework to facilitate better integration of design and construction processes within the D&B procurement delivery method.

The role of other professionals in this concept of critical thinking is very relevant to this research. Colleagues at the work place as well as knowledge and experiences gained from continuous professional development events (CPD) have also helped the researcher not only to mould the research problem but provided the support and critique needed to develop the initial research problem into an intellectual puzzle worthy of a study at doctoral level. This appears to have been at the core of Brookfield (1987)'s thought process when he stated that without the capacity to think and act critically we would never move beyond those assumptions we assimilated uncritically in childhood.

Similarly this concept has further been buttressed by the double-loop learning model cited by Brockbank (2002) in which he states that double-loop learning takes place when assumptions about ways of seeing things are challenged and underlying values are changed thus it is reflective learning for transformation. In another related study by Thompson (2008) this same concept is referred to as technical rationality. This explains the idea that knowledge can be applied directly to practice and that professional knowledge can be seen as a matter of the knowledge base serving as a resource that needs to be adapted to suit circumstances. In this concept of technical rationality there is recognition that there is a scientific knowledge base that can be drawn upon and also a realisation that a degree of artistry is needed to make meaningful links between that knowledge base and the actual demands of practice.

Although the research is about construction processes and procurement methods which may be viewed as scientific the researcher recognises that the world is complex, diverse and variable in nature and therefore qualitative data complemented by quantitative data have been used to address the research problem.



Another researcher in this field, Schon (1995), came up with the reflection-in-action concept which he described as 'thinking on your feet' or 'learning by doing' a process which he says occurs in the midst of a performance. This concept is said to recognise the fact that people sometimes think about what they are doing. This is relevant to the research as the researcher has learnt by doing certain professional practices such as procurement of construction works, cost planning, measurement of construction work, reporting and budgeting for construction work.

The concept of reflecting-in-practice has been described by Schon (1995) as having a bearing on tacit knowledge and is said to have a tendency of becoming spontaneous and automatic thereby conferring upon the practitioner and his/her clients the benefits of specialisation. Through reflection the researcher was able to surface and criticise the tacit understanding that have grown up around the repetitive experiences of a specialised practice.

Reflective research is another concept closely associated with the concept of reflective practice and highlights issues such as frame analysis and repertoire-building research (Schon, 1995). In this concept it is stated that problems and roles are framed and the frame determines their strategy of attention and set the directions which shapes their practice.

Action learning has been described as a process of learning and reflection that happens with the support of a group of a group or 'set of colleagues' working with real problems with the intention of getting things done (McGill & Beaty, 1995). This process is further described as a process which adds structure to our experience by allocating particular time to reflection. This is further said to support individuals in reflecting on their past actions in order to learn from experience and to explore their current issue. Links are said to be made between the past, the present and the future through reflection. It is further said that the quality of reflections that the individual goes through is the key to the success

generated. The working environment and the workshop sessions that the researcher attended at the university provided the additional structure to the experience gained in professional practice.

The Kolb learning cycle is often associated with this concept as stated by McGill & Beaty (1995). In this learning cycle model the learning process is seen as a cycle of events involving observing and reflecting on experience leading on to making sense of that experience in a new way which in turn leads onto an understanding followed by insights which allow for new plans, new strategies for action and new modes of behaviour. McGill & Beaty (1995) further states that action learning and action research are based on the same learning cycle as they share the focus on learning from experience and they both have an action and a reflective phase.

### **Critical reflection and review of researcher's practice**

Throughout the years of the researcher's experience in the construction sector it became evident to the researcher that the construction industry has been criticised for late delivery of projects, cost overruns and what can be referred to as 'shoddy workmanship'. In most of these criticisms a common theme that seemed to take centre stage is that traditional procurement methods which were widely used were perhaps not the appropriate and relevant methods used to deliver these projects as they separated design and construction processes. New procurement methods modelled in a way that integrates design and construction processes were adopted over the years such as D&B, management contracts, partnering and construction management.

The general argument that was used and is still being used is that such relatively modern procurement methods offer better results to clients. Having personally experienced and worked on projects that were delivered using different procurement methods the researcher began to reflect and critically think about

the validity of some of the widely held conceptions about design and construction integration. This reflection and critical thinking resulted in the researcher noticing gaps between the theory and practice of integration associated with design and construction processes.

It is against this background that issues relating to the research problem began to emerge. Through the process of reflection-on-action and reflection-in-action the researcher had to critically evaluate own experience and contribution as a built environment professional. The problem focus emerged from an ongoing observation of construction projects that the researcher has been directly involved with. The researcher's immediate aim in embarking on this research is self-development, professional development and generation of knowledge.

This shows that the benefits of self-reflection are countless. All have a commonality to improve competence, practice and to manage complex situations. Schon (1995) combines these perspectives by stating that situations confronted by professionals in practice are unique, individual and complicated and this 'falls outside the existing knowledge of theory and technique'. In fact Schon (1995) make the role of theory (professional knowledge) as a 'cloth from which professionals tailor their professional response' through the use of 'professional artistry'. Reflection therefore bridges the gap between professional knowledge (high topography) and practice (swampy lowlands) (Thompson, 2008).

The workshop sessions that the researcher has been attending at the University of Salford over the years provided the researcher with action learning benefits associated with group discussions and exchange of information and references. Visiting lecturers and guests invited to the workshops also helped the researcher in sharing their research experiences. Their experiences and knowledge added further insight into the researcher's reflection on the research area.

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 INTRODUCTION**

This chapter introduces the background of the research topic. It identifies the research gap and sets out the aims and objectives of the research. It emphasises the research significance, delineates the scope of the research and provides an overview of the structure of the thesis.

### **1.2 RESEARCH BACKGROUND**

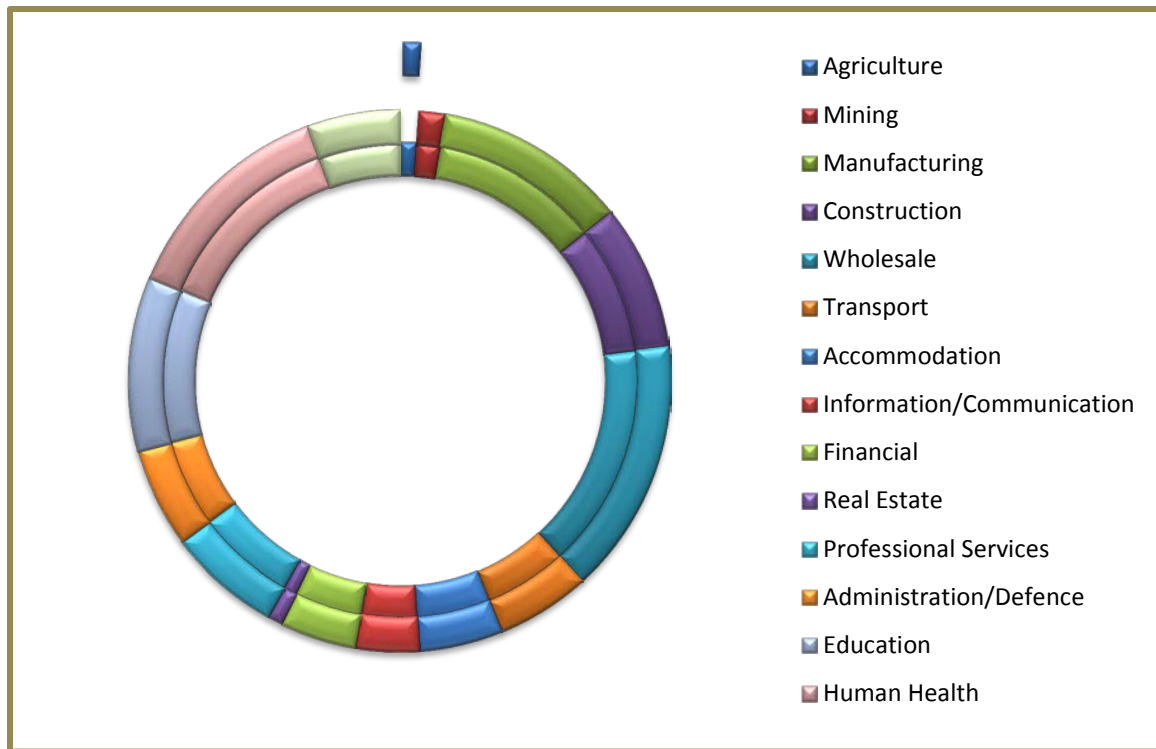
The contribution from the construction industry towards the quality of life and the general economy has since been recognised as significant the world over (European Construction Platform, 2005; Fairclough, 2002). This is despite the existence of problems associated with the definition of the term 'construction industry' (Ofori, 1990). Some researchers consider the construction industry as involving on-site activities. Others suggest that planning and design functions must be included. Yet others advocate for the inclusion of manufacturing and suppliers of materials and plant, finance of projects and management of construction (Turin, 1975; Hillebrandt, 1985).

This is a problem as the data reported and inferences made by different writers/researchers will invariably be dissimilar. This is as a result of their different interpretation of what constitute the construction industry. The author has however adopted the narrower definition of construction industry. This is on the basis of the definition ordinarily adopted by the UK official statistics (Office of National Statistics, 2012). This defines the construction industry as 'the activity of firms that construct and maintain the built environment'. The researcher also felt that including manufacturing and suppliers of materials and plant in the research

will widen the scope of the research making it impossible to complete within the time and cost for this kind of research.

Despite the problem in definition it would appear that there is no dispute regarding the significance and contribution of the construction industry towards the social and economic well-being. The UK construction industry has an output of approximately £100 billion a year and accounts for approximately 6% of the UK's Gross Domestic Product (Brink and Anagboso, 2010). A 2009 LEK Consulting report for UK contractors Group stated that the industry is a driver in other sectors due to its over reliance on an extended and varied supply chain. The report stated that every £1 spent on construction output generates £2.84 in total economic activity (RICS, 2012). The industry also accounts for 9% of all jobs in the UK (Office of National Statistics, 2012) which is the fifth largest employer in the UK behind the wholesale, manufacturing, health and education sectors. Figure 1.1 (See also Appendix A) depicts this graphically by showing the percentage contribution all in employment by industry sector using data up to the first quarter 2012 from the Office of National Statistics (ONS).

The importance of the construction industry is not only a feature of the UK economy but for other regions in the world as well. For instance, it has been reported by FIEC (2002) that construction accounts for 49.20% of all investment goods across the European Union. In addition, FIEC (2002) reported that the construction industry is the largest industrial employer representing nearly 12 million jobs within the European Union.

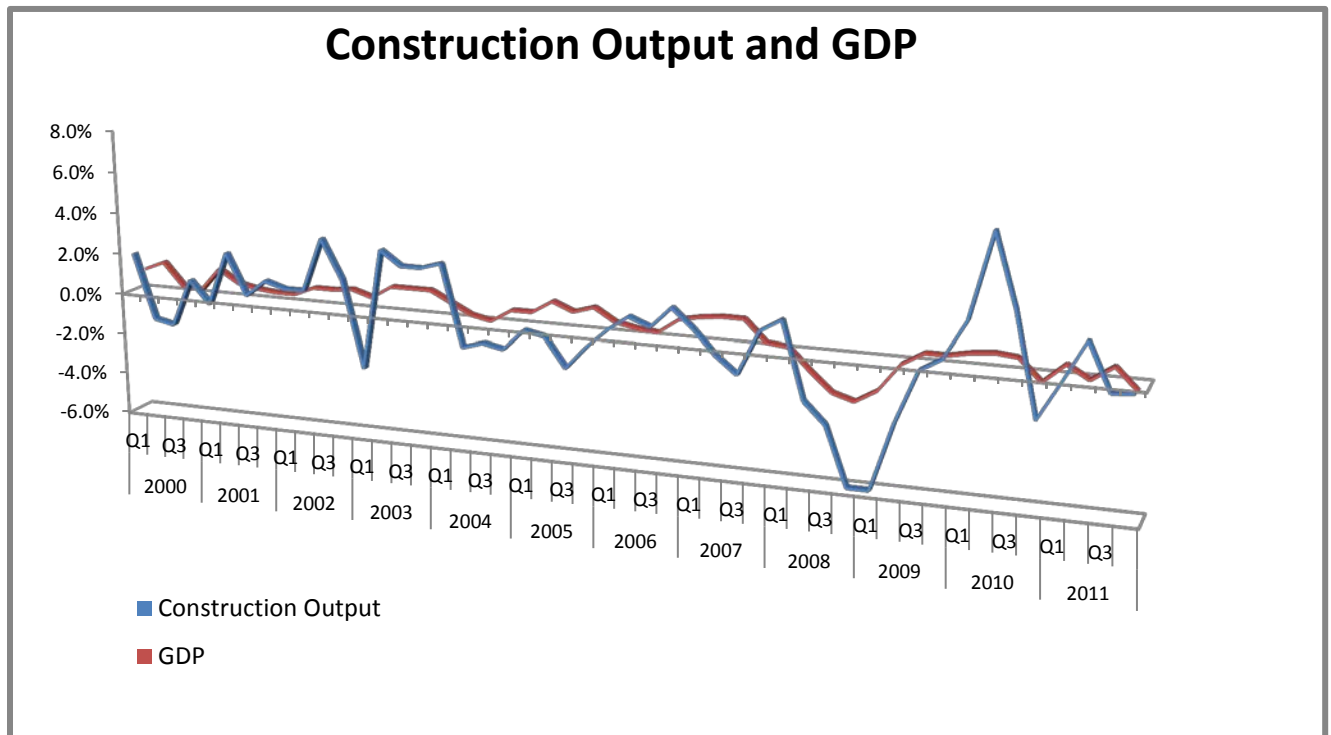


**Figure 1.1: Percentage contribution all in employment by industry sector – 2003 – 2011 yearly average (not seasonally adjusted)**

**Source: Adapted from Office of National Statistics (2012)**

It has since been established that the construction cycle is closely linked with the general business cycle as opined by Tan (1989). His observation has been supported by follow on research work by Hutcheson (1990). He also observed the existence of a relationship between construction demand and growth in Gross Domestic Product (GDP). Both their research efforts observed that the demand for construction work is derived from the demand for consumer goods. This mirrors results from earlier research efforts by Kilian and Suyman (1984). They went further than Tan (1989) and Hutcheson (1990) when they clarified this link. They observed that a period of economic prosperity, which tends to raise consumer demand for goods and services, triggers a rise in the demand for consumer space.

These findings of the early 1980's/1990's are still being supported by recent research efforts especially studies undertaken by Brink and Anagboso (2010). In an attempt to show the link between construction activity and demand and supply factors, Brink and Anagboso (2010) made additional observations. They observed that the recent contraction in construction activity has (to a large extent) been derived by a fall in demand which inevitably led to reduced supply. This observation is further confirmed by data from ONS (2012), which show the intricate link and relationship over the last 10 years between construction output and GDP as depicted in Figure 1.2 below.

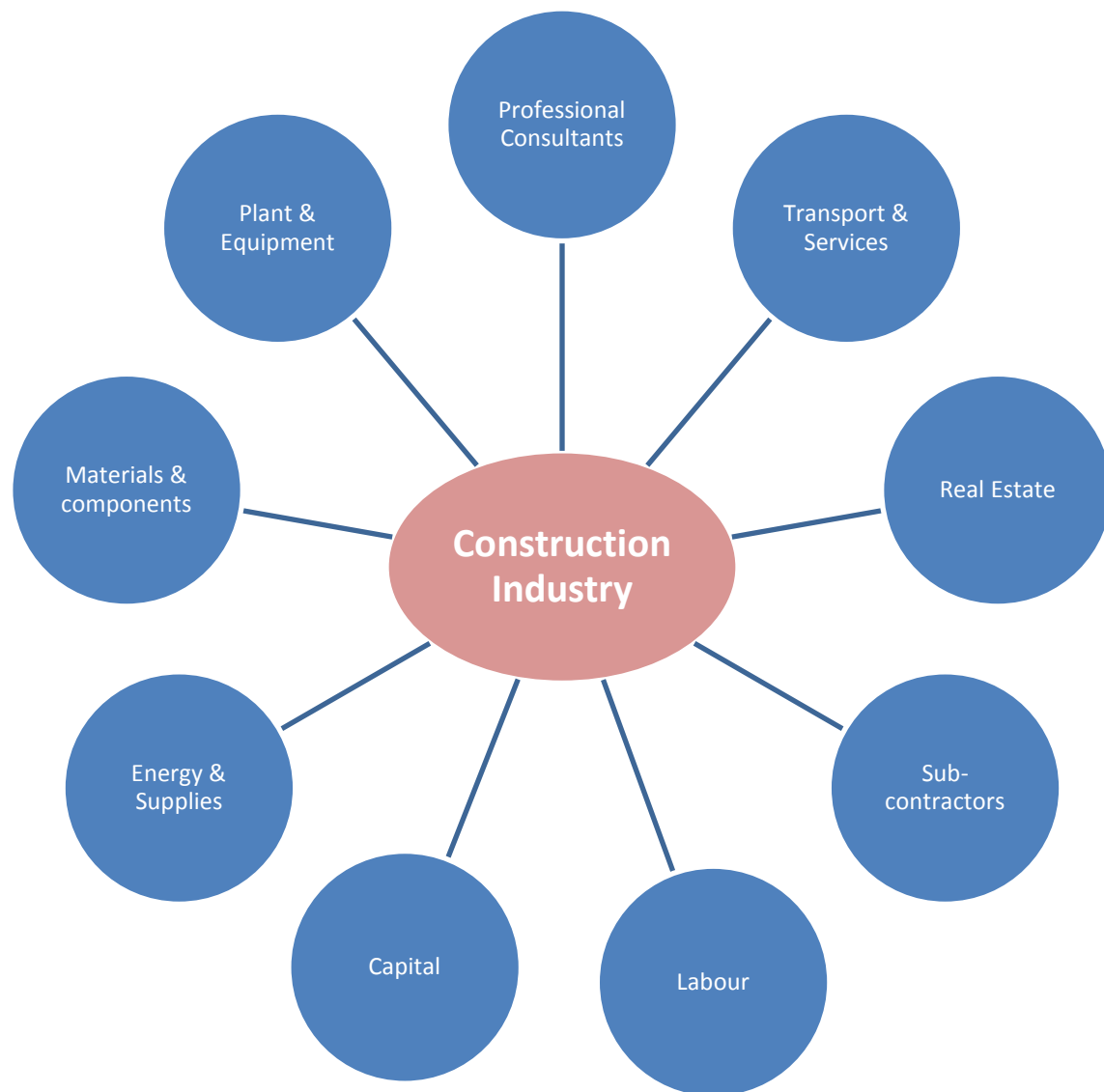


**Figure 1.2: Relationship between construction output and GDP**

**Source: Adapted from ONS (2012)**

The sensitivity of GDP to construction activity is attributed to the fact that construction is intricately linked to other sectors of the economy. These sectors

are the manufacturing, labour market, business investments and a host of other industries. This is further supported by research efforts undertaken by Cuffe (2003). These researchers identified that although the economy is divided into 123 industrial sectors all these sectors (except a few) contribute directly to the construction sector. Their research efforts observed that the industrial sectors that contribute to the construction sector can be split into 7 broad groups as graphically presented in Figure 1.3.

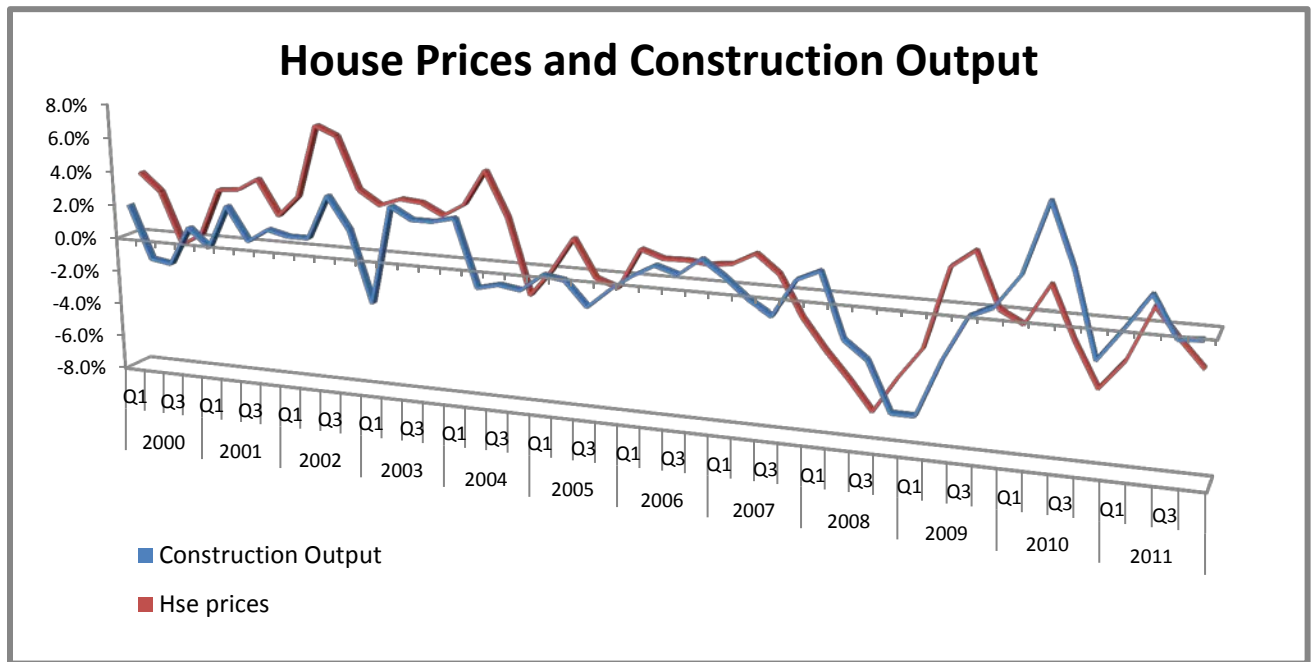


**Figure 1.3: Input structure of the Construction Industry**

**Source: Adapted from Lowe (2011) p.233**



Construction output has also been shown to be closely linked to the housing market since this sector makes up over a  $\frac{1}{3}$  of construction activity (Brink and Anagboso, 2010). Recent data from the ONS appear to support this as shown in Figure 1.4. The Figure also shows that higher prices are likely to lead to an increase in house building and therefore construction output.



**Figure 1.4: The relationship between House Prices and Construction Output**

**Source: Adapted from ONS (2012)**

As depicted graphically above, demand for goods and services produced by the construction industry are affected by numerous factors encompassing the social, political, economical and technological spectrums. Cost of borrowing, demographic factors, government policy, ownership patterns of households, technological developments, changes in taste, business confidence, age and condition of existing built environment are some of the main factors highlighted in previous research efforts (Barter, 1988; Myers, 2004) as impacting on

construction demand. Supply within the construction industry, on the other hand, is made up of several interconnected markets. Costs of production, government policy and technology are some of the main factors that affect the supply of goods and services within the construction industry.

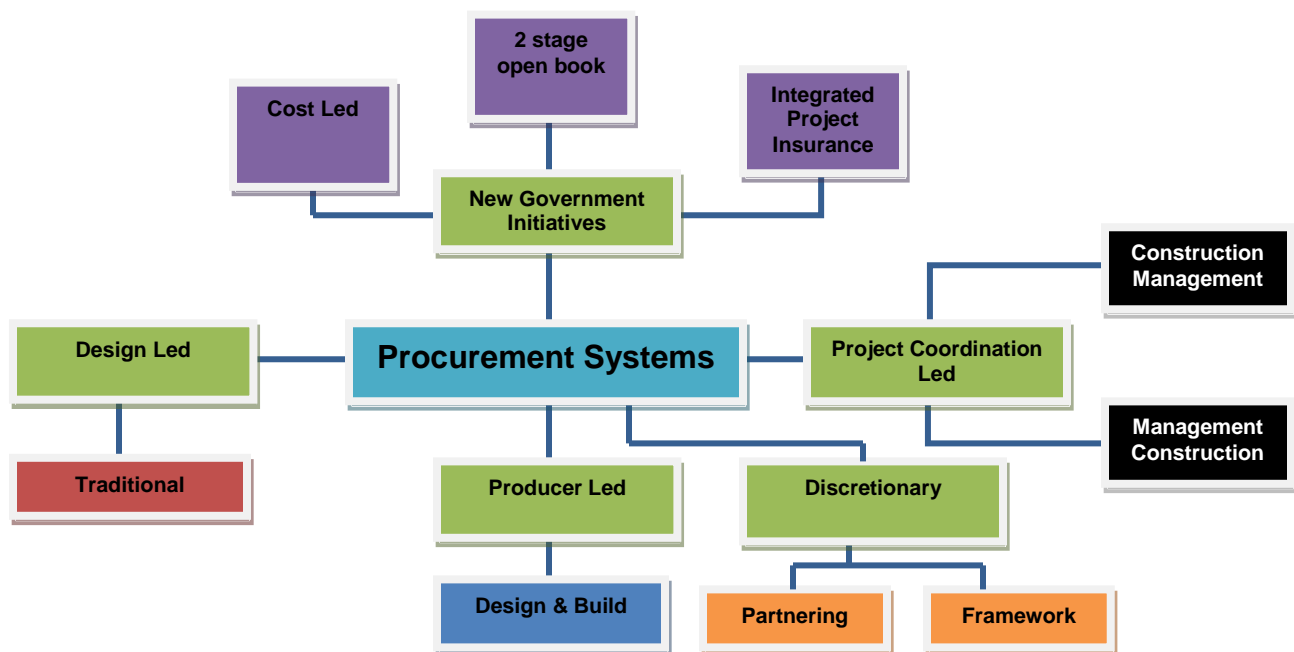
The above indicates that the construction industry not only brings social and economic well-being benefits but, creates local and national markets for plant and material suppliers and all the ancillary services that are required. In addition, there are a host of social benefits that the construction industry brings to the users of the built environment. This is because users need to feel safe at work and during social hours. Construction legislation and the Building Regulations that govern construction activity ensure that safety is designed into the built environment. Other social contributions emanating from the construction industry include sustainability. Sustainability of the built environment is a key topical challenge within the construction industry. This is enhanced by getting the local community involved and actively participating in the local built environment projects which gives local construction projects a key sustainability factor.

The construction process is initiated by the client or the sponsoring organisation who determines the requirements of the goods and services that are required to be fulfilled by the built environment. Although there are different categories of clients with different requirements, the Latham Report (1994) suggested client requirements to be principally driven by the need to: obtaining value for money, ensuring projects are delivered on time, having satisfactory durability, incurring reasonable running costs, being fit for its purpose, being free from defects on completion, having an aesthetically pleasing appearance and being supported by meaningful guarantees.

These requirements are translated and transformed from requirements to physical built environment goods or services through an adopted construction procurement system. Although there are many definitions provided by

researchers to define a procurement system/method, common themes that come up suggest key aspects of procurement. Such themes defines a procurement system as the strategy, the organisational structure, the responsibilities and relationships and the management of a construction project with the overall objective of satisfying the client's developmental and operational needs.

As construction procurement has evolved many different types and categories of procurement routes have been developed over the years. Figure 1.5 shows some of the key procurement systems that have evolved in the UK over the last couple of decades (New models of construction procurement, 2012). The drivers for such evolution appear to be the changing nature of the construction market. This is driven by other socio-economic and political factors together with the complexity of construction projects. This is further compounded by the sophistication of the construction clientele which probably influence the proliferation of construction procurement systems in recent years.



**Figure 1.5: Procurement systems evolution in the UK Construction Industry**

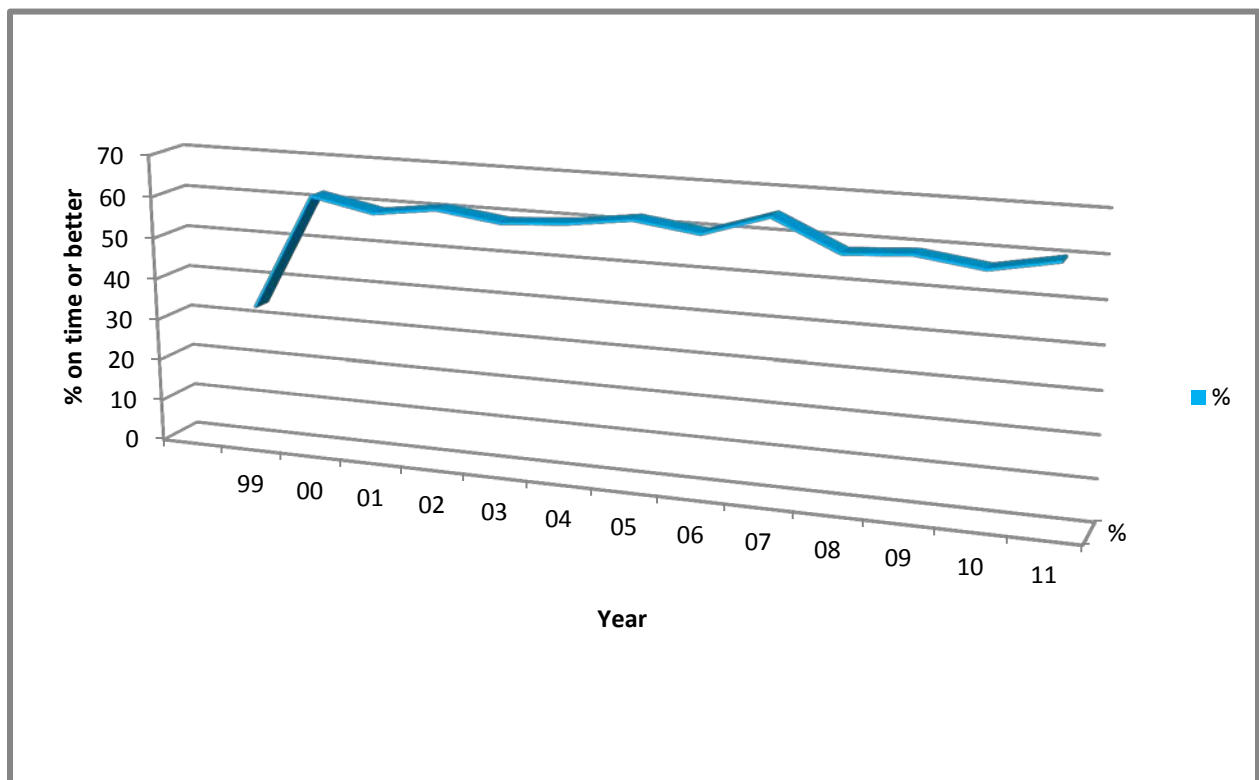
**Source: Adapted from Cabinet Office & Efficiency & Reform Group (2014)**

The new Government initiatives (Cost led, project insurance and the Two stage open book) (Cabinet Office, 2014) demonstrate that there are challenges with current procurement methods which need to be addressed. Briefly, the cost led approach is where the client selects integrated supply chain teams from an existing pool of partners. The selection is based on their ability to work in a collaborative manner to deliver below the cost ceiling on their first project and to achieve cost reductions on subsequent projects while maintaining the required quality outcomes.

The Two stage open book entails the client inviting suppliers from a pool of suppliers on a framework to bid on the basis of an outline brief and cost benchmark. The team that is successful then develops a fully detailed proposal that meets the client's stated outcomes and cost benchmark as a second stage. The proposal is developed on an open book basis. Integrated project insurance entail the client appointing, through competition, an integrated project team responsible for delivery. This would have a single insurance policy to cover all delivery risks, packaging up all insurances that would normally be held by the client and supply chain members who will share the cost of project overruns below a certain threshold. The fundamental themes underlying these relatively new procurement initiatives are early supplier engagement, transparency of costs, integrated team working and collaborative working.

The construction industry has had a long history of problems associated with procurement strategies, their implementation, their efficiency and their measurement. The overall performance of the construction industry in the UK and the USA have been stated as hovering between 60% - 70% range for owner satisfaction (Egan 1998; Vickers 2000; State of the Construction Report 2000, Post 1998). Similarly studies undertaken by the Construction News in the UK also found that the construction industry had several challenges pertaining to failure to predict both construction cost and time resulting in numerous problems to construction clients and other stakeholders. Figures 1.6 and 1.7 depict these

problems. Figure 1.6 shows that over the last 10 years the number of projects completed on time or better has been averaging around the 60% mark while Figure 1.7 show that construction projects completed on budget or better has been largely below 50% over the last 10 years. Similarly Morledge and Sharif (1996) arrived at more or less the same conclusion when they reported that, on a survey of 215 projects surveyed in the UK, 63% were delivered later than expected.

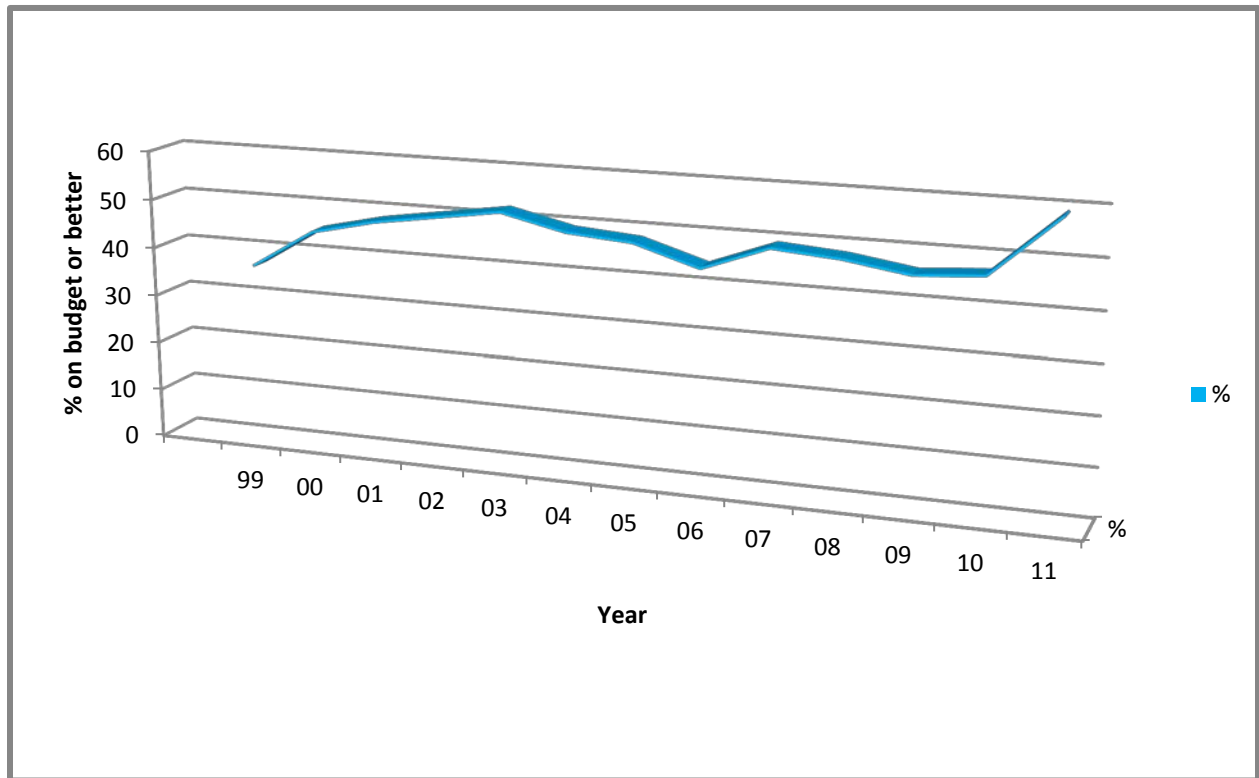


**Figure 1.6: Number of projects completed on time or better**

**Source: Construction News (2012)**

There may well be several reasons for failure to achieve completion on time (or within budget) or better but the bottom line is it is the construction industry that is perceived by the outside world to be underperforming. Apportionment for 'blame' as a result of this underperformance may well be fuzzy and varied among and between the parties involved in construction (clients, contractors, designers,

supply chain) but the implications brought about by the procurement method adopted must have significant effects to the outcome given that the procurement method sets out the organisational and contractual arrangements for project delivery.



**Figure 1.7: Number of Projects completed on budget or better**

**Source: Construction News (2012)**

The poor image of the industry has been widely reported over the last 2 to 3 decades with Smith et al. (2004) observing the construction industry to be complex, responsive and volatile with its essence said to be based on one-off projects and temporary relationships. Love and Li (2000) highlighted another problem related to the poor quality associated with the finished projects which he opined was as a result of lack of adoption of quality assurance programmes. Love and Li (2000) goes on to state that, even where implemented, there was a

general lack of commitment from construction companies to effectively implement such programmes.

More recently Mitchell et al (2011, p.47) highlighted that the traditional fragmentation of the construction industry lie at the 'root of many of the industry problems' - an observation that had earlier been made by Abi-Karam (2005, p.23) who summed up his observations by stating that the construction of a project is a 'fragmented process in a fragmented environment'. To support his claim he observed that typically a project is conceived by the owner, designed by architects and engineers, impacted upon by building officials and planning teams, approved by regulatory agencies, constructed by contractors and their supply chain and maintained and operated by end users.

Such problems, almost all centred on challenges pertaining to procurement systems/methods adopted to deliver construction projects, have prompted construction researchers and practitioners across the world to explore procurement related challenges in an effort to identify appropriate systems, models and frameworks that can be adopted to meet challenges posed by such issues in the construction sector. These challenges are explored further in follow on sections/chapters below. Such an exploration would inevitably expose gaps in current research which then forms the foundation for this research study.

### **1.3 RESEARCH PROBLEM**

Integration of design and construction processes through D&B procurement method (D&B) in the construction industry is commonly thought to result in a seamless procurement process, along with improved team relationships and a product delivered more efficiently. Some of the reasons that have been put forward by previous researchers as to why construction clients select D&B as a procurement method have been identified as follows;

- Innovation – implying that clients expect to get creative solutions for the project (Beard et al, 2001)
- Costs savings – on the basis that, due to shorter construction durations associated with D&B procurement, there is an expectation for project cost to decrease (Songer and Molenaar, 1997)
- Early cost establishment – on the basis that project costs are secured before the start of the detailed design (Songer and Molenaar, 1997)
- Reduced schedule – as the overall project completion time is expected to be relatively shorter compared to other conventional design led procurement methods (Songer and Molenaar, 1997)
- Single entity responsibility for both design and construction (Beard et al, 2001)
- Builder/contractor involvement in the design process (Gransberg and Lopez del Puerto, 2004)
- Best value selection: the project is awarded to the team that offers the most benefits to the owner; price is not the only factor considered (FAR, 1996)

Despite these perceived benefits of such integrated design and construction processes generally associated with D&B procurement, it is argued in this research that there are still significant disparities between the theory and practice of D&B procurement as a method of delivering construction projects. Significant challenges remain which, if not addressed, may continue to impair the performance of the D&B procurement method and paradoxically undermine the achievement of design and construction integration benefits associated with this procurement method.

This is ironic as the D&B procurement method has been perceived to have addressed the problems associated with fragmentation of the traditional design led construction delivery processes. The fragmentation of the design and



construction processes has since been labelled as the root cause of the construction industry problem (Naoum, 2003; Mitchell et al, 2011).

From the review of literature it would appear that there are numerous challenges that have been encountered by participants which hinder better integration. This impacts on the achievement of effective and efficient implementation of the D&B procurement process. Current body of knowledge has identified significant D&B procurement method challenges. These challenges are said to be difficulties in defining requirements clearly and still leaving some room for creativity and ingenuity for the D&B contractor (Fahmy and Jergeas, 2004), perceived inferior quality of D&B projects (Gransberg and Windel, 2008) and clients' perceived loss of control of the design and construction processes. This may be taken advantage of by the D&B contractor (Garnsberg and Windel, 2008) especially considering that there is no overall design and construction supervision from the owner. The perception by clients is that, although there is room for cost savings emanating from the procurement method, they are unsure if the cost savings realised by the D&B contractor are in fact passed on (Fahmy and Jergeas, 2004).

Although such problems associated with D&B procurement have been highlighted in the related literature reviewed, it would appear that such research efforts were more concerned with exploring challenges mostly affecting clients and less concerned with other participants of the process like designers and contractors. In addition, previous research efforts appeared to focus on single challenges of the procurement method with little or no effort to holistically explore the challenges from key participants' perspective given their interconnectedness and interrelationships. It is, therefore, further argued in this research that any attempt to understand such a complex phenomenon should encompass a holistic analysis of experiences from key participants (identified in this research as designers, contractors and clients) involved in D&B procurement method.

Similarly, it is also argued in this research that greater understanding of this complex problem could only be achieved if the fundamental challenges affecting all key D&B participants are explored and understood. This will inform and underpin the development of an enabling framework for better integration and coordination of the design and construction processes within this procurement method. The study therefore explores this problem further and provides further empirical evidence on D&B procurement challenges and how they have been dealt with in practice; another area that appears to have been overlooked by previous researchers as they tended to focus on challenges rather than practice based enablers to be adopted to address the challenges. The study also examines, not only the key reasons why these challenges arise but, the severity of the challenges from key participants' perspective. It is a fundamental premise of this research that the construction industry problems associated with procurement matters are not necessarily resolved by a proliferation of procurement methods but by focusing on improving the existing procurement methods which this research aims to do.

As part of this exploration, the research intends to examine the following: factors underlying key participants' perceptions of the D&B procurement method; possible reasons why such perceptions have come about; identification of the form and nature of the challenges experienced as well as the severity of the challenges identified. Furthermore the study intends to explore how key participants have managed to deal with challenges encountered over the years with a view to understanding possible good practices/practice based enablers that could benefit other D&B procurement method users in the construction industry.

#### **1.4 AIM AND OBJECTIVES**

The aim of this research is to investigate and explore what the prevailing challenges are that key participants of the D&B procurement method within the

UK construction industry are facing and more importantly, understand how they have dealt with such challenges in practice. On the basis of these findings, the research aims to develop a framework that, hopefully, will be of use in facilitating better integration of the design and construction processes resulting in the achievement of effective (i.e. generation of desired results) and efficient implementation of the D&B procurement method. The aim is achieved through the following objectives:

1. To develop an in-depth understanding of the nature (including range and dynamics) of challenges affecting key participants in D&B procurement method. Factors underlying the challenges will also be explored as part of this objective.
2. To explore the severity of challenges encountered by key participants of the D&B procurement method
3. To identify practice based enablers that key participants have used/propose to address the key challenges identified in objective 1
4. To propose a framework that will hopefully facilitate better integration of design and construction processes as well as serve as guidance or toolkit for key participants to refer to and use when utilising the D&B procurement method

## **1.5 RATIONALE/RESEARCH QUESTIONS**

A major contributory factor to the construction industry's poor performance (Love & Gunasekaran, 1998; Egan, 1998; Egan, 2002; Evbuomwan & Aumba, 1998; and Naoumi, 2003;) has been found to be its fragmented nature which in turn has resulted in lack of both integration and coordination between the different disciplines involved in the various stages of the procurement and delivery of construction projects. Whilst research has shown that there is a continuous increase in the use of D&B as a procurement method it is not uncommon to

observe common breakdowns on D&B projects as well as misinterpretations of client goals or wrong interpretation of design documents.

Main research efforts in addressing these challenges tended to focus on looking at D&B procurement method challenges in isolation ignoring the interconnectedness of the challenges and how they impact key participants of the process. For instance, some researchers (Anumba, 1989; Anumba and Watson, 1991; Anumba and Watson, 1992; Brandon and Betts, 1995; Alshawi in Li et al., 2000a) focused on Information Technology (IT) to improve the flow of information between the project participants with the perceived benefits of reducing errors, improving coordination, increasing data integrity, improving communication and product quality. It is arguable whether such research efforts on their own have brought in the desired improvements as IT has simply been used to automate processes and not to adequately look at the challenges affecting integration in D&B procurement. The expected productivity emanating from the utilisation of IT in D&B procurement method has thus not materialised as observed by Li et al (2000b) and Love et al (2000).

Better and achievement of effective integration of design and construction processes is therefore still a major problem in construction. To understand holistically these challenges that emanate from a complex phenomenon like D&B construction procurement would necessarily require an in-depth exploration of key participants' experiences. In addition this would also entail ascertaining the form and nature of the challenges, dimensions of participants' perceptions and examination of why and how their perceptions have come about. The following questions/intellectual puzzles have emerged out of this research and will be explored in order to inform the approach to this research:

1. What are the underlying challenges experienced by key participants of D&B procurement method?
2. What are the factors underpinning such challenges?

3. What is the severity of the challenges that are encountered by key participants of the D&B procurement method?
4. How have these underlying challenges been addressed by key participants of D&B procurement method in practice?

These questions are explored further in the research and the following chapters address these questions in more detail.

## **1.6 RESEARCH APPROACH**

In order to satisfactorily achieve the research aim and objectives as well as address the research questions raised in section 1.5 above the following tasks were undertaken:

1. Review of related literature in order to achieve the following:
  - Develop an understanding of D&B procurement method attributes
  - Examine typical D&B procurement method organisational forms
  - Identify and explore D&B procurement method challenges encountered by key participants of the process
  - Examine the processes involved in D&B procurement method
  - Identify gaps in previous research in order to provide foundation blocks for the research
2. Face to face interviews with D&B procurement method key participants in order to explore and understand further the nature and characteristics of the challenges experienced by clients, design consultants and contractors. Key participants from these categories were selected on the basis of their practical experience of D&B procurement activities, results, problems and challenges. The objective of the interviews is to seek insights and valuable information into the challenges affecting key participants as well as seek to explore further challenges identified in the reviewed literature

3. Questionnaire survey conducted in order to get the views of D&B procurement method key participants from a wider audience in the UK construction industry. In addition another objective of the survey is to get an understanding of the severity of the challenges affecting participants of D&B procurement method.
4. Findings from the reviewed literature and results of the interviews and survey are presented in later chapters.

## **1.7 SCOPE AND LIMITATIONS OF THE RESEARCH**

Although some of the principles covered in the thesis are common in other variants of D&B procurement the scope of this thesis is mainly centred on the variant where the client undertakes some design. The justification for this approach is that previous research indicates that this variant is the most commonly used in practice (Akintoye, 1994).

The research is also targeted at key participants of D&B procurement identified in the research as clients, designers and contractors. These are the primary parties involved in most of the key decisions that are made through the D&B procurement process. The research focused more on D&B organisations in which the designer is sub-contracted to the main contractor rather than being an in-house designer. This type of arrangement, in which the designer is sub-contracted to the main contractor, was adopted as the author wanted to explore more the dynamics that this arrangement brings to the D&B procurement method. The research covered both public and private clients but did not attempt to purposefully focus in any particular construction industry sector. The research makes reference to mainly the traditional procurement method as the reviewed literature indicated that it is due to the fragmentation of the traditional method that led to the resurrection of the D&B method (Mitchell, et al 2011).

## **1.8 EXPECTED OUTCOME AND CONTRIBUTION TO KNOWLEDGE**

The major outcome expected from this research is the development of a framework that will, in addition to helping facilitating better integration of design and construction processes, act as guidance and/or toolkit for users of D&B procurement method. This should be able to help facilitate better integration and the achievement of effective and efficient implementation of the D&B procurement method within the construction industry.

In addition to capturing good practice the framework will hopefully help users address some of the key challenges associated with D&B procurement resulting in its widespread use. Given its reported potential for superior performance in time and cost (Konchar et al, 1997; Ling and Kerh, 2004; Pain and Bennett, 1988; Grifith, 1989; Ndekugri and Turner, 1994; Pockock et al, 1996; Bennett et al, 1996; Hale et al, 2009 and Goftar et al, 2014) its increased adoption will invariably result in improvements in the performance of the construction industry.

Previous studies on underlying challenges associated with D&B procurement method tended to focus more on those challenges affecting clients only and even where other non-client challenges were explored the tendency appeared to isolate and cover challenges singularly and not to provide a holistic examination of the challenges experienced by key participants. Other key participants involved in the procurement process such as design consultants and contractors that appeared to have been overlooked in literature reviewed are included in this research.

The research offers significant opportunities for practitioners to gain more in-depth understanding of the underlying challenges associated with the D&B procurement method. Clients and their advisors will be able to know in advance challenges they need to address prior to engaging D&B contracting

organisations. They will be able to appreciate challenges experienced by the D&B contractor and his/her designer as well. This enlightenment and appreciation will hopefully enable all key parties involved to constructively engage and hopefully share and promote good practice thereby avoiding pitfalls that have hitherto been experienced with this procurement method.

Similarly designers and contractors will be able to understand, appreciate and recognise each other's challenges. This should hopefully result in more collaboration, cooperation and effective communication. Shared understanding of such challenges should result in better team synergy particularly in coordination of the design and construction activities.

The academia will no doubt get more insight into the D&B procurement method which they can use in further research and curriculum development. Findings from the research will help the academia to get another perspective on D&B procurement method in terms of practical aspects as experienced by key participants. Curriculum can also be developed and adapted to suit the practice based aspects of D&B procurement that this research generates. This will add another important dimension to the learning of potential future practitioners of the D&B procurement method.

The research will provide researchers with another point of reference for undertaking further research studies not only within the D&B procurement method field but other existing procurement methods as well. The research will no doubt challenge existing intellectual and theoretical understanding of the D&B procurement method. The research's findings/outcome will also generate a wider theoretical resonance by bringing to the fore, not only the challenges faced by practitioners, but also highlighting key practice based enablers that may be adopted by other D&B procurement practitioners in order to realise/harvest and unlock the benefits that this integrated procurement method may potentially generate. The research places emphasis on practice based enablers as opposed



to just enablers as such enablers originate directly from practitioner's 'lived experience'. Such an experience is not only practitioner based but is based on experience that has been used before and has been found to have worked.

Above all it is estimated that approximately 95% of the industry's clients are occasional or infrequent, with little or no experience of working with the industry or the processes by which consultants, contractors and suppliers are procured (RICS, 2012). It is further stated that they are also less likely to understand the importance of their role in ensuring project success. In addition to providing a useful base for the application of lessons learnt from past experiences for the experienced clients of D&B procurement the results of this study will no doubt provide useful insight to a large audience of occasional clients and users. This will allow them to develop appropriate strategies to apply when utilising D&B as a procurement method to deliver construction projects.

The respondents targeted in this research (as highlighted in the interview and the survey sections in later chapters) are experienced practitioners who have been actively involved in the construction sector for a relatively long period of time. It can therefore be stated that these practitioners (key participants) possess a certain degree of expertise about the domain of this inquiry. This research therefore makes the case that a substantial range of thematic discoveries will thus be generated. This therefore provides the case for generalisation of the thematic discoveries made in this research.

## **1.9 KEY PARTICIPANTS OF THE D&B PROCUREMENT METHOD**

As noted above key participants of the D&B procurement method have been identified as clients, designers and contractors. Although there are other participants involved in the D&B procurement process it is the interaction, relationship and communication between clients, designers and contractors that

the researcher felt was key to addressing the research question and achieving the research aim and objectives due to the following reasons:

### **Clients**

Clients are key to the construction industry in that they are the ones who come up with the need and resources for development of construction projects. Clients play an important role in D&B procurement and in any other procurement method for that matter as they instigate the project development process. This instigation is in response to their business need and/or in response to the requirements of the market – supply and demand factors playing a key factor in some clients particularly private developers.

Since the client enters into contract with a single organisation, the contractor, it is expected that this facilitates single entity responsibility which is expected to benefit the client as liability and obligations are clearly demarcated.

Communication lines are said to be clearly defined and since the contractor is responsible for both design and construction processes the expectation is that this may well facilitate team working and integration of design and construction processes between the parties.

In addition to their other roles and responsibilities in other procurement methods their key roles/responsibilities in D&B procurement method are to clearly articulate their requirements, review tender returns, not only in terms of cost and time parameters, but design proposals as well and to manage the D&B process through design and construction stages up to completion and handover of the project. In this respect they have been, therefore, identified as key participants in this research. Their views and experiences in the whole project development cycle when D&B procurement method is used are of vital importance in order to achieve the aim and objectives of this research.

## **Designers**

Although the nature and extent of designers' involvement in the construction sector is different from one procurement method to the other they nevertheless play an important role in construction project development. They translate the client requirements into designs that contractors use to transform into physical built environment assets. Designers, therefore, play a key role in any procurement method as they are tasked with an important function to translate and transform client requirements and needs into designs. Such designs are a suite of documentation (including drawings, specifications, standards and schedules) that contractors use to construct the built environment.

In a D&B procurement method set up designers are supposed to play a pivotal role in interpreting the employers' requirements and translating these into designs that not only meet the client's requirements but the contractor's proposal as well in terms of cost, time, quality and other criteria that would have been identified in the D&B contract. Due to the design and construction processes being undertaken by one organisation, the D&B contractor, designers are also expected to incorporate buildable aspects from the contractor's input into the design. Designers are also expected to liaise with specialist contractors in order to incorporate their input into the design at an early stage to avoid any issues further down the line during the construction phase.

Designers, therefore, play an important role in the construction industry in general and in D&B procurement in particular. Although in some cases specialist sub-contractors and contractors undertake some designs (for instance temporary works design and specialist work package designs) principal designers may still have some involvement in checking such designs and coordinating the designs to ensure alignment with the overall design intent of the construction project.

## **Contractors**

Contractors generally are the ones who physically translate the designs into the construction facility that clients would ultimately use. This is in order to satisfy their requirements. In this respect their main responsibility is to come up with contractors' proposals that entirely correspond with the employers' requirements. In a D&B procurement method set up contractors enter into contract with the client to design and build the required facility. In most cases contractors would then sub-contract parts of the D&B contractual obligations to the supply chain giving rise to sub-contracts for undertaking the design, sub-contracts for undertaking work packages and other many such sub-contract arrangements as the D&B contractor wishes to set up.

Contractors, in a D&B procurement method, are responsible not only to build the facility for clients but to design it as well. Sometimes they undertake the design in house within their own organisation but in most cases they sub-contract the design element to designers. In a D&B procurement method set up contractors are expected to provide buildability advice to designers. This is to ensure that the designs that are generated are relatively easy to build and take into account the contractor's preferred methodology. This is then expected to result in economical designs that not only reduce costs to clients but are relatively easy to build and therefore reduce construction durations.

Contractors are therefore the ones who have the principal contract with the client and in turn generate further sub-contracts with the supply chain. Contractors are the key player and are at the centre of everything in this set up. Therefore their experiences not only with the client but with designers, specialist trade sub-contractors and others in the supply chain is important in addressing the key research questions of the research and therefore addressing the research aim and objectives.

## **1.10 CONTENT/STRUCTURE OF THE THESIS**

The thesis is divided into eight chapters as described below

### **Chapter 1      Introduction**

The chapter introduces the background to the research problem, identifies the research aim and objectives, highlights the research questions as well as briefly explains the research design, plan and structure of the report.

### **Chapter 2      D&B characteristics, attributes and processes**

The chapter develops the theoretical basis of the research by exploring the concept of integrating design and construction, the organisational structures commonly adopted together with roles and responsibilities of key parties in the process.

### **Chapter 3      Underlying challenges associated with D&B procurement method**

This chapter covers the research questions set out in section 1.5 above. It also covers an in-depth exploration of the challenges encountered by participants of the D&B procurement method.

### **Chapter 4      Research methodology**

The chapter reviews and discusses approaches and philosophies underpinning this research. The most appropriate methodology is chosen and justified in this section.

## **Chapter 5      Analysis of findings: Qualitative data analysis**

This chapter focuses on the analysis of findings from interviews undertaken. Content analysis was undertaken in order to get an understanding of the underlying challenges encountered by key participants of the D&B procurement method.

## **Chapter 6      Analysis of findings: Quantitative data analysis**

This chapter provides an analysis of the questionnaire survey undertaken to understand the views and perceptions of a different wider population in order to gain an appreciation of the severity of the challenges raised in the qualitative phase of the research.

## **Chapter 7      Discussions and Synthesis**

This chapter presents discussions on the main findings of the research and provide a detailed synthesis of the findings. The developed framework is presented and suggestions for its use by practitioners are also provided. Contributions to knowledge and potential benefits of the framework to practitioners are also articulated.

## **Chapter 8      Conclusions and Recommendations**

The chapter presents the research conclusions and recommendations based on the evidence from the findings of the research. Limitations of the research are presented in this chapter.

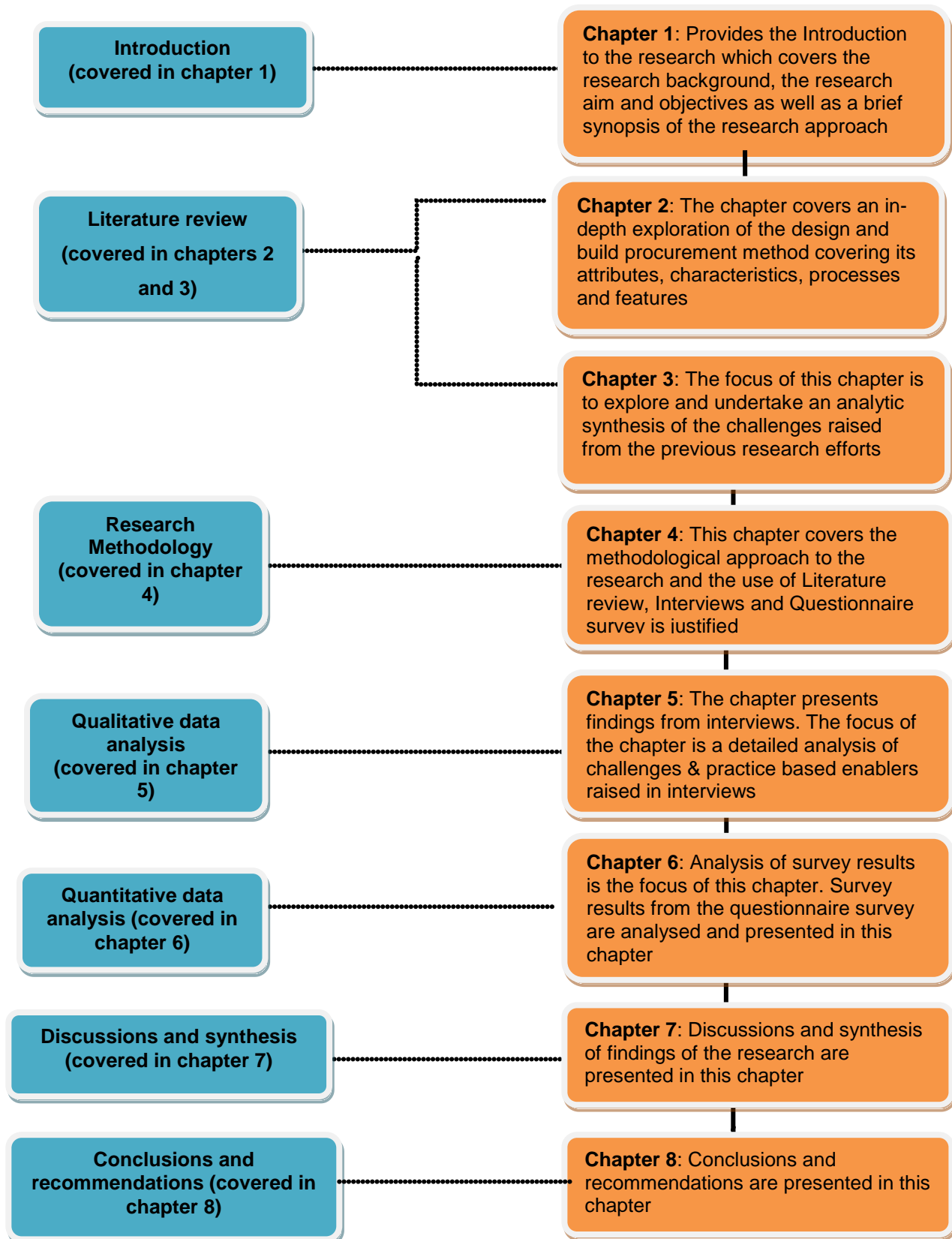


Figure 1.8: Research design & schematic diagram of the thesis

## **1.11 CHAPTER SUMMARY**

The chapter has provided the research background, aim and objectives as well as a brief overview of the research approach adopted. It has also provided arguments for a holistic exploration of D&B procurement method challenges from, not only clients' perspectives, but other key participants to the procurement method such as contractors and designers as well. Key participants of the D&B procurement method have been noted and their roles and responsibilities in D&B procurement method have been highlighted.

Through these arguments the chapter has put forward a case that there is a need to explore underlying challenges encountered by key participants (clients, design consultants and contractors) in order to get a holistic understanding of this complex procurement method that integrates design and construction processes. A schematic diagram of the thesis has been provided to graphically present how this problem is explored by this research. A brief synopsis of the research approach involving literature review, interviews and questionnaire surveys has also been presented.

The next two chapters of the thesis (chapters 2 and 3) review and provide an in-depth synthesis of related literature. They are mainly centred on D&B procurement method characteristics, attributes, typical formats, processes and challenges that have been encountered by construction industry clients, contractors and design consultants within a D&B procurement setting. In addition to exploring the aforesaid challenges the chapters identify and highlight existing gaps in the current body of knowledge reviewed in order to provide the basis for this research.



## **CHAPTER 2:**

### **D&B CHARACTERISTICS, ATTRIBUTES AND PROCESSES**

#### **2.1 INTRODUCTION**

This chapter provides a review of related literature that has been undertaken in order to inform the research questions that have been formulated in chapter 1 above. It is the first of the two literature review chapters in this research/study. The aim of the review of related literature is to explore and understand underlying challenges impacting on key participants of the D&B procurement method. In addition to this exploration of challenges the review of related literature is aimed at identifying and clarifying gaps in existing body of knowledge reviewed which should then provide the case for undertaking this research/study.

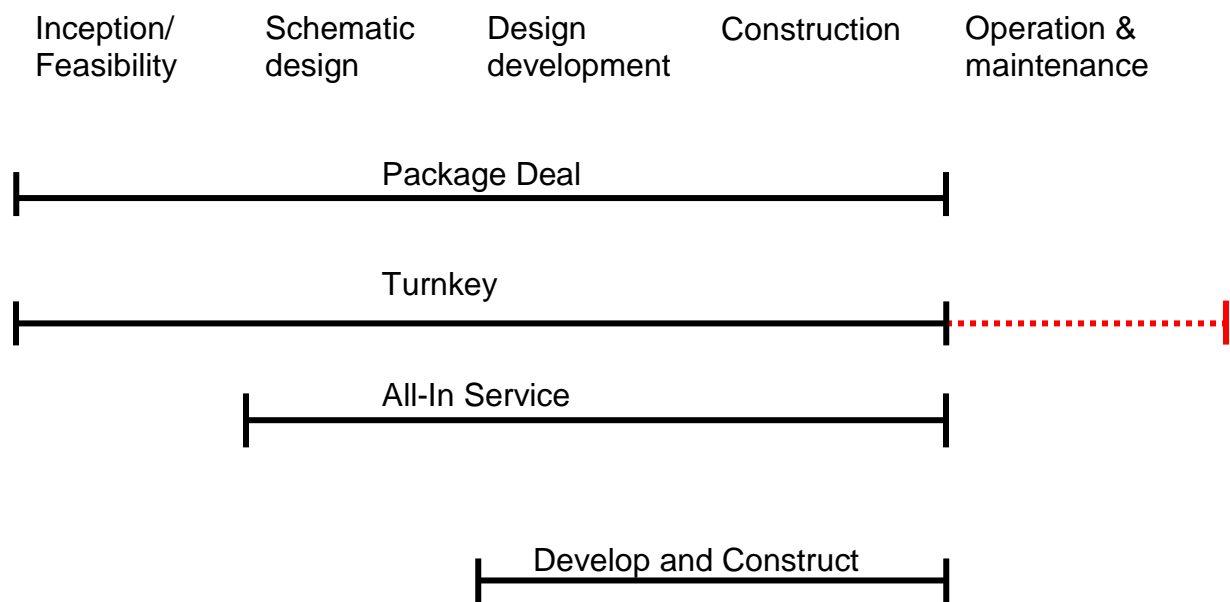
The chapter examines in detail those attributes associated with D&B procurement method with a view to understanding its nature, organisational form and processes involved. This will form the basis for understanding how and why challenges underlying this integrated procurement method have evolved. In addition the typical building processes associated with this procurement method are critically analysed in order to decipher how and why such processes may have lead to the surfacing of challenges that have been linked to this procurement method.

In articulating the key aspects of the D&B procurement method comparisons, where appropriate, with the design led procurement method (traditional procurement method) will be highlighted. Although there are several other procurement methods in existence that the D&B procurement can be compared with, the researcher felt that since it is from the perceived failings of the traditional procurement method that the D&B procurement method emerged, it is appropriate to highlight and note these differences in a comparative basis.

The chapter concludes by summarising the main chapter findings which should provide the foundation of the exploration of challenges underlying the D&B procurement method covered in chapter 3 of the thesis.

## 2.2 D&B PROCUREMENT METHOD FORMAT, TRENDS AND EVOLUTION

D&B procurement definition, as stated by Potter (1994), is said to vary and is also said to be ‘difficult to categorise as many so called D&B approaches overlap one another’ (Potter, 1994 p.3). The existence of such a variety of approaches has led to what is commonly referred to as D&B continuum. Figure 2.1 show a graphical representation of the relationship between D&B procurement types and project phases.



**Figure 2.1: The relationship between D&B types and project phases**

**Source:** Adapted from Sutheerawatthana (1998)

According to Potts and Patchell (1995) and Turner (1995) the major difference between the different types/categories is the varied degree of design

management by the owner's designers and the design-builder. These phases are shown in Figure 2.1. Contractors are introduced at the inception-feasibility stage in package deal and turnkey procurement, at the schematic design stage in all-in services and at the design development stage in develop and construct.

D&B is increasingly skewed towards being more developed prior to involving the contractor. Although some of the challenges noted are common to other D&B procurement variants the focus of this research is on the more conventional type of approach – the develop and construct variant - which has been noted as one of the most commonly used variant in practice by Akintoye (1994) and Anumba and Evbuomwan (1997). The develop and construct variant which involves some partial involvement of the client and the designer in the initial design to be later developed by the contractor potentially brings to the fore the interaction of the key participants at different stages in the whole project development cycle. It is this interaction and experiences that key participants get out of this process that this research aims to 'unearth'. This hopefully will enable the researcher to better understand the issues and enablers that have been used to deal with the issues. Potential for better integration in future D&B procured construction projects will be enhanced by this holistic approach that captures key participant experiences in the entire project development cycle.

Despite this difficulty in definition and categorisation, D&B procurement method is generally viewed as an integrated procurement method in which the contractor is responsible for both design and construction of the built environment based on a set of requirements set by the client (Yu et al, 2010; Masterman, 2002). A typical D&B procurement method organisational structure is depicted in Figure 2.2.

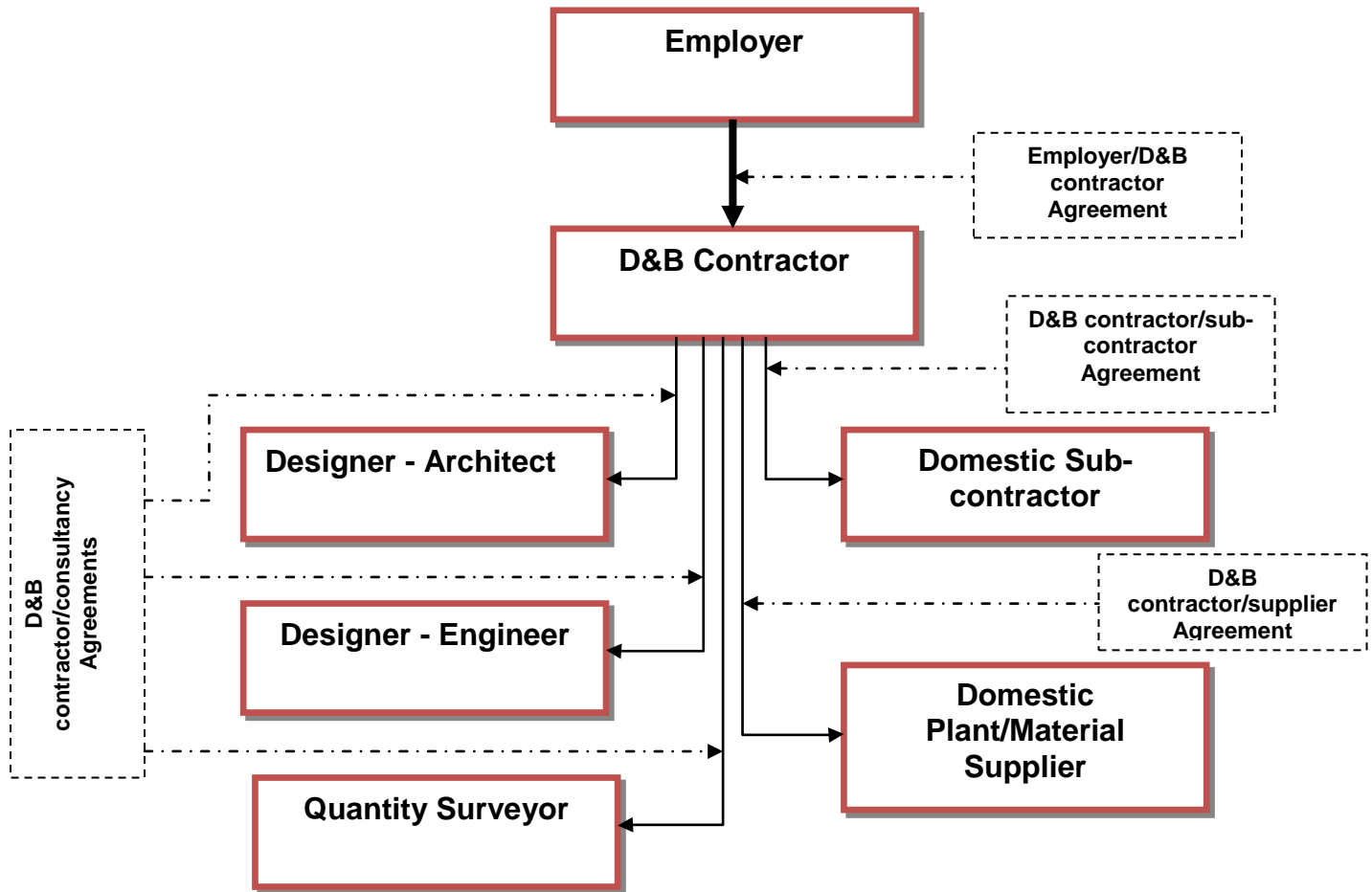


Figure 2.2: D&B procurement method: typical organisational structure

Source: Adapted from Masterman (2002)

The concept of integrating both design and construction is said to be the key to the procurement approach particularly considering that in the design led traditional procurement method design and construction are distinct disparate phases. Such a separation of these two key processes in construction projects has since been seen as the root cause of construction problems. The disparate phasing and arrangement of the construction development process have been commented upon by Opfer et al (2002) in their research. They stated that such fragmentation is the source of the problem whereby construction clients find themselves in the middle of a battle as design and construction participants blame each other for project problems.

Due to the integration of both design and construction activities brought about by D&B procurement responsibility is pinpointed to a single entity (the D&B organisation) thereby, it was perceived, avoiding many of these problems for the construction clients. The concept of integration, underpinned within the D&B procurement method, has also been seen from another angle by Opfer et al (2002) when they stated that it leads to single point accountability as a result of streamlined delivery processes.

The observation by Opfer et al (2002) had been echoed earlier by CIRC (2001) in which the integrated approach was claimed to be helpful in achieving better project outcomes for the construction industry including buildability. Similarly Chan et al (2010) asserted that if a contractor is involved at the pre-construction stage (as is the case with some D&B procurement method arrangements) activities such as programme planning, materials procurement as well as buildability will be enhanced and lead to project outcomes that are remarkably enhanced.

The concept of integration of design and construction was also summed up by David and Dorman (2008) when they advanced the notion that early engagement of a contractor brought about by D&B procurement method can result in better

buildability of the eventual design. As part of their argument they identified a number of buildability factors emanating from this integration such as:

- Allowing economic use of contractor's resources
- Enabling contractors to develop and adopt alternative construction details
- Enabling standardisation and repetition
- Enabling freedom of choice between prefabrication and on site works
- Enabling simplification of construction details in case of non-repetitive elements
- Minimising the impact due to adverse weather by enabling a more flexible construction programme
- Allowing design to achieve safe construction sequence on site

In contrast other researchers like Abi-Karam (2005, p.23) traced the origins of the D&B procurement ethos and emergence of the principles of integration of design and construction by a single organisation as originating from the effects of external factors such as:

- Paradigm shift in the project delivery process
- Re-focus on the front end and back ends of the project life cycle
- Construction market becoming a service market rather than a commodity market
- Emphasis on life cycle costs and total project costs
- Emphasis on value of construction goods and services
- Niche marketing (micro-marketing)
- Global competition (open global economy)

This paradigm shift in project delivery process appears to be supported by a survey undertaken by the RICS's Contracts in use survey (2010) which show remarkable shifts in trends in procurement methods over the period 1985 – 2010 as depicted in Tables 2.1 and 2.2.

**Table 2.1: Trends in procurement methods in the UK by number of contracts: 1985-2010**

	<i>% By number of contracts</i>											
<b>Procurement Method</b>	1985	1987	1989	1991	1993	1995	1998	2001	2004	2007	2010	% change [1985-2010]
<b>Traditional - Firm BQ</b>	42.8	35.6	39.7	29	34.5	39.2	30.8	19.6	30	20	24.5	<b>-18%</b>
<b>Other Lump Sum Contracts</b>	51.9	59.6	53.5	60.9	48.2	46.5	46.1	64.8	46.9	49.4	53	<b>1%</b>
<b>D&amp;B</b>	3.6	3.6	5.2	9.1	16	11.8	20.7	13.9	13.3	21.8	17.5	<b>14%</b>
<b>Target</b>	0	0	0	0	0	0	0	0	6	4.5	3.7	<b>4%</b>
<b>Management</b>	1.7	1.2	1.4	0.8	0.9	1.2	1.5	0.6	0.2	0.7	0	<b>-2%</b>
<b>Construction Mgmt</b>	0	0	0.2	0.2	0.4	1.3	0.8	0.4	0.9	1.1	0.3	<b>0%</b>
<b>Partnering</b>	0	0	0	0	0	0	0	0.6	2.7	2.3	1	<b>1%</b>
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	

**Source: Adapted from the RICS Contracts in use survey (2010)**

As shown in Table 2.1 the traditional procurement method, which is sometimes referred to as the ‘design led’ procurement method, has been the most prevalent procurement method over the years and appears to have been on a downward trend in its use over the period 1985 to 2010 (18% reduction) while other procurement methods, particularly the D&B procurement method, are shown to be on the upward trend (14% increase) over the same period of time.

The RICS Contracts in use survey further published trends in procurement method by value of contracts, which complements the trends shown in Table 2.1. Table 2.2 depicts such trends. This shows that traditional procurement method usage by value of contracts declined by 41% over the period 1985 – 2010 while the D&B procurement method increased by 31% over the same period. It is clear

that the shift has been from the conventional design led traditional procurement towards both integrated and management procurement methods. D&B procurement method expanded considerably from below 10% share in the 1985 to 39% share of the procurement market by value of contracts. The opposite appear to have been the case with the traditional procurement method which plummeted from 59% of the market share in 1985 to approximately 19% of the market share by value of contracts in 2010. This is tabulated in Table 2.2.

**Table 2.2: Trends in procurement methods in the UK by value of contracts: 1985-2010**

	<i>% By value of contracts</i>											
<b>Procurement Method</b>	1985	1987	1989	1991	1993	1995	1998	2001	2004	2007	2010	% change [1985-2010]
<b>Traditional - Firm BQ</b>	59.3	52.1	52.3	48.3	41.6	43.7	28.4	20.3	23.2	13.2	18.8	-41%
<b>Other Lump Sum Contracts</b>	18.3	26.3	14.9	9.6	12.6	15.1	12	23.3	13.7	20.4	23.9	6%
<b>D&amp;B</b>	8	12.2	10.9	14.8	35.7	30.1	41.4	42.7	43.2	32.6	39.2	31%
<b>Target</b>	0	0	0	0	0	0	0	0	11.6	7.6	17.1	17%
<b>Management</b>	14.4	9.4	15	7.9	6.2	6.9	10.4	2.3	0.8	1.1	0	-14%
<b>Construction Mgmt</b>	0	0	6.9	19.4	3.9	4.2	7.7	9.6	0.9	9.6	0.1	0%
<b>Partnering</b>	0	0	0	0	0	0	0	1.7	6.6	15.6	0.9	1%
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100.1</b>	<b>100</b>	

**Source: Adapted from the RICS Contracts in use survey (2010)**

As depicted in Table 2.2 it is clear that construction clients have been trying to use different procurement methods to satisfy their built environment requirements. However, the dominance of the conventional 'design led' procurement appear to be relatively declining over the years compared to



alternative integrated procurement methods (including D&B) as depicted by Table 2.2.

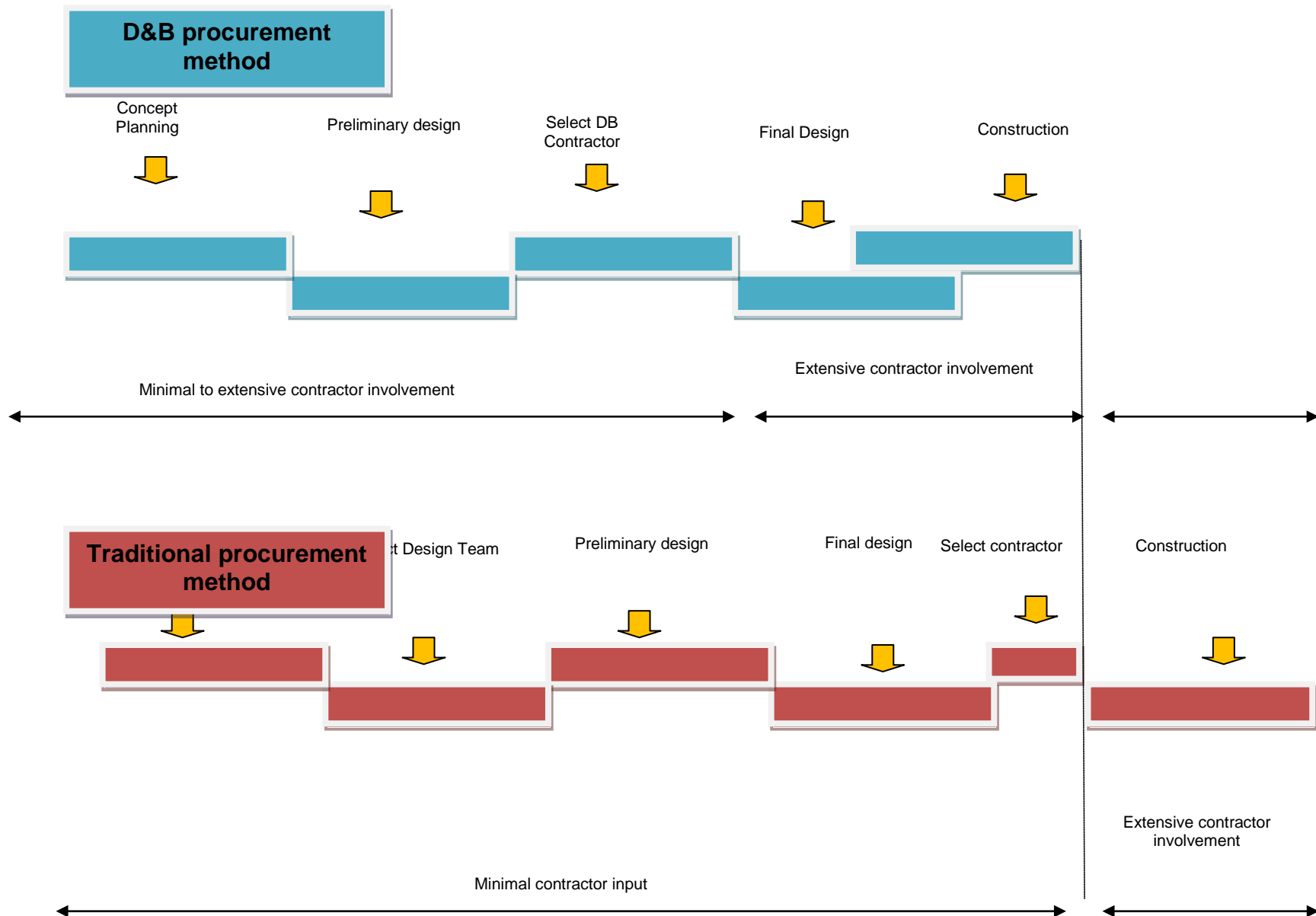
It is also noticeable from Tables 2.1 and 2.2 that the period after 2007 experienced significant declines in most of the procurement methods surveyed particularly in terms of the number of contracts used. The traditional firm bill of quantities and other lump sum contracts are the only procurement methods not to have experienced declines in this period. However the result appears to be different when value of contracts is used in the analysis for contracts surveyed after 2007. In this analysis the only procurement methods that experienced decline out of the surveyed contracts are the management, construction management and partnering.

Part of the explanation for such declines may be due to the economic decline that was experienced mostly in 2007. Perhaps in this period the perception of risks in the construction sector associated with non-design led traditional contracts had shifted in this period leading to clients and their advisers more inclined to use the 'tried and tested' traditional procurement methods as opposed to the relatively modern procurement methods such as construction management, management contracting and partnering. However although there was a decline after 2007 in terms of the number of contracts using D&B procurement method it was still the highest used procurement method in terms of value of contracts out of the surveyed contracts.

This trend appears to be supported by research efforts undertaken by several other researchers. For example Ndekugri and Turner (1994) observed that there was a noticeable trend towards D&B procurement method with the majority of clients and contractors welcoming such a development. The same observations were reported elsewhere in other parts of the world, for example, Grobber and Pretorius (2002) indicated that 29% of building and civil engineering projects in South Africa are delivered by the D&B procurement method. Yates (1995, p.33)

suggested that 'more than one-third of the then current construction projects in the United States are using the design/build approach'.

Elsewhere Ndekugri and Turner (1994) observed similar trends, in support of the above findings, that the D&B procurement method is perceived by clients as providing better value for money (and thus resulting in increased use of the method) particularly where time for completion is of the essence. Other reasoning given by Songer and Molenaar (1996) in support of these trends is that the primary reason why the D&B procurement method has been adopted is because of the time savings inherent in the process (See Figure 2.3 which graphically show how some of these time savings come out of the process).



**Figure 2.3: Typical sequence of project delivery activities of D&B compared to traditional procurement method**

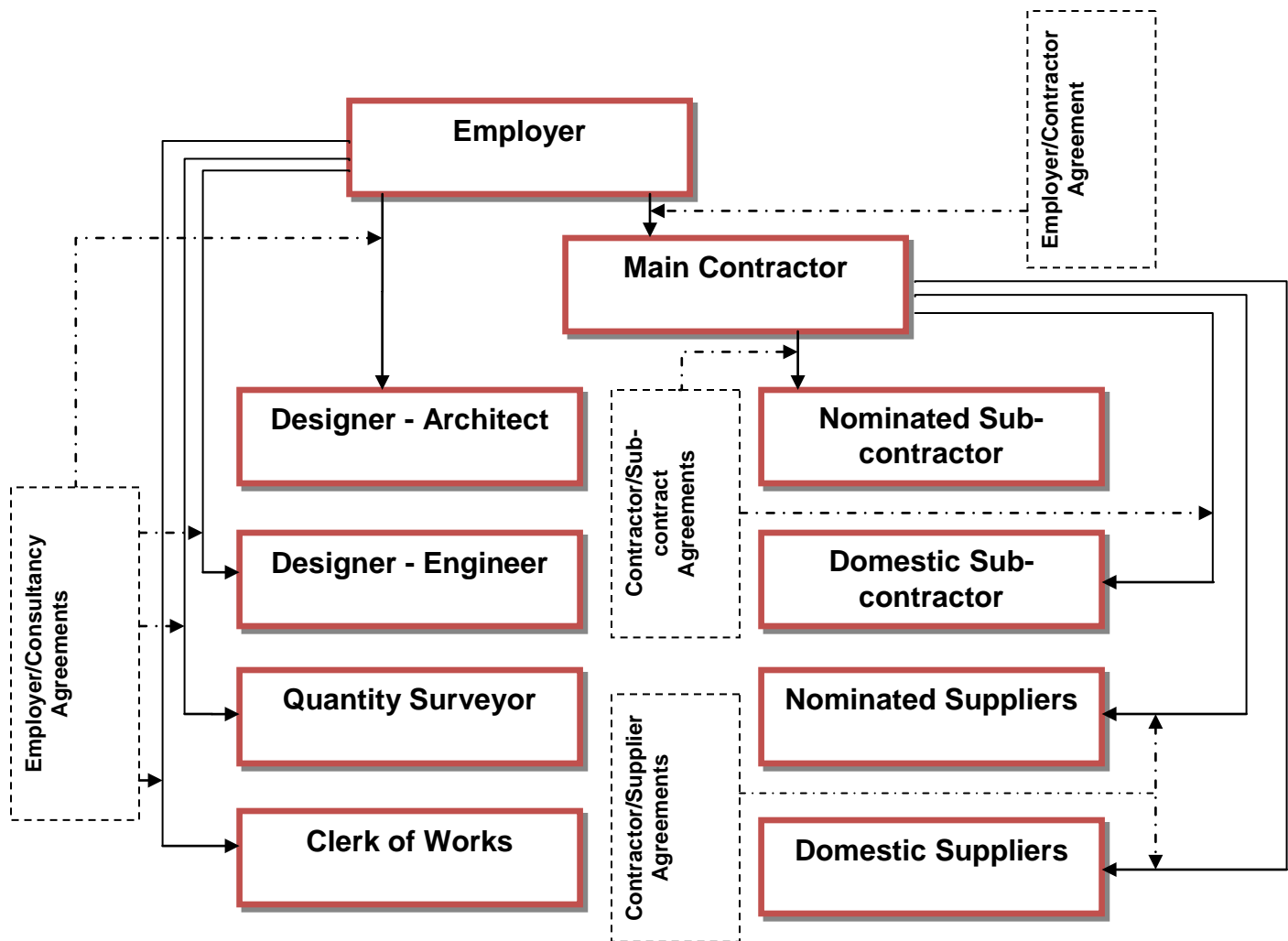
**Source: Adapted from Perkins (2006)**

It would also appear that the resurgence or relative increase in use over the years of the D&B procurement method had its roots mainly from the failings of the traditional design led procurement method in which the project is delivered using a fragmented process as observed by Abi-Karam (2005). The fragmented nature of the traditional design-led procurement method was identified by Abi-Karam (2005) as emanating from the fact that:

- The project is conceived by the owner
- The project is designed by design consultants (architects and engineers)
- The project is impacted upon by officials (planners and building control)
- The project is approved by regulatory agencies
- The project is constructed by contractors
- The project is maintained and operated by end users

A typical organisation of such a fragmented design-led procurement method is shown in Figure 2.4.

Abi-Karam (2005) goes on to opine that every step of the design led traditional procurement process is laden with risks and as parties perform their duties there is a perception that they try to reallocate risks to the next party which invariably leads to adversarial relationships. Such adversarial relationships created by the process, he further opines, results in the degradation of the product quality and loss of value to the built environment clients. It is therefore not surprising that the D&B procurement method, regarded as an alternative integrated procurement method offering a one stop shopping concept with a single source of responsibility for delivering built environment projects, experienced a relatively greater increase in use over the last couple of decades compared to the design-led traditional procurement method.



**Figure 2.4: Traditional Procurement method: Typical Organisational structure**

**Source: Adapted from Masterman (2002)**

Government initiated studies that have been undertaken over the last couple of decades also appear to have encouraged the adoption of integrated production led procurement methods such as D&B. Prominent among these are the following: Constructing the team (Latham, 1994), the Levene efficiency scrutiny into construction procurement (1995), rethinking construction by Egan (1998), modernising construction (NAO, 2001), and improving public services through better construction (NAO, 2005), the Office of Government Commerce's Achieving Excellence in Construction Initiative (1999-2003) and the supporting Achieving Excellence in Construction Procurement Guides, the Construction

Industry Council's Selecting the Team (2005), the National Audit Office's Improving Public Services Through Better Construction (2005), the Strategic Forum's Construction Commitments (2006); Constructing Excellence in the Built Environment's Never Waste a Good Crisis: A Review of Progress since Rethinking Construction and Thoughts for Our Future (2009), Constructing Excellence in the Built Environment's Business Case for Lowest Price Tendering? (2011). Common themes emanating from these reports can be identified as follows:

- Involvement of key members of the project team at an early stage
- Selection by value rather than lowest price
- Adoption and sharing of common processes
- Agreement of performance measurement targets
- Involvement and engagement of participants into longer term supply chain relationships

It is therefore perhaps not surprising that trends in procurement methods over the last decades have depicted a noticeable shift from the traditional design-led fragmented approach to integrated approaches that combine both design and construction activities.

It is evident from the above section discussion on D&B procurement method trends and attributes that its attributes and characteristics have the potential to resolve the many challenges that have been associated with the traditional design-led procurement method. The question that naturally arises from this observation is whether experiences observed in practice support this conceptualisation. Previous research efforts, as discussed above, focused on what the D&B procurement method looks like and then elaborated on what should come out of the process. To support the 'what' aspects of previous researchers' focus trends and attributes have been provided but principal aspects relating to how key participants (clients, contractors and designers) involved

relate and work together to deliver, in practice, the integration of design and construction aspects of this delivery method appear to have been overlooked. In order to holistically understand such a complex process questions relating to how these processes come together will need to be explored.

### **2.3 D&B PROCUREMENT METHOD TYPICAL PROCESSES**

An understanding of the construction process is key to understanding the challenges that underlie the D&B procurement method. The D&B process sets out the framework and activities within which the built environment projects are delivered through the D&B procurement method.

There has not been a shortage of definitions and categorisation of the construction process over the years, with some describing it as a flow diagram indicating tasks to be completed at various stages of the project (NEDO, 1976; RIBA, 2012) and others (Morris, 1983) viewing it as a conceptual model which incorporates the four broadly defined stages depicted in a continuum rather than discrete phases of feasibility, design, production and start-up.

Others such as DoE (1982) depicts the process as a logical link of decisions from one decision to the other connected by means of feedback loops. Parties involved in the process have included activities they perform in the process. From these later models there is therefore an implied argument and challenge that earlier views of the process as a set of discrete technical activities may not be entirely representative of the process.

Sidwell (1982) viewed the process in terms of variables which he identified as client and project characteristics, the building team and project procedures. However, Ireland (1983) viewed the process from a different angle altogether by looking at technology used, structure chosen, the psychosocial aspects and the

way the project is managed as key effects on the achievement of the process objectives.

Similarly Walker (1985) adopted a systems approach in viewing the construction process as commencing with client's need to build and ending with the satisfaction of the client's need. He viewed the process broadly as made up of three main stages, namely project conception, inception and realisation within a system comprising behavioural responses, techniques and technology, organisational structure and decision making.

Anumba and Evbuomwan (1997) appear to adopt yet another approach by looking at the process as an encapsulation of not only activities involved, but actors involved as well as outputs emanating from each of the identified activities.

Despite the different views regarding the construction process what is clear from the above review is that it is a complex process which is characterised by the existence of many different parties and organisations forming what can be described as a multiplicity of actors and organisations all linked up in an intricate framework of processes and activities. Outputs from one activity feed in and act as inputs to the other (See Figure 2.5).

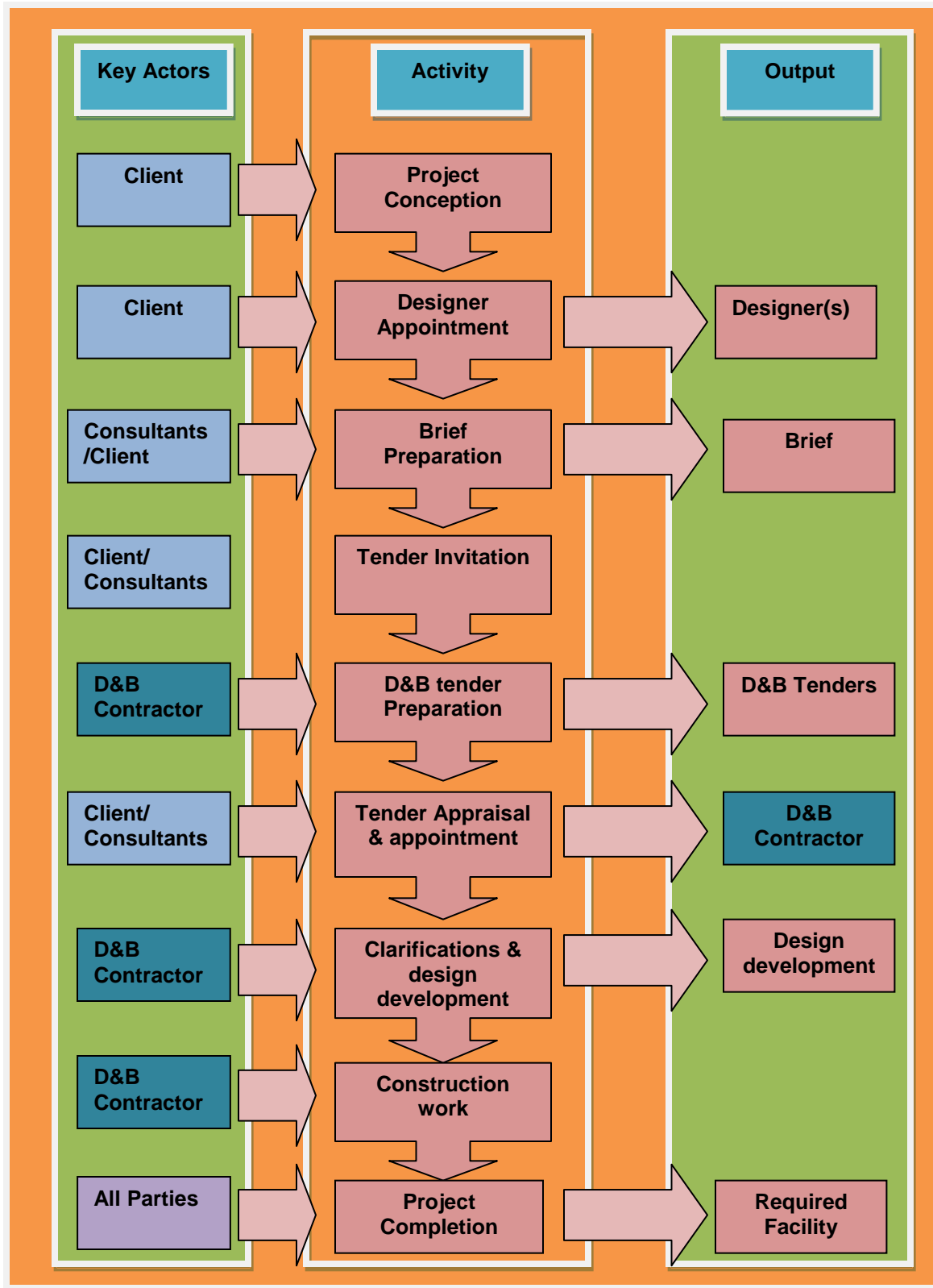
The existence of a multiplicity of parties all working on the same project as an organisational unit has led to some researchers like Cherns and Bryant (1984) applying the concept of a temporary multi-organisation to the building team also referred to as an organisation of organisations by Stocks (1984). The concept of 'organisation of organisations' and its challenges is further explored in the next section where roles, relationships and responsibilities of the different participants brought together in a D&B procurement method are examined in detail.



From the above typical D&B procurement method process it is evident that the engagement of the design consultant by the client in order to develop the scope for the D&B contract brings to the fore the following challenges:

Although the design consultant engaged by the client to develop the initial design is perceived to assist clients in developing scope of the D&B contract it is often seen as a challenge to clients as they will have to incur additional costs in appointing design consultants for the purposes of preparing the outline design that is used as a basis for D&B tenders (Anumba and Evbuomwan, 1997). In addition, according to Fahmy and Jergeas (2004), the outline design that is produced by design consultants to form the basis for the D&B tenders is perceived to be inhibitive to the D&B contractor in terms of their ability to apply and incorporate ingenuity and creativity into the design.

On the basis that there may well be situations in which the outline design may require changes to suit site conditions, significant re-work and duplication in design is perceived by Chan (2000) to be a common problem associated with this process as the initially appointed design consultants are not novated to the successful D&B contractor. The change of design consultants from the initially appointed designers to those appointed by the D&B contractor to develop the design is perceived by Chan (2000) as resulting in double handling design activities.



**Figure 2.5: Conventional D&B procurement: Typical Processes**

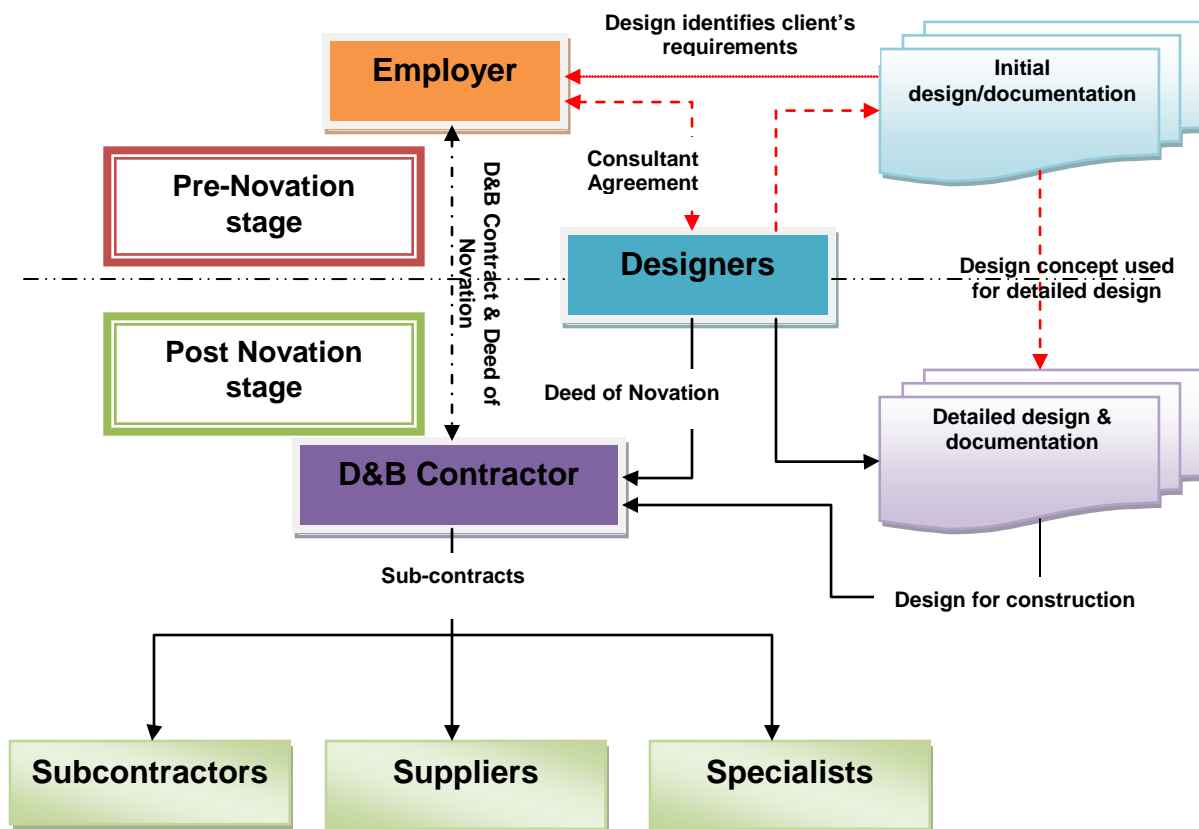
**Source: Adapted from Anumba & Evbuomwan (1997) p.273**

Delays are also said, according to Anumba and Evbuomwan (1997), to be commonplace with this process due to the significant amount of time spent by the successful D&B contractor in developing the outline design, clarifying client requirements and liaison with the initial design consultants appointed by the client to develop the outline design. It is also argued by Anumba and Evbuomwan (1997) that there is a significant amount of time spent sourcing and seeking approvals from the client of alternative materials and design changes to suit the construction method favoured by the successful D&B contractor.

Furthermore it is perceived by Ng and Skitmore (2002) that there is a significant potential for disputes and claims at the construction stage of such a process due to likelihood of client requirements not being well defined and interpreted by the initial design consultants at the early stages.

Another typical D&B variant to the processes discussed above is one in which the initial design consultants appointed by the client to produce outline design are novated to the successful D&B contractor as depicted in Figure 2.6. The processes involved are the same as shown in Figure 2.5 except that in this case the design consultant is novated to the D&B contractor and becomes part of the D&B project team.

This arrangement is said to be attractive to construction clients but leaves the D&B contractor with the problem of identifying and managing the extra risks involved. The major risks to the D&B contractor have been shown to be as follows: design team performance, lack of fees for the design team to develop the design beyond outline design, poor relationship between the D&B contractor and the novated design team, as well as challenges coming out of the timing of the novation process itself as opined by Ng and Skitmore (2002).



**Figure 2.6: Novated D & B Procurement: Typical Organisational structure**

**Source: Adapted from Thomas and Martin (2002)**

## 2.4 CHAPTER SUMMARY

The chapter collates key findings from literature reviewed pertaining to the D&B procurement method typical organisation, attributes, trends, processes and unique features. Although D&B procurement method brings about both design and construction together as activities to be undertaken by a single organisation it would appear that there are some challenges inherent in the process that require further empirical investigation encompassing experiences of key participants involved in the process.

Key findings from literature reviewed in this chapter are:

- D&B procurement method has experienced noticeable growth over the years due to its unique feature of integrating design and construction activities thereby creating a single point of contact between clients and contracting organisations.
- Typical D&B procurement organisation depicts construction clients entering into a contractual arrangement with a single D&B organisation bringing in the perception that lines of communication and responsibility are simplified and therefore advantageous to the client.
- The D&B typical building process is perceived to be involving a series of interconnected activities with identifiable outputs. Although the reviewed literature focused mainly on the processes involved it is how these processes are undertaken in practice that requires further elaboration which is the subject of the next chapter.

## **CHAPTER 3**

### **UNDERLYING CHALLENGES ASSOCIATED WITH D&B PROCUREMENT METHOD**

#### **3.1 INTRODUCTION**

This chapter looks at the underlying challenges associated with the D&B procurement method covering in detail the concepts that have been examined in chapter 2. The chapter focuses on challenges experienced by key participants when utilising the D&B procurement method and examines how the organisation structure of the method, the processes involved and relationships created all relate to each other. How the structure of this procurement method impacts the efficient operation of this integrated production led procurement method is also examined.

Findings from chapter 2 showed that the D&B procurement method has been certainly on the ascendency over the last 3 decades. Several reasons have been provided to explain this noticeable shift from the predominantly design-led traditional procurement methods to integrated production led procurement methods such as the D&B method.

Some of the reasons cited are: Single point responsibility, potential for tapping the contractor's ingenuity and creativity during the design stages leading to potential cost and time savings as well as early price confirmation before completion of design and the start of construction thereby allowing clients to better plan and control project cash flow. In addition the fact that since contractors are practitioners in actual building it is reasonable that they contribute into the design their experience of handling materials, assembling detailed parts of the work and organising the whole site operations. This, it is argued by Turner (1995), should be designed into the scheme to promote buildability with speed and economy.

The chapter therefore explores these perceptions in light of related research that has been reviewed in order to get an understanding of empirical evidence in connection with the practice of D&B procurement method. The chapter summarises all findings from chapters 2 and 3 and presents a holistic view of key underlying challenges of the D&B procurement method.

### **3.2 SINGLE POINT RESPONSIBILITY**

Single point responsibility has been cited by Beard et al (2001) as one of the key attributes and perceived advantages of the D&B procurement method. The single point responsibility notion comes from the observation that with this method of project delivery the construction client enters into contract with a single organisation that provides the client with all of the services necessary to both design and construct all or portions of the project (Twomey, 1989). Refer also to Figure 2.2 which provides a graphic presentation of the organisation of this procurement method.

Follow on benefits flowing from this have been cited by Gransberg and Lopez del Puerto (2004) as better coordination between design and construction activities, elimination of second hand information, elimination of the 'blame culture' that has been associated with the traditional design-led fragmented procurement method, early involvement of sub-contractors and suppliers, one simpler contractual relationship with one D&B contracting organisation which means errors/omissions in design are not the responsibility of the client. Such benefits and perceptions linked with the single point responsibility brought about by the D&B procurement method have, however, been challenged in the reviewed literature (Fahmy and Jergeas, 2004) with a host of arguments presented leading to some claims that such single point responsibility can be deeply disadvantageous to the owner.

One such concern has been raised by Lee et al (2009) who opined and claimed that single point responsibility is only advantageous when the client's administration of the quality performance of the D&B contractor is assured and secured. Elsewhere Fahmy and Jergeas (2004) went further on this same issue and provided additional arguments on how such single point responsibility can impact on the client's ability to effectively administer the quality performance of the single D&B contracting organisation. They opined that since clients lose the traditional direct control over the design and the fact that the designer is accountable to the D&B contractor design decisions usually are inappropriately influenced by the D&B contractor, who in most cases, they opined, may pressure designers to reduce quality criteria or design standards to minimum levels in order to maximise profit.

Fahmy and Jergeas (2004) also went on to claim that single point responsibility can result in clients being out of the loop as all design and construction decisions and any trade-offs made are internal to the D&B contracting entity and clients are excluded. Ironically and in contradiction to views from other researchers on this issue their opinions and claims went on to suggest that having two independent and separate contractual relationships with designers and contractors is perceived to be helpful to clients as they have the potential benefit of having two views given that designers and contractors can detect each other's mistakes.

Correspondingly such concerns were echoed by Tietz (1999) when he highlighted that, the D&B contractor being the principal agent within the D&B procurement method, and the fact that construction value overshadows design costs, the D&B contractor's opinion tends to prevail when quality of design and construction savings come into conflict which appear to support Lee et al (2009)'s observations that single point responsibility created by D&B procurement arrangement is disadvantageous to the client in some respects. Single point responsibility is therefore perceived to bring with it the elimination of third party 'quality control' by the client which is clearly a challenge as the party now



responsible for completing the construction work as quickly and as 'cheaply' as possible (the D&B contractor) also has control over the passing of the quality and quantity of the work. Combining design and construction functions into a single contracting entity is also said to create challenges with clients. Clients see themselves as losing the checks and balances that exist with the traditional design led fragmented procurement method. The integration of the designer and contractor into a single organisation is also said (Fahmy and Jergeas, 2004) to cause problems to the client. Clients see this as a loss of the benefit of a 'watchdog' that existed in the design led fragmented procurement method. In conventional methods of procurement the client had unlimited access to the designer. The existence of limited or no access to the designer provided by the creation of a single entity organisation responsible for both design and construction is perceived by clients to be problematic. They see this as a loss to a vital link that used to bring to their attention any problems with design or site challenges.

Similarly McDonough (2002) earlier commented that the quality of the process and of the finished product cannot be guaranteed. This is due to the monitoring of quality which is not as transparent as it is in the traditional design-led procurement method again in support of observations made by Lee et al (2009).

This challenge perhaps led Lee and Arditi (2006) to develop a quality measurement tool that produced a quality performance index for D&B construction projects. Unfortunately the tool has been found to be of limited use in practice as the tool's inputs and outputs are deterministic values (Lee et al 2009). Lee et al (2009) developed further this tool by generating an automated stochastic method. The method Lee et al (2009) developed statistically models inputs and analyses the variability in the output. This was done in an effort to help D&B tender assessors to determine the probability that a D&B contractor would deliver a project in a manner that exceeds a quality performance index set by the owners. However the tool's usefulness and effectiveness in practice remains to

be seen. In addition such development of a one dimensional tool appears to be an oversimplification of a complicated phenomenon that clearly requires and demands a holistic approach in order to deal with, and manage effectively, the problem areas associated with the D&B procurement approach.

Challenges coming out of this sub-section (single point responsibility and concerns about the quality of the finished product) led the researcher to examine how clients go about determining their requirements and communicating same to the D&B contracting organisation. This is the subject of the follow on section 3.3 below.

### **3.3 THE BRIEFING PROCESS**

The briefing process is defined as the process of eliciting and defining client requirements in construction (Perkinson et al 1994). The documents which contain these requirements are collectively known as the brief. This definition has been further explored and expanded by Kamara and Anumba (2000) and Oberg et al (2003) when they described the whole briefing process as including defining, eliciting, analysing, translating, organising and documenting requirements and incorporating them into the project.

Client requirements are therefore seen as the initial connection to the construction industry (Kamara and Anumba, 2000) and are further seen to be reflective of targets, desires, expectations or challenges imposed by the client on the project functionality and quality (Gilb, 2005; Zielczynski, 2008; and Robertson and Robertson, 2005). Yu et al (2005), Kamara and Anumba (2001) and Murray (1995) summed this up in their observation of the link between the brief and client requirements when they stated that in order to communicate with the design organisation the client initiates the briefing process by articulating a formal document which encloses the desired outcomes, challenges, functional and technical requirements and encompassed in a document termed as Employer's requirements in D&B projects.

Kamara (1999) undertook a comprehensive survey and came up with an assessment of how the process is carried out in the UK construction industry. A review of the main features that he observed indicate that the process is fraught with numerous problems; for instance he observed that although information collected is sometimes documented in formal documents such documents are not usually stored as part of the brief and normally the design organisation relies on recollections of verbal communications with the client.

In addition Kamara (1999) also found decision making in the briefing process to be a process involving the resolution of competing interests between different groups within the client body and between professionals with diverse perspectives. Other researchers (e.g. Newman et al, 1981; Goodacre et al, 1982, and CIT, 1996) similarly came up with observations that mirror Kamara (1999)'s findings. However they came up with additional findings that suggest that the use of the solution (i.e. design) to clarify the problem can shift focus from client requirements to the preferences of the designer due to the fact that proposed solutions are usually made before having a thorough understanding of the client requirements. This has led Howie (1996) to comment that due to this underlying challenge it is not surprising that many briefs are generated out of design rather than a clear understanding of the client's actual objectives. Clearly this is an issue that may impact on the project outcome considering that later researchers such as Liu et al (2015) have observed that decision making of the project delivery system is an important link in the entire lifecycle of a project and, they went on to opine, is one of the critical factors leading to project success.

Some researchers, for example Yu et al (2007), have reported problems associated with meeting clients needs when the D&B procurement approach has been used. This had earlier been reported by Chinyio et al (1998) who went on to state that this problem left many clients short of realising the full value for money from their construction investments. Kamara et al (2000a) went further to explore this problem by initially defining the client requirements as objectives, needs,

wishes and expectations of the client. They went on to state that these requirements are supposed to be captured during the briefing process. However other researchers who carried out further studies on this theme such as Smith and Love (2004), Othman et al (2005) and Yu et al (2007) claimed that the briefing process is a complex, dynamic and iterative process within which business strategy, building requirements, operations and maintenance must integrate. Figure 3.1 depicts this process diagrammatically.

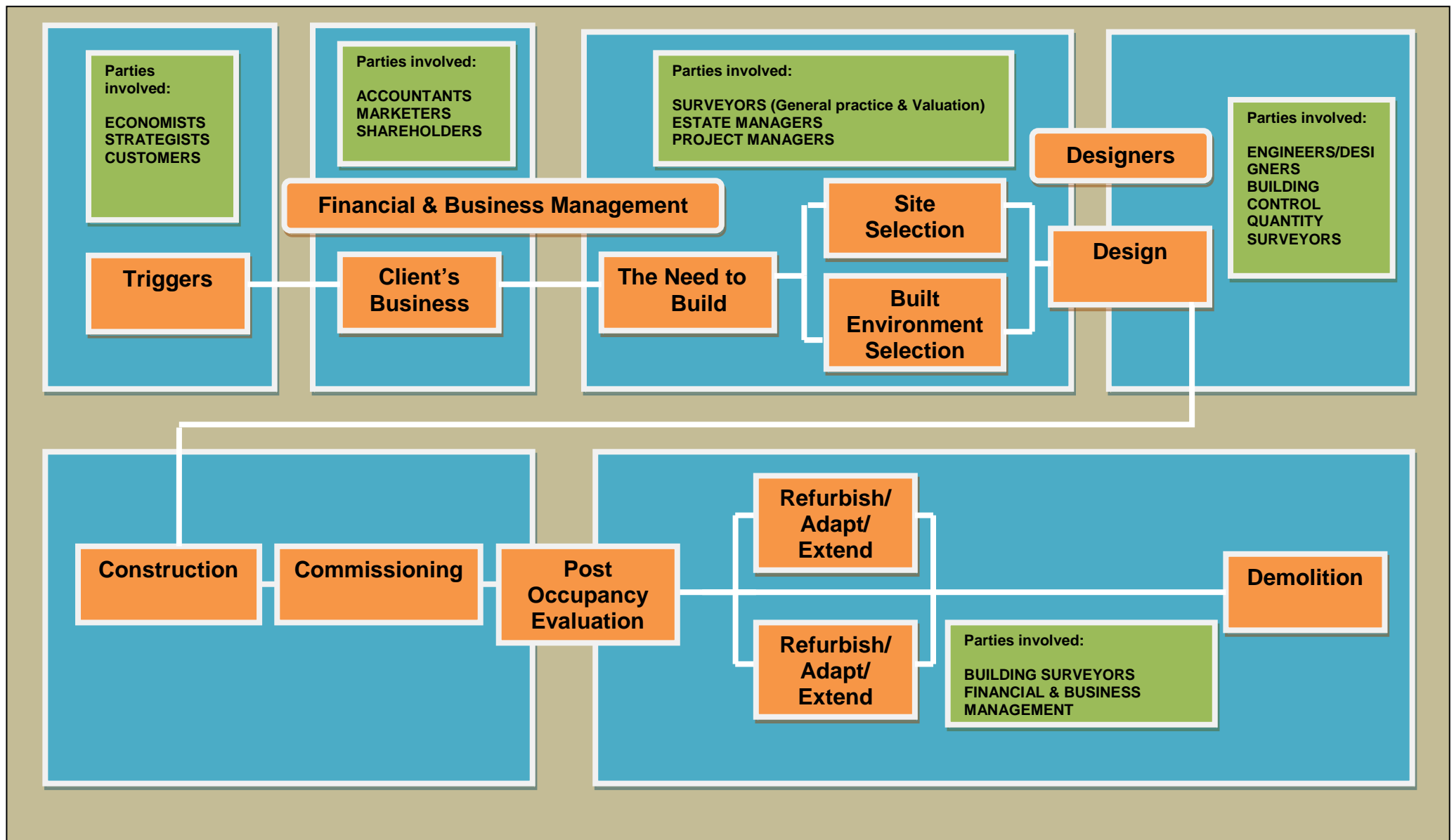


Figure 3.1: A profile of disciplines involved within the project life cycle

Source: Adapted from Woodhead and Male (1993)

In related studies undertaken by Lim and Mohamad (2000) and Hassan (2009) they explored challenges relating to the briefing process and opined that failings of the D&B procurement method emanate from unclear client brief, specification and statement of needs; insufficient time allocated during the briefing stages, tender documentation and evaluation processes as depicted in Figure 2.5.

Lim and Mohamad (2000)'s comments have been echoed previously by NEDO (1974), Kelly et al (1992), Latham (1994) and Murray (1996) when both argued that inadequate briefing is partly responsible for the level of client dissatisfaction with their buildings in the UK.

Although Kelly et al (1992), Murray (1996) and Xia et al (2015) regarded the briefing process as one of the most critical factors in determining the client's satisfaction with a building project other researchers like Bowen et al (1999) identified a host of other factors all pointing to the fact that the process is inadequately undertaken. Among their principal findings, Bowen et al (1999) observed that oral presentation is the medium by which the brief is most commonly communicated resulting in considerable potential for miscommunication. In addition clients were found to be unclear as to their requirements and objectives in initiating projects. They were also found to frequently fail to provide a comprehensive listing of their requirements. Insufficient time, Bowen et al (1999) also observed, is devoted to the briefing process and in some cases they found that briefing is prematurely initiated before alternatives have been analysed. This observation has been echoed in later research efforts in particular research findings by Xia et al (2015) in their research efforts investigating the impact of project definition clarity on project performance.

Kelly et al (1992)'s observations have been confirmed in Kamara (1999)'s study when he observed some limitations in the briefing process as follows:

- Inadequate involvement of all relevant parties to the project
- Insufficient time allocated to the briefing process

- Inadequate considerations of the perspectives of the client
- Inadequate communication between those involved in the briefing process
- Inadequate management of changes to requirements

Other researchers like Arayici et al (2006), Yu et al (2005) and Shen and Chung (2006) observed that the briefing process only covered a limited perspective of the proposed construction facility as stakeholders overlooked some vital parts of the building. Similarly professionals and clients were found to seldom perceive the project as a whole at the inception stage, an observation that has also been made by Leite et al (2005) but also added that this lack of holistic view leads to an underestimation of those critical requirements that appear to be negligible at first glance but of great effect in future. This, they noted, inherently makes the process open to future changes leading to prolongation in costs and time of delivery. Later researchers such as Xia et al (2013) and Xia (2012) similarly observed the same views regarding this challenge when they stated that determining the optimal proportion of design to be provided by D&B tenderers presents difficulties to D&B procurement method clients.

Zielczynski (2008) observed that the language used and the clarity of client requirements in a brief always frustrate stakeholders causing misunderstanding and misinterpretation, a point that had earlier been raised by Barrett and Stanley (1999) when they commented that the client has two choices in brief development i.e. either to pay little attention to brief writing resulting in greater potential for disputes or pay greater attention to writing clear briefs (thereby removing any misunderstanding and misinterpretation). This, together with the choice of construction delivery system has also been highlighted in later research, for example Minchin et al (2013), as one of the most important decisions that a client will make with regard to a construction project. The challenges in connection with the language used were also highlighted by Hooks and Farry (2001) when they commented that improper use of phrasings and wordings can mislead D&B contractors and in the worst case can lead them to commit errors during the requirements development.

By contrast to this opinion some clients appear to have a different interpretation. In their view what the D&B contractor considered to be vague and ambiguous in client requirements was seen to be allowing flexibility in the process; an example often used to back this view is that often in the Employer's requirements material specifications are prescribed with the permission of 'similar or equivalent' which by implication means that there could be more options or preferences of the client which are not precisely indicated in the contract. This view point therefore supports and accepts that the employer's requirements may not necessarily reflect completely and accurately the desires of the building client.

Othman et al (2005) found the existence of inadequate time allocated to the briefing process as a challenge as many clients considered briefing as an event which does not generate any value to the project and therefore refuse to put resources to the briefing process. Such clients were found to tend to save time in briefing for early commitment of design work. They also observed that only a limited number of stakeholders are allowed to be involved in the brief preparation. Similar observations have been reported by Kujala et al (2005) when they observed that the late involvement of end users leaves little room for alterations. The user requirements were also found to be at times contradictory to client needs.

In contrast to this view regarding the involvement of stakeholders Odeh and Battaineh (2002) commented that end users are not fully acquainted with requirements management practice leading to slow response rates which poses difficulties to D&B contractors in reflecting end users' needs promptly and on tightening the project schedule. They further on observed that decision making by end-users could be time consuming but then commented that since end users' obligations are not bound by contract the completed facility is still expected to fulfil users' operational needs which means that the risk was then shifted to the D&B contractor.

Zeisel (1981) had earlier on commented on this discrepancy when he stated that the usual 'gap' between user requirements and paying clients is an area



that creates complexity in determining the requirements of the client 'body'. This client 'body' has been defined by BPF (1983) as the person or firm responsible for communicating and paying for the design and construction of a facility. The clientele 'body' has been further considered as a body which incorporates the interests of the buyer of construction services, prospective users and other interest groups. A similar definition of this client 'body' has been provided by Bahill and Dean (1999) who defined clients as a particular entity including all stakeholders who have the right to impose requirements to the end product or facility.

Inaccurate documents, late exposition of requirements, overlooking of other requirements such as environmental and other unanticipated conditions is said to lead to a lack of frozen requirements. This lack of frozen requirements has been commented upon by Othman et al (2005) who opined that apart from creating unforeseeable impacts, changes often follow the will of clients and designers who occasionally overlook the initial intention of the project. They go on to state that such changes violating the original goals of the project bring about a negative impact as a result of the mismatch between the master plan and the details. In a contrary view Leite et al (2005) opined that repetitive refinement of employer's requirements was needed if beneficial to the project however Murray (1995) disagreed by stating that this would be contradictory to D&B procurement principles which aims to minimise changes of design from clients.

Lawson (1990) and Ferreira et al (2007) offered an alternate view/explanation of what they believed was the root cause of inadequate time allowed for the briefing process by stating that it is the inexperience of clients in construction project delivery process which resulted in improper timing and bringing up requirements. They went on to opine that such inexperience results in their inability to express themselves accurately and precisely unless they could visualise the final products. Such clients may well have overlooked parts of their requirements until the design became progressively fixed. Interestingly this observation was also made by Ngoc et al (2012) as part of their research into critical success factors of large design projects. Although Ngoc et al

(2012) came up with what they called the parties' lack of competencies in managing the D&B process there is no doubt in their research findings that they were actually referring to difficulties encountered by the parties due mainly to unfamiliarity and inexperience with the D&B approach. This is despite how earlier Xia and Chan (2010) had undertaken a research to determine key competencies of D&B clients.

The six ranked key competencies of D&B clients identified by Xia and Chan (2010) have been listed as ability to clearly define project scope and objectives, financial capacity of the projects, capacity in contract management, adequate staff or consulting team, effective coordination with D&B contractors and experience with similar D&B projects. The key message coming out of their research is that clients should clearly understand the competence requirements in D&B projects and should assess their D&B capability before going for the D&B procurement option. No wonder competence of D&B contractors and clients, among other barriers, have been observed as a barrier to entry in the D&B construction market of the People's Republic of China according to Bo and Chan (2012) research findings.

Problems associated with the briefing process and client requirements articulation has attracted yet some other researchers, for instance Kamara et al (2000b), to develop a process model for processing client requirements as an initiative aimed at improving the efficiency of the construction process through the introduction of new business processes and strategies. This theme had been echoed earlier by Egan (1998) where such improvements in the construction process were said to be brought about by a renewed focus on not only integrated processes and teams, a quality driven agenda, commitment to people, development of committed leadership but also a renewed focus on the requirements of the construction industry. However the effectiveness and usefulness of the process model advocated by Kamara et al (2000c) has yet to be seen in the real world.

The review of related literature above particularly pertaining to challenges underlying the briefing process and employer's requirements articulation puts

this research study into sharp perspective and focus as clearly there is a paradox developing in which clients of the D&B procurement find themselves in on the basis of the following:

As Ellis et al (1991) opined quality as espoused within the traditional procurement method is established by finalising a completed design for the construction upon which contractors bid. With the contract completion date usually being specified the only criterion left to consider is the price (Gransberg and Molenaar, 2001). In the traditional approach, Gransberg and Molenaar (2001) observed that, the contractor tells the client how much it will cost to deliver the quality defined in the design within the specified period of performance.

This is in contrast to the D&B procurement approach in which, as highlighted by Molenaar and Gransberg (2001), the process itself demands that the D&B contractor offer a firm fixed price for a project whose scope is defined by a set of performance criteria within a specified period of time. Therefore the variable criteria in the D&B procurement method is the detail of design which puts the D&B contractor in a situation where details of design and hence the level of quality are constrained by both the budget and the programme. In other words the D&B contractor must design to cost and programme.

These observations point to the extremely important fact that the requirements of quality in a D&B procurement must be clearly communicated in the employer's requirements so that the resultant D&B contractor's proposal and final product will be as responsive to the client's needs as the cost, technical and time challenges of the project allow.

### **3.4 D&B PROCUREMENT: OTHER PROCESS RELATED CHALLENGES**

The D&B procurement method key processes that have been widely analysed in related reviewed literature pertain to the tender preparation process, the tender evaluation process, the design process and the construction process.

#### **3.4.1 D&B TENDER PREPARATION**

The Employer's requirements is often the term that is used to describe the client's requirements. They should contain well defined and comprehensive scope, the importance of which has been highlighted by Songer and Molenaar (1997) when he claimed that the Employer's requirements is one of the critical success factors of a D&B project. Gransberg and Molenaar (2004) further explored this theme. They claimed that the Employer's requirements should detail aesthetic and performance criteria and D&B bidders should be requested to submit quality management plans.

However there are challenges militating against the smooth operation of this process as highlighted in section 3.3 above. In addition Fahmy and Jergeas (2004) opined that the very challenge of producing and defining requirements imposes problems to clients. They opined that it is more labour intensive and technically demanding compared to the design led fragmented procurement process. This had earlier been echoed by Ndekugri and Church (1996) when they claimed that for owners who do not possess any knowledge of the construction industry the D&B procurement route may not be advisable. This, they opined, would potentially result in such clients facing problems if they are not experienced enough to produce a brief that is clear and comprehensive.

In the same vein Chan et al (2001) further stated that owners' competencies that affect D&B procurement project success include their capability in managing D&B projects, their understanding of D&B project scope and their ability to clearly articulate end users' requirements.

They further opined that since the tender documents have to reflect client requirements it is important that it is prepared by a person with appropriate skills. Although Clients who are not technically inclined can approach external consultants to undertake this task, challenges of the briefing process as described in section 3.3 above are still to be contended with.

The other significant challenge closely related to the tender preparation process has been found by Fredrickson (1998) to centre on the question of how much information needs to be provided in order to get bids from D&B contractors. The paradox is said to be centred on the fact that the less information that is provided the more the D&B contractor will have to assume leading to another challenge in which the more that each D&B tenderer assumes the less likely that each D&B tender will be similar leading to difficulty to compare bids in terms of 'best value' and significant differences in quality, operation and maintenance of the proposed construction facility.

In a related study undertaken by Ernzen and Schexnayder (2000) centred on a case study of two similar projects; one project was a typical D&B project and the other was a traditional design led project. Based on this study they observed that the D&B project experience consistently greater fluctuations in the labour cost. These fluctuations seem to indicate that it is very difficult for D&B contractors to accurately estimate labour costs for D&B projects thus adding to the risk of such projects.

On the other hand the more information provided to D&B tenderers the less flexibility the D&B bids will have to apply their expertise in coming up with 'best value' solutions. In addition there is a risk that if the client requires the entire design development to be completed and included in the bidding documents the D&B contractor might not be considered the designer of record in the event of future problems with the construction facility (Fredrickson, 1998 p.78). In any case this will be against the principle of the D&B procurement method and the client is best placed to pursue other procurement methods if it's their intention to produce and control design in this way.

The more uncertainty there is in the definition of the work when the price is established the more contingency/risk money is added to the D&B price in order to take into account the unknowns. The less design there is to clearly explain the project the greater this contingency is.

### **3.4.2 D&B TENDER EVALUATION**

The selection of an appropriate D&B contracting organisation is seen as a key aspect of the D&B procurement method. This process is seen to be dependent on the D&B contractor's characteristics as noted by Chan et al (2001) and Ling (2004). Chan et al (2001) went further on this theme and commented that competent D&B contracting organisations are perceived to be knowledgeable in: design development, innovative techniques and materials, project management and are said to possess a thorough understanding of the design process.

This observation and commentary in a way highlights the characteristics that are required of a D&B contractor in order to effectively and efficiently deliver a D&B project. Nahapiet and Nahapiet (1985) had earlier noted that, compared to the design led traditional procurement process, it is more difficult to evaluate D&B tenders. This is because of the need to evaluate both price and design. D&B tenderers offer different systems and services and are perceived to provide a limited amount of information for evaluation. This was also echoed in later research efforts Molenaar et al (2010). Their research revealed opportunities to improve existing D&B tender evaluation processes by incorporating what they termed 'best value procurement practices for sustainable design-build projects'. Although their research focused on public sector projects it would appear from the reviewed literature that this is a common problem faced by D&B clients when evaluating D&B tenders.

Asmar et al (2010) appear to agree with research findings by Molenaar et al (2010). They also observed in their research that one significant barrier with the D&B procurement method is getting acceptance of a best-value selection process. A process in which technical aspects of a proposal are considered

separately and then combined with price to determine the winning proposal. They went on to observe that these technical aspects mostly consist of qualitative criteria which makes room for human errors or biases. This is a significant issue particularly in public funded projects as any perceived presence of bias or influence in the selection process can lead to public mistrust and protests by other bidders.

Compounded with challenges associated with the briefing process and articulation of client requirements covered in section 3.3 above Masterman (1996) highlighted that great difficulty can be experienced in evaluating tenders if the owner's requirements and brief are ambiguous and does not communicate clients' precise wishes to the D&B contracting organisation.

In the public sector particularly where clients are constrained to select the lowest bidder except in exceptional circumstances, this may cause problems. The approach (of selecting by cost rather than value) may be valid in simple and straightforward situations but as Palaneeswaran and Kumaraswamy (2000) observed the award of a contract to a bidder based on lowest price alone may result in a 'false economy'.

In addition to evaluating the contracting arm of the D&B contracting organisation clients also need to evaluate whether consultants engaged by D&B contractors are acceptable in particular the quality of the designers. Criteria for evaluation, as noted by Kubr (1993), would include consultants' financial capacity, level of expertise, experience in design skills and track record in D&B tenders. The challenge, as Opfer (2002) observed, is to adopt a stringent but fair selection criteria which deviate from strict price reliance toward 'best value' contracting.

All this evaluation process demands time and resources of D&B clients hence the comment by Fahmy and Jergeas (2004) that the D&B procurement method is more labour-intensive and technically demanding for clients than is required in the design led fragmented procurement method. There is therefore recognition that traditional evaluation methods applicable to design led

procurement methods do not apply to D&B procurement methods. This is compounded by the existence of many operational variations of the D&B procurement method. This, as observed by Xia and Chan (2012), has resulted in a lack of appropriate evaluation criteria for determining the appropriateness of each D&B operational variation.

It would appear that besides the challenge of the process being labour intensive and technically demanding to clients there is recognition that clients who are not construction experts may have difficulty choosing which D&B contractor to engage.

### **3.4.3 D&B DESIGN STAGE**

As depicted in Figure 2.5 typically the D&B contractor develops the design after appointment carrying it through to construction and handover. After the D&B contract award the D&B construction manager has many important roles to play which he normally does not have in design led traditional procurement methods. According to Stillman (2002) the D&B construction manager has to be responsible for managing both the design and construction and their integration. As can be visualised from Figure 2.5, which depicts a typical D&B process map, the detailed design stage is the stage most frequently included within the D&B contractor's responsibility as observed by Gray and Hughes (2001).

This brings with it several challenges as the design development process is considered to be the most extensive and complex stage of the construction process based on Mitchell et al (2011) findings. This is particularly in terms of the volume of information produced by the design team and the degree of detail produced. This stage interfaces with the initial stages of the construction process. This also include enlarging the project team through the selection and appointment of specialist sub-contractors and gaining access to their specialist knowledge and design information.



As a result of this complexity and interfaces it is no wonder that Austin et al (1999) reported that D&B contractors have found that planning based on the critical path method has been significantly less successful in planning the design process. This is because D&B contractors have found the design process to be frequently ill defined, generally iterative and usually containing design cycles which cannot be modelled using sequential planning techniques. D&B contractors have therefore been found not to be able to extend the use of their traditional planning techniques into the design process. This meant that they have been denied the opportunity to use their tried and tested procedures in the management of their design responsibility.

In addition to technical capability of the D&B team, teamwork among project team members has been observed by Akintoye and Skitmore (1994) to be important. This is to enable the D&B project to reap the advantages of good coordination and ease of decision making. This theme has been further highlighted by Kumaraswamy et al (2005) who also opined that teamwork engenders good relationships which lead to team integration. Moore and Dainty (2001) had earlier commented on the need to focus on integrating D&B team members into the project team. This is in order to engender single focus and culture of cooperation.

Project integration has been seen by Petersen and Murphee (2004) as having a significant, positive impact in balancing project challenges and producing effective D&B projects. However such integration and team working is contradicted by the perception from clients who, due to their exclusion from D&B team discussions, feel that such exclusion may compromise quality.

Such a perception arises from the assumption that, in D&B projects, design consultants are not required to take care of clients' interests as observed by Ling and Poh (2008). They further state that in D&B procurement design consultants are urged to think like a contractor. The same view has been expressed by Linowes (2000). Similarly Fahmy and Jergeas (2004) opined that design decisions are sometimes inappropriately influenced by contractors who, in some cases, are not familiar with design challenges.

In a similar critique of the process Preece and Tarawnah (1997) highlighted a challenge which appears to resonate with earlier comments on design development by stating that in some projects D&B contracting organisations have failed to provide care and attention to understand client requirements. As a direct consequence of the perceived exclusion of the client from design development discussions Fahmy and Jergeas (2004) opined that communication is sometimes a problem due to the fact that once a D&B contract is awarded clients may be out of the loop and all design and construction decisions and trade-offs are internal to the D&B team and do not involve clients.

#### **3.4.4 D&B CONSTRUCTION STAGE**

Tietz (1999) expressed concerns coming out of his research when he stated that the D&B contractor, being the principal agent and the fact that the construction value overshadows design costs the contractor's opinion tends to prevail when the supervisory part of the design team wishes to reject work which the contractor regards as adequate.

This view appears to mirror Cecil (1983)'s earlier findings when he highlighted the underlying challenge to be coming out of the perception by clients who feel that they lose control of not only the design but the construction process as well. He went on to opine that because of this feeling of 'loss of control' clients feel they may be taken advantage of by the D&B contractor whenever the D&B contractor has the opportunity to do so.

This finding was further collaborated by Huse (1997) who further explained that the loss of control felt by clients is mainly due to the absence of design and construction supervision from the owner in a D&B procurement method setting. These observations appear to be supported by the typical organisational structure of the D&B contracting organisation shown in Figure 2.1 which shows only one contractual line of relationship between the client and the D&B contractor with all other contractual and functional relationships

with the designer and the supply chain being controlled and managed by the D&B contractor. This is heavily contrasted with the typical traditional design led procurement method in which clients have, in addition to functional & contractual links with the contractor and other specialist supply chain involved; there are independent links with the design team and other supervisory functions of the organisation (for instance the Clerk of Works).

Although some clients may feel inclined to deviate from the typical D&B organisational structure as depicted in Figure 2.1 and allow for the appointment of consultants to manage the process, Turner (1986) noted that the D&B approach generally contemplates less day-to-day intervention than is available under the design-led traditional procurement method.

The challenge of less control of both the design and construction processes has led other researchers to explore further this theme and determine the extent of the problem from clients' perspectives. For instance Preece and Tarawnah (1997) observed that the standard of services experienced by owners during the construction stage of D&B procurement method project delivery was less than satisfactory. Similarly Ling and Mong (2005) observed that D&B contractors' service quality performance did not meet clients' expectations.

### **3.5 D&B PROCUREMENT: TEAM SYNERGY AND PROCESS INTEGRATION CHALLENGES**

The D&B procurement method, in its present day context, involves a multidisciplinary team which is in stark contrast to what it used to be in its original format as highlighted by Palaneeswaran and Kumaraswamy (2000) when they stated that the D&B concept has deep historical roots. They trace these historical roots to the ancient times in which the 'master builder' had full responsibility for all phases of a project in the construction of churches, temples and pyramids.

The existence of multidisciplinary teams within the D&B procurement method is perhaps unavoidable due to the integration of both design and construction processes closer together culturally, functionally and contractually (Smit, 1995). The bringing together of these processes, as highlighted by Bennett et al (1996) is perceived to result in improvements in cost and time certainty as the process is perceived to facilitate a seamless procurement process which improves team relationships with further capability to produce a more efficiently delivered construction product.

However such perceptions and rhetoric have been contradicted by research findings reviewed in this research. For instance Moore and Dainty (1999; 2000) found that an integrated project culture had failed to develop within D&B procurement delivery methods and that roles and responsibilities had continued as if under a traditional design led procurement method. Their research also found evidence that professional divisions between team members had led to discontinuities and ineffective responses to unexpected changes that had occurred during the construction phase.

The D&B team was observed to be composed of a series of strategic alliances and barriers bounded by professional and cultural prejudices of their members which resulted in a workgroup of disparate individuals rather than an integrated team (Moore and Dainty, 2001, p.560). This was observed to result in the design team having a clear emphasis on design quality whereas the commercial team had their focus on financial aspects and the construction team on delivering the project to programme. This has perhaps been the basis of an earlier observation of Gale (1992) when he stated that the construction industry is characterised by a masculine, crisis and conflict ridden culture. This same theme had been raised earlier by Ball (1988) when he observed the construction industry as synonymous with high cost, low quality and chaotic working practices.

On the basis of these challenges it is perhaps not surprising that several other researchers have responded to the problem by producing some sort of guidance on how project teams/organisations may be strengthened. In

addition such research efforts appear to have been aimed at overcoming the interfaces within and between teams forming the D&B supply chain. For instance Albanese (1993) undertook an exploration into the implications of the term 'building processes for the D&B process and Federle and Rowings (1996) researched on the optimisation of project organisations. In the following year following Federle and Rowings (1996)'s research Tucker et al (1997) developed an assessment tool for improving team communications.

The effectiveness of such research efforts remains unclear particularly as to whether cultural integration can be achieved in a manner that ensures the collective identification with production problems during the D&B process (Moore and Dainty, 2001). What is clear is that team divisions within the D&B procurement method still exist as per findings from research efforts of Moore and Dainty (1999; 2000). These divisions were found to result in reactive problem solving as opposed to proactive problem avoidance and on 'best fit' approaches rather than innovative solutions. Such divisions have also resulted in construction teams within D&B organisations failing to foresee the impact of impracticable design solutions due to barriers to construction team input in the design process.

This cultural non-interoperability in D&B project teams due to role rigidity and cultural misalignment as observed by Moore and Dainty (2001) above is in stark contradiction to observations made by Soetanto and Proverbs (1993) in which they stated that interactions and interrelationships between main participants in construction largely determine the overall performance of a construction project. Mohsini (1989) had also observed the same theme but went further to state that participant performance is interdependent thereby bringing in the concept of mutual dependency.

Similarly Smith and Wilkins (1996) and Egan (1998) made similar observations. Other researchers like Nam and Tatum (1992), Pocock et al (1996) and Cohenca-Zall (1994) used the term 'degree of involvement' (DOI) to express the interactions and relationships between teams. DOI was defined as the extent of interaction among designers, contractors and project related

personnel during a project's planning, conceptual design, detailed design, procurement, construction and handover stages. To emphasise the significance of interactions between teams their study highlighted that projects with low DOI have a wide range of cost and schedule growth and number of modifications in contrast to projects with high DOI which were found to have less variance, lower schedule/programme growth and fewer modifications.

In other related themes on team synergy and process integration Austin et al (2001) provide an interesting view in their work on integrated collaborative design. Although their research effort discusses in detail the need for development of project supply chains from an existing business supply chain where problems can be passed down the supply chain to appropriate specialists and solutions and innovations can be passed back up to the design team Mitchell et al (2004), however, observed that significant sections of the construction industry are not yet mature enough to facilitate the management of the interface between design and construction nor to provide robust design chains and the corresponding access to solutions and innovations.

Barlow et al (1997) and Cox and Thompson (1997) looked at the lack of team synergy and process integration from a different angle to others reviewed above. They traced the origins of the problem to the formation of sub-contracts between the D&B contractor and the supply chain. They observed that construction actors rely heavily on standard form of subcontracts which are instruments seeking strict liability and attaching blame to events that occur, encouraging non-collaborative behaviour and driving distance between the parties. This has been taken up by Aulakh and Gencturk (2000) who expanded on the effect of subcontracting on team synergy by stating that output control through fixed prices very often characterised by D&B procurement methods may lead to inflexibility since suppliers may resist adapting to changed circumstances.

The lack of joint action resulting from this, as observed by Heide and John (1990) is said to hinder integration of construction actors and their activities making them work on arm's length distance from each other. Chan and Yu

(2005) in an effort to understand this problem further undertook a research to examine these challenges on team synergy and noted that roles and responsibility of the D&B parties are less than clear in their respective engagement contracts. In addition they highlighted the challenge that within the D&B contracting organisation there remains the concern of coordinating the design and construction processes.

Chan and Yu (2005) concern above has been explored and expanded further by Zaneldin et al (2001), Hampton (2001), Chan and Chan (2001) and Chan and Chan (2000) under the umbrella theme of 'design management challenges'. The term 'design management' was defined by Gray and Will (2000) and Dulamini et al (1995) as a process undertaken to ensure that all construction information is managed and distributed sensibly and responsibly at the right time. However the major difficulty in design management, as observed by Zaneldin et al (2001), Hampton (2001), Chan and Chan (2001) and Chan and Chan (2000) arises from the need for collaborating multidisciplinary personnel and challenges that arise as part of the D&B procurement process.

Although the D&B contracting organisation is generally perceived to be the best party to be responsible for the overall design management process Chan and Yu (2005) viewed this new role that the contracting organisation carries as the biggest challenge to D&B contractors as most of them are not trained to design or to manage the design process. This view had previously been raised by Love et al (1999) and Chan and Kumaraswamy (1997) who observed in their research efforts that poor design management is a primary factor that contributes to poor quality and time overruns in construction projects undertaken through D&B procurement.

The D&B contractors' unfamiliarity with the design process and its management has been observed and traced back to the designer selection and appointment by other researchers. For instances Janssens (1991) and Kirmani and Baum (1992) noted that although one of the most important decisions for a D&B contractor is who should undertake the design work on its

behalf there appears to be no evidence that this process was undertaken robustly to enable the D&B contractor to engage the right consultant who has the capability to interpret the client's needs. Even when the right consultant who has the capability to interpret the client's needs is appointed it would appear from Ndekugri and Turner (1994)'s research that D&B contractors are still experiencing considerable resistance from the professions (architects, designers and quantity surveyors).

An even more serious concern observed by Ndekugri and Turner (1994) is that it appeared that many D&B contractors fail to insure against design liability. This should be a worrying concern to clients utilising the D&B procurement method considering that the implied duty applicable to a D&B contractor working under a D&B contract is not just one of exerting reasonable skill and care but one of strict obligation in respect of fitness for purpose. This challenge has been highlighted by Chan and Yu (2005) as well when they observed that the most important practical problem brought about by D&B procurement method is the unavailability of insurance to cover design liability for 'fitness for purpose'.

This is a problem particularly to clients as in many common law jurisdictions such as the UK the main role of a D&B contractor is comparable to that of a manufacturer and the role is taken to be inclusive of responsibility for delivering a building that is 'fit for the purpose'. As part of their findings Gaafar and Perry (1999) made another observation that design liability is not well understood by project participants which further highlights the extent of the problem. Views of designers and contractors were observed by Chan and Yu (2005) to be opposite to each other with the contractors preferring to restrict their design liability to 'due care and skill'. As part of their findings most respondents were found to be lacking a full understanding or realisation of the difference (between the two distinct levels of liability viz fitness for purpose and reasonable skill and care) and the extent of their liability in design. Nor do most standard forms of contracts reviewed by Chan and Yu (2005) help the situation as the review showed a lack of clarity or consistency in international practice on the definition and level of design liability required of



the project participants. For instance in the ICE clause 8 (2)(a) design and construct conditions which provides that, in carrying out all his obligations the D&B contractor shall exercise 'skill and diligence'.

Similarly in the NEC form of contract where the contractor undertakes design the design is submitted to the Project Manager (PM) for acceptance and for liability less than 'fit for purpose' a secondary option X in the contract may be elected which relieves the D&B contractor from liability for defects in the works due to his/her design as far as he proves that he has used 'reasonable skill and care'. However, Chan and Yu (2005) observed that there is no definition in both the NEC and ICE standard forms of contract as to the nature of 'skill and care'.

### **3.6 CHAPTER SUMMARY AND KEY FINDINGS**

Production led procurement methods such as D&B procurement have been shown in both chapters 2 and 3 as having several challenges that can be traced back to generic processes, organisational structures, team communication and collaboration, contractual, managerial and legal aspects emanating from the procurement method itself. It would appear from the research reviewed in chapters 2 and 3 that the D&B procurement method, far from resolving the so called 'root causes' of construction problems by integrating design and construction it has brought its own challenges, concerns and problems that require resolution in one way or the other if the construction industry problems are to be resolved. Although there has been significant research in trying to understand the challenges encountered with the D&B procurement method what is evident from the literature reviewed is what could be perceived to be a focus on challenges that affects mostly clients in the process without examining other key participants' challenges in the process (contractors and designers).

This research advances the argument that only a holistic exploration of the challenges affecting key participants in the process can lead to an effective solution/framework of this complex phenomenon. In addition to this gap it is

also apparent from the literature reviewed in these two chapters that although previous research highlighted numerous challenges encountered in utilising D&B procurement method it is not clear to what extent the challenges are prevalent in the UK construction sector. Similarly it is not clear from the literature reviewed the severity of the challenges encountered nor is it clear what practice based enablers have been adopted to address the challenges encountered by key participants.

These gaps then established the foundations for the formulation of the research problem, articulation of the research aim and objectives and identification of research questions as highlighted in sections 1.3, 1.4 and 1.5 respectively. Whilst arguing for a holistic exploration of D&B procurement challenges from the perspective of key participants, as this research entail, the researcher seeks to explore further the challenges faced by key participants and their severity together with best practice that key participants have adopted over the years in order to come up with a framework that could be used to facilitate more effective integration of design and construction processes in future D&B procured projects.

Such a framework, it is argued, would go a long way in ensuring that benefits of integration of design and construction brought about by D&B procurement are not lost but recouped and utilised for the benefit of not only key participants involved but the construction industry as a whole. Based on the critical analysis and critical evaluation of reviewed related literature of the challenges that are faced with D&B procurement method practitioners the summary of the main findings are listed as follows:

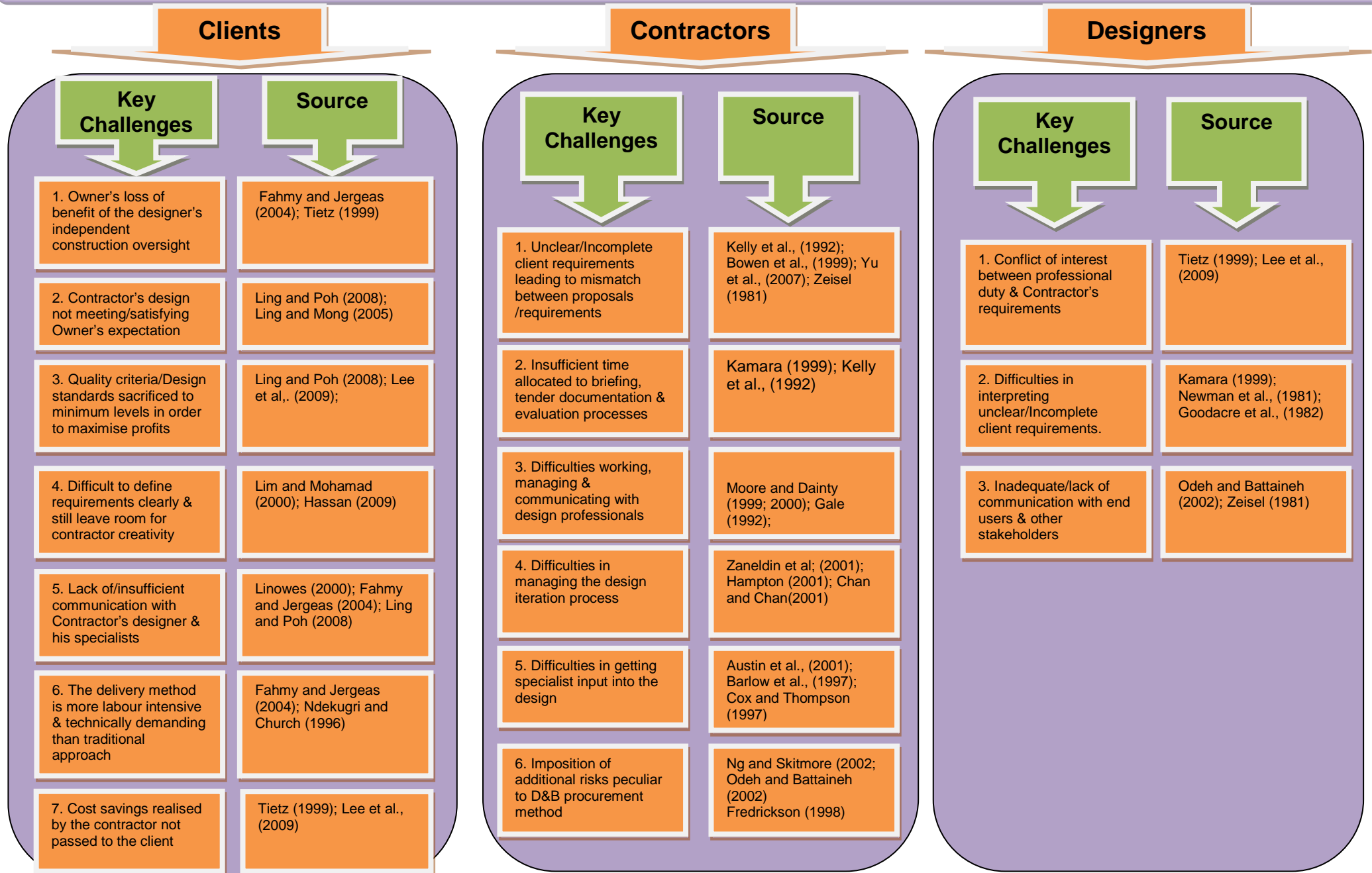
- D&B procurement typical development processes appear to be fraught with significant challenges particularly in terms of involvement of the parties in the whole D&B process, timing of involvement, the contractual arrangements between the parties and the administration of the D&B contract generally
- Some of the perceived advantages of D&B procurement such as single point responsibility have been shown to be at times disadvantageous to

the client as the client feels to be excluded from the process once the D&B contractor is appointed. In addition cost certainty and time saving perceived advantages of the process appears to be nonexistent

- Designer appointment, design management and design/construction coordination skills of some D&B contractors have been observed to be at times inadequate and lacking
- There has been observations of lack of team synergy and process integration within D&B contracting organisations which can be traced back to lack of experience and understanding of the D&B procurement process
- Significant challenges have been observed with not only the quality and content of client requirements but the whole briefing process has been shown to be fraught with problems leading to misinterpretation and misunderstandings and therefore a mismatch between employer's requirements and contractor's proposals.
- There appear to be a strong perception by the parties that risks that flow through the D&B procurement process are being passed down the supply chain resulting in strained relationships and conflicts among and between the parties involved.

Figure 3.2 portrays these findings and lists the key challenges that key participants have faced when using D&B procurement method as a delivery vehicle for construction projects.

# D&B procurement method key challenges gleaned from reviewed literature



**Figure 3.2: Key Challenges with the D&B procurement method**

In summary challenges extracted from the reviewed literature in chapters 2 and 3 above and the resultant gaps that were observed as highlighted in section 3.6 above culminated in the development of the conceptual framework of the research graphically depicted in Figure 3.3.

The framework summarises the key aspects of this research and portrays these aspects in a diagram. It depicts the central research problem as the exploration of experiences from the identified key participants which are shown as clients on the one side and D&B organisations (comprising contractors and designers) on the other. Having identified the key participants involved in the process the framework highlights the 'what' aspects of the challenges as well as the 'how' aspects of the practice based enablers adopted to address the challenges. It is 'how' the key participants have dealt with the 'experienced challenges' with the D&B procurement method that then informs the formulation of the framework for better integration of D&B procurement method.

The 'what are they' and 'how they were dealt with' aspects of the conceptual framework have been identified from the reviewed literature key challenges as portrayed in Figure 3.2. It can be noted from the key challenges noted that key challenges numbers 1 and 4 noted by clients, numbers 1 and 5 noted by contractors and number 3 noted by designers is mainly to do with what can be grouped as organisational challenges. Key challenges numbers 4, 5 and 7 (raised by clients); numbers 5 and 6 (raised by contractors) and number 1 (raised by designers) can be grouped as contractual challenges.

Key challenges noted by clients (numbered 2, 4, 6 and 7); numbers 1 and 4 (noted by contractors) and numbers 2 and 3 (noted by designers) can be grouped all be grouped as process related challenges. Similarly key challenges noted by clients (numbered 3, 5 - 7), (numbered 1) noted by designers and numbered 6 noted by contractors can be grouped as financial and technical challenges. In a similar grouping system key challenges numbered 6, 3 and 1 noted by clients, contractors and designers respectively can be grouped as managerial/people related challenges.

The conceptual framework shows the bringing together of these challenge groupings. Through a comprehensive process of identification, exploration and analysis of the key challenges encountered by key participants of the D&B procurement method a holistic view of this complex phenomenon can be understood and explained. Factors underpinning such challenges are also explored and analysed. The conceptual framework highlights the key aspects that the researcher would want to focus on to be able to achieve the aim and objectives set out in chapter 1.

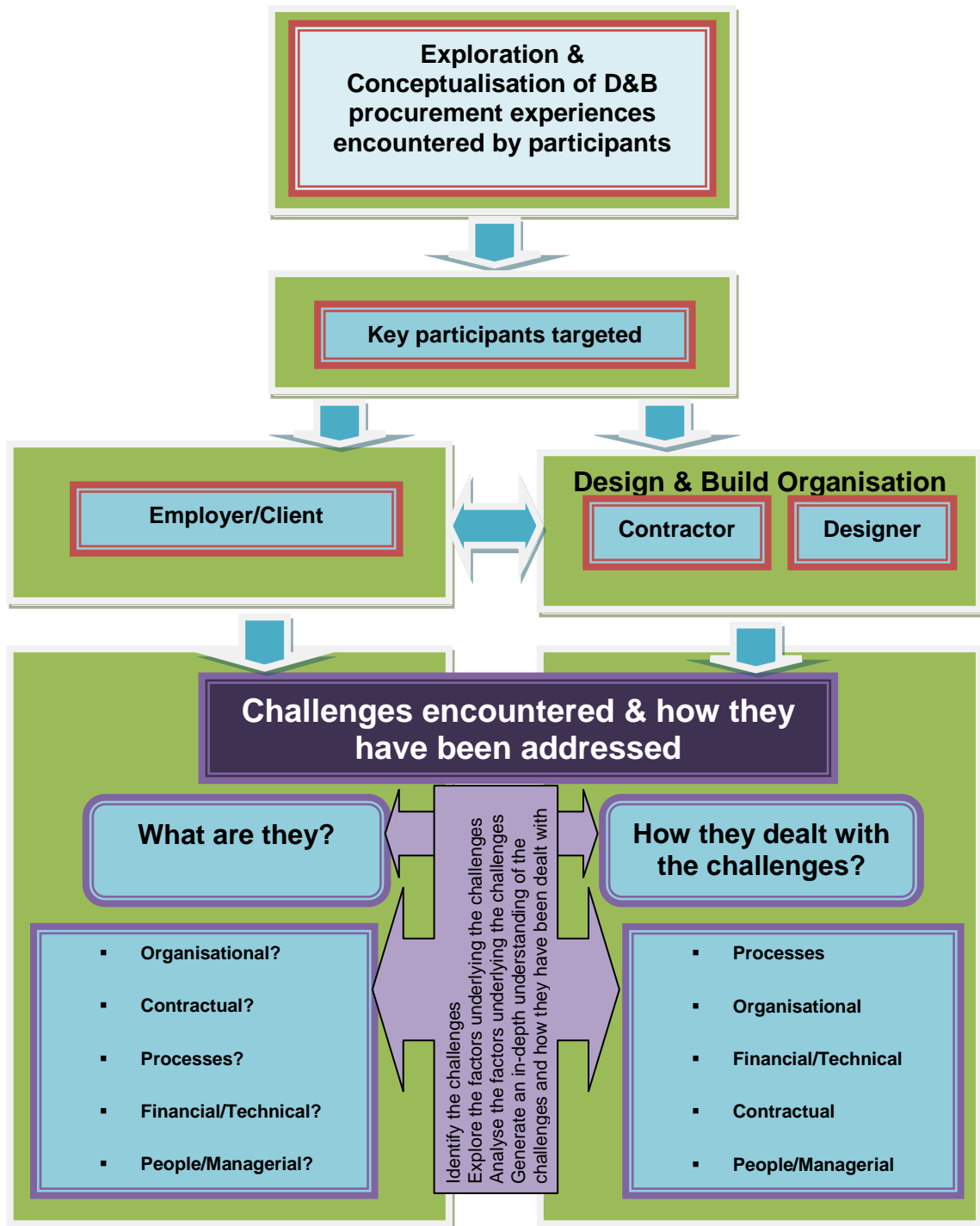
Designers and contractors are shown in the framework in the same box to emphasise the point that, although the actual design process can be sub-contracted to organisations outside the contractor organisation, in terms of contractual relationship between the client and the contractor there is only a single D&B organisation that has been contracted to do both design and construction processes.

The conceptual framework was developed on the basis of theory identified in the reviewed literature phase of the research. Having identified a focus of the research on key participants (clients, designers and contractors) and identified the research gap, the research aim and objectives research questions were formulated. The main questions of this research are 'what' the challenges are and 'how' they are dealt with in practice. From the reviewed literature it appears that the challenges may well be emanating from the organisational, contractual, processes, financial/technical, people and managerial aspects of the D&B procurement method. This then prompted the researcher to incorporate these aspects in the development of the framework as portrayed in Figure 3.3.

The reviewed literature generated secondary data in connection with the research area which in turn was used in the formulation of interview questions. Informal Interviews were used due to their ability to 'dig deeper and get a rich understanding than the formal interview'. In order to get more substance to both the reviewed literature data and informal interview data the research questionnaire survey was used as the final phase of the research.

The focus of the survey was to answer research question 3 and accomplish objective 2 of the study. This sequencing of the research involving research findings from one phase providing input into the next phase of a 3 phase research process was then synthesised in the final chapter and modelled into a framework. The validation of the framework is presented in chapter 7 of the research.

In order to achieve the objectives of the research the following chapter (chapter 4) provides a comprehensive synopsis and justification of the research methodology employed while the gaps that have been identified in this chapter are further explored in chapter 5 where findings from interviews undertaken are presented and analysed.



**Figure 3.3: Research Conceptual Framework**



## **CHAPTER 4**

### **RESEARCH METHODOLOGY**

This chapter provides the research methodology/design that has been employed in the research and discusses the methods and tools of analysis that have been employed. The chapter introduces and elaborates on the research process encompassing the research philosophy underpinning the research inquiry, research approach employed, research strategy employed choice of research and techniques and procedures employed in data collection, data analysis and interpretation.

#### **4.1 INTRODUCTION**

Research, according to Kumar (2005), is one of the ways used to find answers to questions. It involves a structured purposeful investigation that leads to the discovery of facts or knowledge in connection with an identifiable research question or problem. This highlights the fact that research is a process and not a product. He further noted that for the research process to be valid it has to be undertaken within a framework of a set of philosophies, use procedures and methodologies that have been tested and has to be designed to be unbiased and objective. This perhaps led Robson (1993, p.38) to state that 'research design is concerned with turning research questions into projects'. However Creswell (2009) went further than Robson (1993) by encapsulating the interconnection of this intricate system and describing it as an intersection of philosophies, strategies of inquiry and specific methods of data collection, analysis and interpretation.

Research methodology is also referred to as the procedural framework within which the research is conducted (Remenyi et al, 1998). Remenyi et al (ibid) goes on to state that the primary drivers to be considered when choosing an appropriate research methodology are the topic to be researched and the specific research question. The procedural framework referred to by Remenyi

et al (ibid) demands and requires an established methodology that has been tested and verified for its validity and transparency.

Research methodology identifies and links together research techniques guided by research approaches which are in turn guided by the research philosophy in an intricate manner as has been presented by Kagioglou et al (1998) by way of a hierarchical model. Due to its integration of the elements that make up research methodology the study used this hierarchical model as the basis for selecting the methodology for this research that is most appropriate and suitable to accomplish the objectives stated in chapter 1.

Research methodology is driven by certain ontological and epistemological assumptions. It consists of research questions or hypotheses, a conceptual approach to a topic, the methods to be used in the study (and their justification), and consequently the data source. All of these components are linked to one another in a logical manner. Manstead and Semin (1988), in an attempt to show the link between the elements that make up research methodology, adopts a river crossing analogy. The task of crossing the river corresponds to the general focus of the research. Specific research questions are analogous to asking how many people want to cross the river; the frequency with which they want to cross; the current of the river and so on. The choice of research strategy is akin to a choice among swimming, walking, flying or sailing across. The research tactics (methods of investigation) concern the particular type of boat, bridge, aircraft, etc. to be used in the crossing.

This chapter therefore addresses four main questions that inform and guide the manner in which the research has been conducted:

- What is the epistemological perspective adopted in connection with the nature, scope and source of knowledge underpinning the research?
- What is the research approach?
- What is the research plan/strategy?

- What are the methods (techniques and procedures) intended to be used in the research?

As part of this focus the chapter explores the various research philosophies, approaches, methodologies and methods of data collection that were available to the researcher and concludes by providing justification of the researcher's choice of research design.

## **4.2 EPISTEMOLOGICAL PERSPECTIVES**

Although philosophical ideas remain largely hidden in research as noted by Slife and Williams (1995) they still influence the practice of research and need to be identified. The importance of understanding philosophical challenges when conducting research have been identified by Easterby-Smith et al (2004) to help the researcher in the following ways; clarify the research design, identify research designs which will work and those which will not work under different circumstances, helps the researcher to identify and create research designs which may be outside his/her past experience and also helps the researcher to adapt research designs within different subject areas and different knowledge structures.

Creswell (2009) identifies five major perspectives to knowledge as the following:

- Ontology – pertaining to what it is
- Epistemology – pertaining to how it is known
- Axiology – pertaining to what value goes into it
- Rhetoric – pertaining to how it is reported
- Methodology – pertaining to how it is studied

Claims to knowledge are diverse which resulted in many writers coming up with differing viewpoints. The differences in these writers' viewpoints appear to originate from their assumptions about the nature of reality i.e. idealism or realism as noted by Easterby-Smith (2004). For instance, according to

Williamson (2006), there are two basic research philosophical traditions which are the positivist and the interpretative traditions while, according to Creswell (2009), there are four basic research traditions which are, in addition to the positivist and interpretative traditions stated by Williamson (2006) above, advocacy/participatory and pragmatic traditions. However both Creswell (ibid) and Williamson (ibid) agree on their views relating to the viewpoints of positivists and interpretivists. Both writers view positivists as deterministic (in which causes determine outcomes) and reductionist (intention to reduce ideas into small, discrete set of ideas to test).

Positivists' view of knowledge is therefore on the premise that it can only be based on what can be measured while the interpretivist/social constructivist view is that it cannot be studied in bits and pieces since individuals develop subjective meanings of their experiences. This therefore means that, according to interpretivists/social constructivists, meanings are varied and multiple. Based on this viewpoint Interpretivist researchers look for the complexity of views rather than narrowing meanings into a few categories. The interpretivists' view of the world, as an ever changing place, perhaps led Pickard and Dixon (2004) to their observation that such a paradigm is more likely to take place in a natural setting where topic of study is focused on everyday activity. The Interpretivist researcher's aim is therefore to make sense of (interpret) the meaning others have of the world.

The advocacy and participatory worldview, on the other hand, holds that research inquiry needs to be intertwined with politics and must have a political agenda. It emphasises on specific challenges that need to be addressed such as empowerment, inequality, oppression, domination, suppression and alienation. Because of its focus on social challenges advocacy and participatory worldview is primarily concerned with the needs of marginalised and disenfranchised people in the society. Pragmatic worldview is concerned with applications i.e. what works and solutions to problems as noted by Patton (1990). In this worldview rather than focusing on methods researchers emphasise on the research problem and use all approaches available to understand the problem. There is therefore a tendency of not committing to

any one philosophy and reality and individual researchers are free to choose the methods, the techniques and procedures of research that best meet their needs and purposes.

These four schools of thought or inquiry paradigms also differ significantly in terms of their axiological view points for instance the positivists axiological view is that research is free and unbiased. This reflects their belief that the world is external and objective and the observer is independent which means science is value-free. On the other hand the interpretivists/social constructivists' axiological view is that research is laden and biased on the basis that the world is socially constructed and subjective and that the observer is part of what is observed. Contrary to the positivists the interpretivists/constructivists maintain that science is driven by human interests.

Based on their axiological viewpoint the positivists maintain that the researcher should focus on facts; look for causality and fundamental laws; reduce phenomena to simplest elements and formulate hypotheses and test them. This is in contrast to social constructivists/interpretivists who maintain that researchers should focus on meanings; understand what is happening; look at the totality of each situation and develop ideas through induction from data.

The above discussion on philosophical viewpoints offering four fundamentally different and competing schools of thought provide a good basis for judging the philosophical stand point of this research. From the aims and objectives of the research presented in section 1.4 above it is clear that the research is not solely concerned with theory testing (positivism), nor is it concerned with advocating for social needs of marginalised or disenfranchised people (advocacy and participatory worldview). The research's focus on the D&B procurement method and examination of complex challenges concerning people (key participants involved in the D&B procurement method), organisations (clients', contractors' and designers' organisations), construction processes, situations and ordinary events in their natural settings dictates that

the study is of an exploratory nature. Exploratory type studies are characterised by a quest to have a deeper insight in little understood situations; seeking new insights of phenomena; asking questions in order to assess phenomena in a new light and to generate ideas and hypotheses for future research (Robson, 2002).

This research can also be viewed as a practitioner oriented research which aims, among other things, to provide improvements on how D&B procurement should be implemented in practice in order to negate some of the impediments/challenges that they may come across. It also concerns what is deemed to have worked and provide practical suggestions to problems faced by practitioners utilising D&B as a procurement method. It is therefore apparent that because of the nature of the problem it is aligned more towards use of interpretivist philosophical viewpoint in order to understand and solve the research problem. The following section describes how this philosophical view point has influenced the selection of the research approach adopted.

#### **4.3 RESEARCH APPROACH**

Research approach, according to Creswell (2009), refers to the types of qualitative, quantitative and mixed methods designs or models that provide specific direction for procedures in a research design. Although there are several research approaches that a social researcher can avail himself/herself to, Denscombe (2007) noted that there is no single approach that can solve all research problems.

It is evident from the research problem, its nature and characteristic, that the problem is a multifaceted phenomenon that demands not only a detailed understanding through a qualitative exploration of the challenges encountered but a more general understanding of the challenges from the perspective of a wider audience through a quantitative exploration/survey of the challenges to complement the findings from the qualitative phase. In order to accomplish the research goal of exploring challenges underlying the D&B procurement method through the experience of key participants as well as measuring the

severity of such challenges it is evident that the mixed methods approach is the most appropriate for this research in order to address the research questions and accomplish the objectives set in chapter 1.

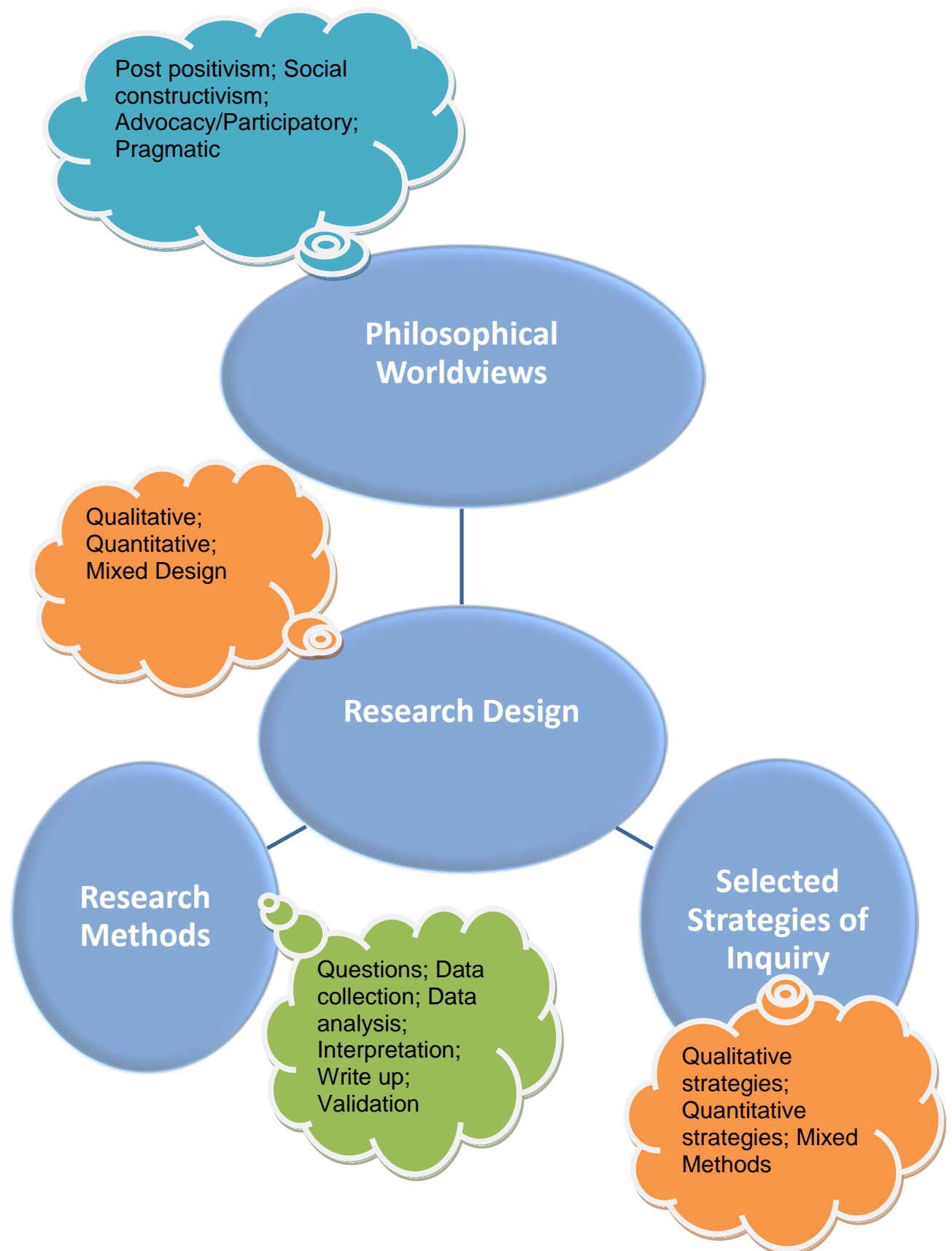
One data source has been deemed in this case to be insufficient to adequately address the problem raised in section 1 of this research. In order to get a qualitative understanding of the challenges of the study qualitative interviews have been undertaken with clients, designers and contractors who have had extensive practical experience of the D&B procurement method activities, processes, results, problems and/or challenges. Such abundant experience from these practitioners provided valuable information for this research and indeed provided more insight into questions and other variables that need to be explored and measured in the quantitative phase of the research. The seeking of answers to the research problem therefore demands a follow up from the qualitative exploration of the challenges experienced by key participants with a quantitative study that will enable the researcher to generalise and measure the severity of the challenges raised in the qualitative exploration phase of the research.

The qualitative phase, in addition to providing a detailed understanding of the problem, highlights and explores this complex multifaceted problem followed up with a quantitative phase to gain further insights into the severity of the challenges from a wider audience's perspective. As the research begins with and prioritises the collection and analysis of qualitative data in the first phase it is generally referred to as an exploratory sequential design. Building from the exploratory initial phase a second phase of the research (the questionnaire survey) will be conducted to assess the severity of the challenges raised in the qualitative phase of the research. In this research qualitative results are used to inform the quantitative research questions, sampling and data collection in the quantitative phase of the research. This approach has been successfully used by other researchers before, for instance Kutner et al (1999 p.1350), who commented that 'the use of initial open ended interviews to explore the important challenges allowed us to

formulate relevant questions and discover what were truly concerns to this population’.

This supports and justifies the use of the qualitative phase of the research undertaken in order to get a detailed understanding of the challenges experienced by key participants of the D&B procurement method. As noted by Denzin and Lincoln (2000) the word qualitative implies an emphasis on the qualities of entities and on processes and meanings that are not experimentally examined or measured (if measured at all) in terms of quantity, amount, intensity, or frequency. They go on to state that qualitative researchers stress the socially constructed nature of reality, the intimate relationship between the researcher and what is studied and the situational constraints that shape inquiry. This detailed understanding of challenges encountered by key participants provides the basis of question formulation in the questionnaire survey and thus enable the researcher to discover the severity of the challenges from a different and wider sample of respondents. Results from both phases of the research as described would then be used to develop the framework to be used in future D&B projects. Figure 4.1 shows the interconnectedness and links of the philosophical viewpoint, research design, research methods and selected strategy of inquiry.





**Figure 4.1: Framework for Design – The interconnection of worldviews, strategies of inquiry & Research methods**

**Source:** Adapted from Creswell (2007)

#### 4.4 RESEARCH PLAN/STRATEGY OF INQUIRY

Methodology of research has been viewed by Travers (2001) as to include not only the methods used to resolve a research problem but also including the researcher's theoretical position and how the employed methods have resolved the research question. There are many methodologies that can be employed by a researcher and the most common types provided by Creswell and Plano (2007) are tabulated in Table 4.1

**Table 4.1: Alternative research approaches/strategies of inquiry**

Quantitative	Qualitative	Mixed Methods
Experimental design	Narrative	Sequential
Non-Experimental (e.g. Surveys)	Phenomenology	Concurrent
	Ethnographies	Transformative
	Grounded theory	
	Case study	

**Source: Adapted from Creswell and Plano (2007)**

Based on the nature and characteristics of the research question as well as the goals and objectives of the research as elaborated in chapter 1 above this research demands the use of a mixed methods approach so as to bring together a more comprehensive account of not only the challenges underlying the D&B procurement method in the UK construction industry but practice based enablers used to address the challenges. The results from one method would be used to inform the other method.

The initial phase centred on the qualitative data collection and analysis in order to develop an in-depth understanding of the problem. Commencing with the qualitative phase provided the researcher with secondary data associated with the research problem. This enabled the researcher to appreciate and

understand in more detail the challenges affecting key participants of the D&B procurement method. The qualitative phase involving a comprehensive literature review of related literature and in-depth interviews provided the bed rock for accomplishing objectives 1 and 3 of the identified research objectives. Literature review, which is part of this initial qualitative phase, was commenced first as it can better support the researcher to establish subject background, learn from other research, formulate research problems, synthesise the work of others and compare with other research strategies as noted by Ridley (2008). This was then followed by the quantitative phase to assess, from a wider different audience, the severity of the challenges raised in the qualitative phase of the research. Table 4.2 tabulates the research methodology clearly identifying the research process, main research questions to be addressed, research methods used and objectives of each phase.

**Table 4.2: Research Methodology**

<b>Research Process</b>	<b>Research questions</b>	<b>Research methods</b>	<b>Objectives</b>
<b>Phase 1</b>	What are the underlying challenges of the D&B procurement method?	1. Literature review 2. Face to face interviews	1. Identify the challenges 2. Seek insights into how they come about 3. Identify factors underlying the challenge
	How have the underlying challenges been addressed in practice?	1. Face to face interviews	1. Identify practice based enablers 2. Identify factors underlying practice based enablers
<b>Phase 2</b>	What is the view of a broader and different population regarding the challenges raised in phase 1?	1. Questionnaire survey	1. Assess outcomes from wider population 2. Determine severity of the challenges raised

The foregoing is in tandem with what Yin (2009) stated regarding research approach/strategy. He said that each research approach/strategy has its own specific approach to collect and analyse empirical data. In order to avoid gross misfits between the desired outcome and the chosen strategy Yin (2009) stresses that the type of question(s) posed; the control over actual behavioural elements; and the degree of focus on historical or contemporary events; are the conditions which should provide the grounds for strategy choice. Table 4.3 depicts Yin's views on research strategies versus characteristics of the research questions.

**Table 4.3: Research strategies versus characteristics**

Strategy	Form of research question	Control over behavioural events	Focus on contemporary events
Experiment	How, why	Yes	Yes
Survey	Who, what, Where, how many, how much	No	Yes
Archival Analysis	How, why	No	Yes/No
History	How, why	No	No
Case Study	How, why	No	Yes

**Source: Adapted from Yin (2009)**

From the above tabulation adopted from Yin (2009) it is clear that experiments, through their reliance on an investigator manipulating behaviour

directly, precisely and systematically are not applicable to this research where the relevant behaviours affecting and directing the unit of analysis cannot be manipulated. Histories are the preferred strategy where there is virtually no access or control. Histories therefore tend to deal with the 'dead' past and are therefore not relevant to the focus of this research which focuses on contemporary events. Similarly archival analysis, as a strategy which focuses on examining records, does not lend itself to the aims and objectives of this research.

On the other hand, case study design, as stated by Yin (2009), should be considered in the following situations: when the focus of the study is to answer 'how' and 'why' questions, if the researcher cannot manipulate the behaviour of those involved in the study, if the researcher wants to cover contextual conditions or the boundaries between phenomenon and context are not clear. As the focus of this research is not only focused to answer the 'how' and 'why' questions but the 'what' questions as well in connection with the underlying challenges of the D&B procurement method the case study research design was discounted as not appropriate for the research.

Action research and ethnography have been discounted as not appropriate for the proposed study. Ethnographic study approaches have been discounted on the basis that they focus on the description and interpretation of the culture and social structure of a social group typically involving participant observation over an extended period of time. Similarly action research strategy has been discounted on the basis that it is concerned with learning about organisations through trying to change them (Lewin, 1946).

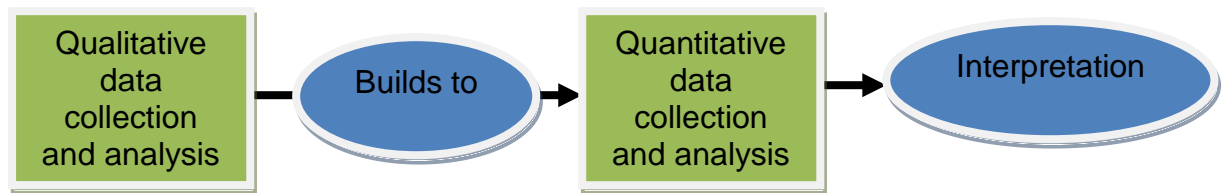
Given that the research is an empirical inquiry that investigates a contemporary phenomenon in which the research questions are mainly to do with not only the 'how' and 'why' but the 'what' aspects of the research problem being investigated makes the case for a combination of mixed method research design in which both the qualitative design (interviews) and the quantitative design (survey) approaches to be the most preferred research strategy for this research problem. This underpinned by the recognition that

the adoption of one method (either qualitative or quantitative design) alone would not be able to adequately fulfil and satisfy the research objectives stated in chapter 1 above meant that the explanatory sequential mixed method design is the most appropriate to address the research questions of the research.

#### **4.5 RESEARCH TECHNIQUES & PROCEDURES**

Research techniques/methods have been defined by Creswell (2007) as forms of data collection, analysis and interpretation that the researcher propose for the research. This contrasts with Bryman et al., (2009)'s definition which appear to refer to a research method as simply a technique for collecting data. Given the nature of the research problem and the objectives of the research a two-phase mixed method exploratory research method has been adopted as explained and justified in the above sections.

As indicated in Table 4.2 the mixed methods data collection approach has been adopted involving extensive review of related literature undertaken in order to get insights on findings from other related research. In addition, as noted by Cooper (1984), Marshall and Rossman (2006) literature review has been undertaken to relate this current research to the larger, ongoing dialogue in literature, filling in gaps and extending prior studies. Literature review was therefore chosen as a research method due to the fact that it can better support the researcher to establish subject background, learn from other research, formulate research problems, synthesise the work of others and compare with other research strategies as noted by Ridley (2008). Figure 4.2 is a graphical presentation of this design and method.



**Figure 4.2: The Exploratory mixed methods sequential design**

**Source: Adapted from Creswell and Clark (2011)**

In addition to the literature review semi structured interviews were conducted in order to identify and explore underlying challenges experienced by key participants of the D&B procurement method. One may want to ask the question – why interviews? As may be recalled in earlier sections the researcher’s ontological position is that people’s knowledge, views, understandings, interpretations, experiences, and interactions are meaningful properties of the social reality which most of the research questions are designed to explore. More importantly this research’s main tenet is in key participants’ perceptions of the challenges they have experienced and how they have addressed those challenges in practice.

In addition the researcher’s epistemological position, as stated in earlier sections, is that a meaningful way to generate data on these ontological properties is to talk interactively with people, to ask them questions, to listen to them, to gain access to their accounts and articulations. Underpinning this position is the view that knowledge is situational and that the interview is just as much a social situation as is any other interaction. Therefore the adopted approach, according to Hollway and Jefferson (2000), is for the interview itself to be as contextual as possible to draw upon as fully as possible the social experiences which this research is interested in exploring. Semi structured interviews were adopted due to their flexibility as well as their ability to allow exploration of emergent themes and ideas rather than reliance on concepts and questions defined and set in advance of the interview as asserted by Moser and Kalton (1979).



Correspondingly Moser and Kalton (1979 p.299) concluded that informal interviews 'can dig deeper and get a rich understanding than the formal interview'. They went on to expand on this assertion by stating that formal interviews may limit the investigation to too superficial a level to be appropriate. With informal interviews, if skilfully done, they went on to state that, the interviewer should be able to cut through any embarrassment and emotional inhibitions surrounding the subject and to 'dig as deep' as may be necessary to get to the heart of each person's attitude/perception.

In addition to semi-structured interviews questionnaire surveys were used to gain further insights into the initial findings from the qualitative phase (the literature review and the interview phases) and assess the severity of the challenges encountered by key participants of the D&B procurement method. In addition to providing this important dimension of the research questionnaire surveys are also used to add rigour and more substance to the qualitative data collected from interviews and the reviewed literature.

#### **4.5.1 LITERATURE REVIEW**

Conducting reviews of literature has been viewed by Light and Pillener (1984) as a critical competence that any researcher should have in order to position his/her contribution to knowledge and to construct reasoned, logical and substantial arguments. Similarly Leitch et al (2010) state that literature review is important to any kind of research as it serves as an account of what has been published by accredited scholars and researchers. Leitch et al (2010) goes on further on this and state that literature review is used to review published works, to critique literature and to identify the gap in research and to inform the proposed research. This review, according to Kulatunga (2008), helps the researcher to understand existing research from others regarding a particular field and ensure that the researcher's knowledge is up to date in the selected subject area.

In order for the gains in scholarship to be cumulative there must be a link between the past and future research, Light and Pillener (1984) goes on to

opine. They go on to state that often the need for a new study is not as great as the need for the assimilation of already existing studies. Thus the latter is a prerequisite of the former. Therefore in addition to contributing to the research the review of existing research evidence has the potential to guide researchers by providing ideas, illustrations and recommendations for practice. Correspondingly Ridley (2008) supports the views by Kulatunga (2008) and Light and Pillener (1984) by stating that review of related literature can better support researchers to establish subject background, learn from other research, formulate research problems, synthesise the work of others and compare with other research strategies.

It is commonly assumed that the validity of the findings of a review is dependent on the comprehensiveness of the studies located. It is with this in mind that a systematic review has been undertaken in this research in order to discover important challenges relevant to the research topic, synthesise and gain new insights, identify challenges affecting D&B procurement method key participants in practice, establish the context of the problem, rationalise the significance of the underlying challenges, understand the structure of the subject area and relating aspects associated with the problem. In addition to providing these important insights into the problem the reviewed literature assisted the researcher in narrowing down the focus of the research as well as helping in the identification and narrowing down on the most appropriate methodological approach to use.

#### **4.5.2 INTERVIEWS**

Interviews are undertaken principally to gain in-depth information about a challenge or phenomenon as asserted by Cargan (2007). Although asking questions and getting answers is a much harder task than it may seem Denzin and Lincoln (2000, p.645) observed that 'interviewing is one of the most common and powerful ways in which we try to understand our fellow human beings'. Their purpose, according to Opdenakker (2006), is to gather descriptions of the life-world of the interviewee with respect to interpretation of the meaning of the described phenomena.

As noted in earlier sections the choice of interviews in this research is deeply embedded in the way in which social explanations of the central research question is constructed by way of its emphasis on depth, nuance, complexity and roundedness in data, rather than the kind of broad surveys of surface patterns which for example questionnaires might provide. The argument underpinning this is that key participant experiences with D&B procurement requires an understanding of depth and complexity in their contextual accounts and experiences rather than a more superficial analysis surface comparability between accounts of large numbers of people. Interviews were therefore adopted as the main data gathering tool for this research in order to achieve depth and roundedness of understanding in D&B procurement key participant experiences as opposed to a broad understanding of surface patterns.

Interviews can be either structured (formal/closed) or unstructured (informal/open) and according to Creswell (2003) there is a midway point between these two principal methods called the semi-structured interviews. In this format, as opined by Kvale and Brinkmann (2000), an interview guide may be developed for some parts of the study rather than develop an interview schedule or none at all. The interview guide will provide direction to the interview so that the content focuses on the critical challenges of the study. This, according to Kvale and Brinkmann (2000), allows for greater flexibility than closed ended type interviews and permits more valid responses from the respondents' perception of reality.

The semi-structured interviews also allowed the interviewees to discuss and develop their own ideas and provide an opportunity to cover wider challenges, elaborating on points of interest and importance. The very fluidity and flexibility of semi-structured interviewing is the pivotal strength that enhances validity in contrast to the rigidity and standardisation of structured questionnaires which appear to lack sensitivity to validity in favour of what can be interpreted as excessive concern with reliability and ease of quantification in analysis.

In this research a series of face-to-face unstructured interviews with key D&B procurement method participants (clients, design consultants and contractors) have been undertaken. This is in line with Denzin and Lincoln (2000)'s observation that unstructured interviews can provide a greater breadth of data than the other types given its qualitative nature. Given that unstructured interviews take place in the largely situational everyday worlds of members of society they further argue that interviewers and interviewees must necessarily be creative, forget how-to rules and adapt themselves to the ever-changing situations they face.

Experienced senior representatives from clients, design consultants and contractors were interviewed (mainly targeted at Project Managers, Design Managers, Contracts Managers, Commercial Managers, Directors and Programme Delivery Managers of various seniority levels) as they are believed to have practical experience of D&B procurement method including activities, processes and challenges of this method of project delivery. Respondents from both the private and public sectors with D&B procurement method (in particular the 'develop and construct' variant) were targeted. Research findings from these interviews would enable the accomplishment of research objectives identified in chapter 1.

#### **4.5.3 QUESTIONNAIRE SURVEY**

According to Cargan (2007) a survey is a means of gathering information about the characteristics, actions or opinions of a large population of people referred to as a population. Questionnaire surveys, as viewed by Cargan (2007), are very efficient both in time and effort.

The questionnaire survey will be used to explore the opinions of D&B procurement method key participants in the UK construction sector. In order to ensure representativeness of the survey aspects such questionnaire design, extensive piloting, effective challenge and thorough follow up procedures were looked at closely and addressed. The target population comprised D&B contractors, design consultants and clients (both public and private). The

questionnaire survey was conducted by means of a web-based questionnaire survey system due to its efficiency in both time and effort. In addition, using this method, the questionnaire was easily created and distributed with the ability that enabled responses to be collated ready for statistical analysis.

The questionnaire was sent to the target population by e-mail with an attached covering letter briefly explaining the purpose of the questionnaire survey.

Participants were requested to answer questions on line with the data/responses automatically saved in an on line database. The role of the questionnaire, as described by Brace (2008), is to provide a standardised interview across all subjects so that all respondents are asked the questions that are appropriate to them. Brace (2008) further states that, in the questionnaire, the researcher articulates the questions to which he or she wants to know the answers and, through the questionnaire, the subjects' answers are conveyed back to the researcher. The questionnaire, he further asserts, can thus be described as the medium of conversation between two people. Albeit that they are remote from each other and never communicate directly.

Considerations such as population, sampling, question and content challenges were considered prior to embarking on this survey as recommended by Trochim (2006). The nature of the research problem and the objectives of the study identified in chapter 1 of this research together with the methodology adopted make the case for the use of the questionnaire survey in order to generalise and measure the severity of the challenges learned from the qualitative exploration undertaken in the qualitative phase of the research through the review of related literature and semi-structured interviews.

#### **4.5.4 QUESTIONNAIRE PILOT WORK**

Pilot work of the questionnaire was used to allow the researcher to create or adapt the questionnaire to maturity and to try out the questionnaire before launching it. This was done to ensure that the questionnaire worked as intended and that it yielded the data that the research required.

Pilot work of the questionnaire also helped with the wording of the questions and other procedural matters such as the design of the introductory letter and the ordering of the question sequence. This process commenced as an exploratory phase. It involved lengthy, unstructured interviews with 5 key participants (2 designers, 1 client and 2 contractors) known to the researcher who are experienced with the D&B procurement method. The respondents used in the pilot work were therefore relatively representative to those of the main sample. The respondents used in the pilot work were told that they are taking part in a try-out study and that the researcher wanted them to be critical and to ask questions they don't understand and to help the researcher to make a better question schedule. This process enabled the survey questions to be simplified. Information from pilot interviews in the qualitative phase discussed earlier provided the development of a list of key topics to be covered in the first phase of the questionnaire survey phase.

Other aspects of the survey such as layout of the questionnaire and coding/ numbering of the questions for data processing were also covered in the pilot work. The use of the 'Other' category followed by spaces where respondents would be expected to provide responses was also covered in the pilot work.

Pilot work enabled the researcher to amend the questions and to focus the questions in line with objective of the survey discussed in chapter 1. Through the pilot work the researcher realised that there was little point in burdening respondents and risking reduced response rates by asking for detailed lengthy answers when the results were going to be treated in highly condensed form in the analysis phase of the survey. The pilot work helped the researcher to critically examine not only the wording of the questions but also the necessity of the question in the overall context of the research. Ambiguous questions were removed and questions were re-drafted to ensure that the questions would mean the same thing to all respondents experienced with the D&B procurement method.

The covering letter to the survey was also amended to tailor it to the audience and assurance of confidentiality that was previously not stated in the draft

letter was introduced following feedback from the pilot work. The importance of the survey was also re-phrased to encourage respondents to partake in the survey.

#### **4.5.5 RELIABILITY AND VALIDITY**

Reliability, according to Yanow (2006), is about the quality of the findings and without it, he goes on to state that, it will be difficult for any inquirer to convince his/her audience that his/her findings are worthy. To ensure reliability in qualitative research, Golafshani (2003) stated that examination of trustworthiness is important because, according to Leitch (2010), it addresses how accurately the research method and techniques will produce data. Validity, on the other hand, is viewed by Leitch (2010), as a way to address if the research explains or measures what it originally sets out to measure. Validity sets out to answer whether the method(s) employed are appropriate for the research questions and objectives.

In order to ensure reliability and validity of the research the researcher followed the following procedural matters proposed by Creswell (2003):

- Member checking – determining the accuracy of the interview transcripts by sending them back to the interviewees for vetting
- Use of rich descriptions to convey interpretations to show that the researcher has not invented findings
- Reporting of negative and discrepant information. Even when information had not been in line with major findings it was still taken on board

Validity of the research has been accomplished by several processes that the researcher employed which are:

- Constant comparative method – in which all the research data fragments arising from clients, contractors and contractors were constantly inspected, compared and analysed. This helped in

understanding the interconnectedness of both the challenges and the practice based enablers identified by key participants

- Comprehensive data treatment – all data were from interviews and surveys were incorporated in the data analysis. The result was an integrated data set that comprehensively describes both the challenges, their severity and practice based enablers to be adopted to address the challenges faced by key participants of the D&B procurement method.
- Use of appropriate tabulations – this was used to improve the quality of data analysis. The use of Nvivo data management software enabled the researcher to organise and code all interview data, analyse and query the interview data as well as manage to run query reports, matrix coding queries and cross case queries. This helped the researcher to present convincing critical analysis of the data and come up with convincing arguments to support the research conclusions. Quantitative measurements were also used in the qualitative section where appropriate to support the data analysis to enable the reader to gain a sense of the flavour of the data as a whole. Refer to 5.7 as an example of such tabulations.
- The use of multiple data sources from the review of related literature, qualitative interviews and questionnaire survey also strengthened validity of the research findings.

The procedural process that has been followed in the interview process in terms of member checking, use of rich descriptions to convey interpretations and reporting of negative and discrepant information all helped to address any issues with researcher bias. The fundamental objective of the researcher in this process was to not only show and document what was being said in the interview but to show that what was being said relates to the experiences and perceptions being studied in the research.

There are a number of ways to determine the reliability of a test such as the following:



- ❖ Split half method
- ❖ Internal consistency method
- ❖ Alternative forms method
- ❖ Test-rest method

Of these methods the internal consistency method Cronbach's alpha method has been said to be one of the most important ways to measure reliability (Yu, 2005). It is an internal consistency method which examines the number of questions on a questionnaire and the average inter-item correlation. A commonly accepted rule for describing internal consistency using Cronbach's alpha is as follows:

**Table 4.4: Reliability Statistics ranges and internal consistencies per range**

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent (High-Stakes testing)
$0.7 \leq \alpha < 0.9$	Good (Low-Stakes testing)
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

The result ranges between less than 0.5 for unacceptable/unreliable tests and equal to/or greater than 0.9 for excellent/completely reliable tests. SPSS is used for the computation of the Cronbach's alpha for the questionnaires and the results are shown in Tables 4.5, 4.6 and 4.7

**Table 4.5: Reliability Statistics on Contractor Questionnaire**

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.993	.994	10

**Table 4.6: Reliability Statistics on Client Questionnaire**

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.969	.975	10

**Table 4.7: Reliability Statistics on Designer Questionnaire**

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.987	.989	10

Tables 4.6, 4.6 and 4.7 show the Cronbach's Alpha as 0.993, 0.969 and 0.987 for contractors', clients' and designers' questionnaires respectively. This shows extremely high reliability of the questionnaires used for all the respondents in the survey. This implies that the results obtained from the analysis of this questionnaire are trustworthy, repeatable, dependable and reliable to an acceptable range.

To ensure content validity a comprehensive pilot work was undertaken to ensure that the statements and questions used in the questionnaire provoked significant interest from the respondents and willingness to cooperate. Validity and reliability are related to each other and above all reliability is a necessary condition for validity. A measure which is unreliable cannot attain an adequate degree of validity. Due to the research question that the questionnaire survey was designed to answer, content validity was used.

Experienced professionals in D&B procurement method consulted in the pilot survey were used to assess the test and to establish that the questions covered in the questionnaire are representative of the domain of the aspects being measured i.e. how all 3 category respondents perceived the severity of the challenges encountered in D&B procured projects. The experienced professionals consulted confirmed that items and questions in the questionnaire covered the full range of the issues in connection with severity of challenges faced by key participants of the D&B procurement method. The professional experts were requested to compute the percentage of questions within the questionnaire they deemed to be relevant.

The average percentage of questions deemed to be relevant by the professionals consulted was 95% which shows that they considered the questions in the questionnaire to be providing answers to the research question for which it was intended. They were satisfied that each of the key challenges commonly faced in D&B procured projects had adequate representation in the questions contained within the questionnaire. The experienced professionals consulted in the pilot survey also evaluated the questionnaire in terms of readability, feasibility, clarity of wording, layout and style of the questionnaire and confirmed that the questions were valid measures for the intended investigation.

#### **4.5.6 SEQUENCING OF INVESTIGATION**

The use of a combination of qualitative (literature review and face to face interviews) and quantitative techniques is common in research. Edwards and Holt (2010) states that this approach in research as an established branch of research methodology that promotes at least three converging distinct 'components' to a research design. Fellows and Liu (2003) similarly describes it as the means of using both qualitative and quantitative techniques together and goes on to suggest that such a combination can be very useful and powerful to gain insights and results. On the other hand Chileshe and Watson (2005) stated that arguments can be strengthened through the use of this method combination, an assertion that was also supported by Bryman (2008) when he said that the most persuasive evidence comes through what may be referred to as different methodological sequencing or triangulation of measurement processes.

Bryman (2008) identified 5 main types of triangulation namely data triangulation, investigator triangulation, theory triangulation, methodological triangulation and multiple triangulation. These are tabulated in Table 4.8:

**Table 4.8: Types of Triangulation**

Type	Description	Short Explanation
Data	Data triangulation	More than one method of data sampling
Investigator	Investigator triangulation	More than one observer is employed in data collection and or is employed in data interpretation
Theory	Theory triangulation	More than one theoretical scheme or theoretical standpoint is employed to interpret the phenomenon
Method	Methodological triangulation	More than one method of data collection and/or analysis is employed (e.g. a mix of qualitative and quantitative sources)
Multiple	Multiple triangulation	Any combination of different observers, perspectives, data sources, theories, methodologies used in the same investigation.

**Source:** Adapted from Bryman (2008)

Triangulation is used in research for three main purposes, according to Adam and Kiger (2005) and Jack and Raturi (2006) and these were identified as follows: completeness, contingency and confirmation. Completeness rationale of triangulation stems from the recognition that any single methodology will have inherent flaws which a second or third methodology might reveal and amend. The contingency rationale is about the need to have insight into how and why a particular strategy is chosen. The confirmation rationale is based on the premise of having more robust and generalised set of findings.

Given the nature of the problem in this study the researcher adopted a methodological sequence involving the qualitative phase (comprising literature review and face to face interviews) followed by a quantitative phase (comprising a questionnaire survey). The three main data sources for the research are therefore the review of related literature findings, findings from semi structured face to face interviews with D&B procurement method key participants and questionnaire surveys directed to a wider audience who were not involved in the qualitative interview phase of the research. The methods of analysis are the use of content analysis for the qualitative interview transcripts and statistical analysis for the quantitative data from the questionnaire survey.

Figure 4.3 is a graphical presentation of the data sources described above and identifies what each research method aims to achieve and how the research aim is accomplished from this sequential methodological and data mining approach.

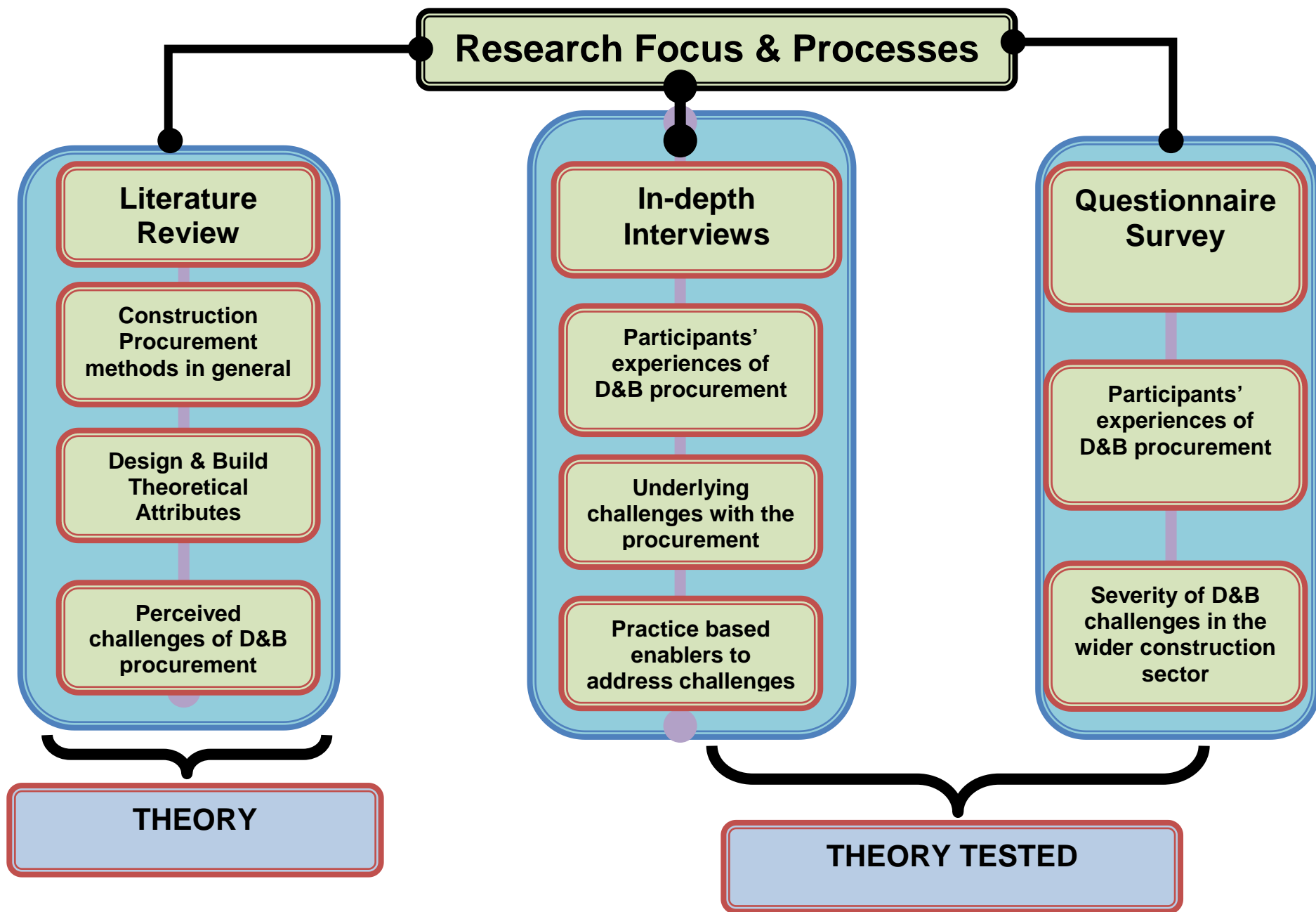
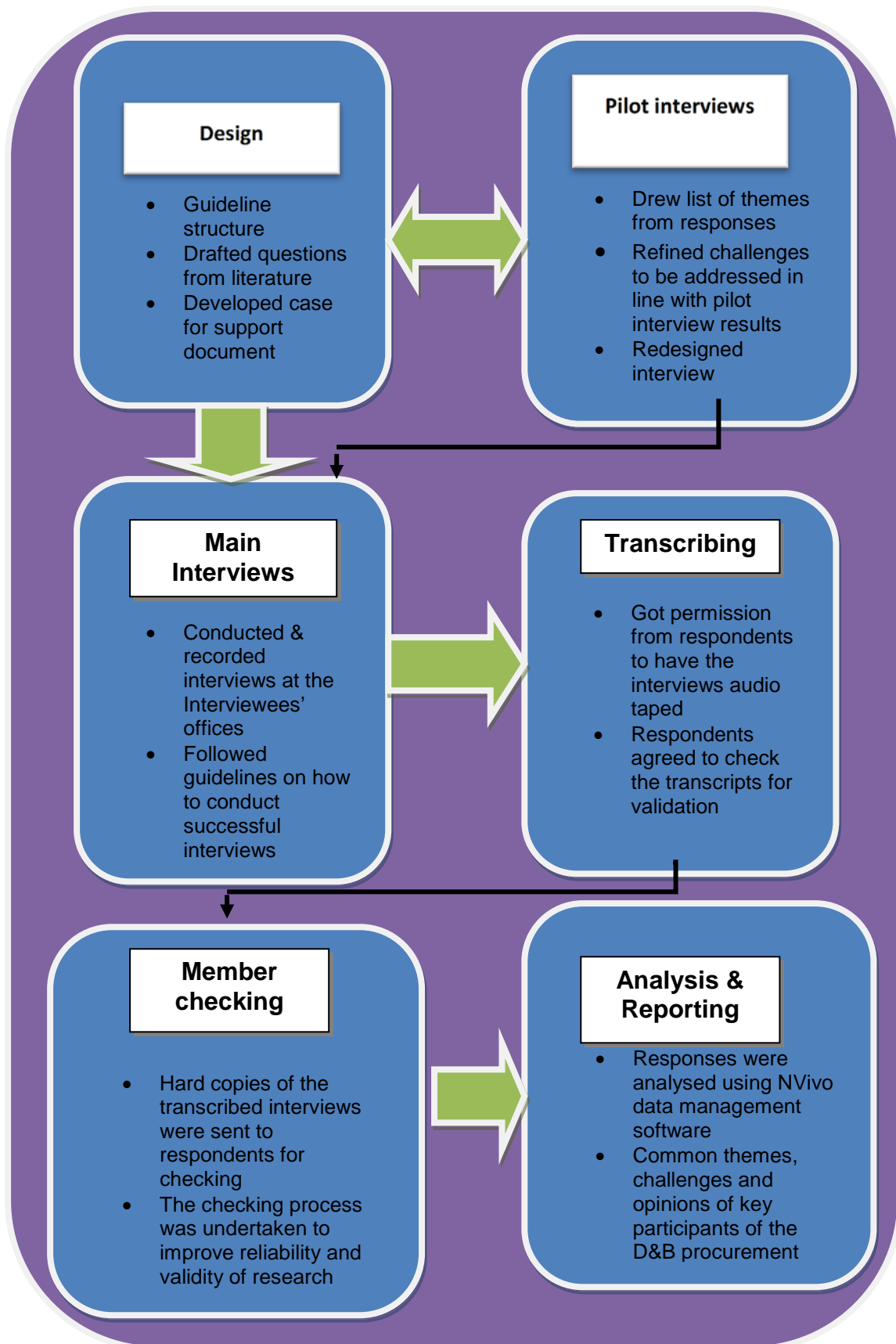


Figure 4.3: Sequential method and data mining approach to the research

#### **4.5.7      INTERVIEW DESIGN**

The interview design process followed is shown in Figure 4.4 As stated before the review of related literature helped to identify the major relevant challenges. From these challenges interview questions were compiled to examine how key participants perceive D&B procurement from their experience. In addition to the processes shown in Figure 4.4 underlying questions coming out of the reviewed literature have been explored and these key questions informed the structure of the interviews.

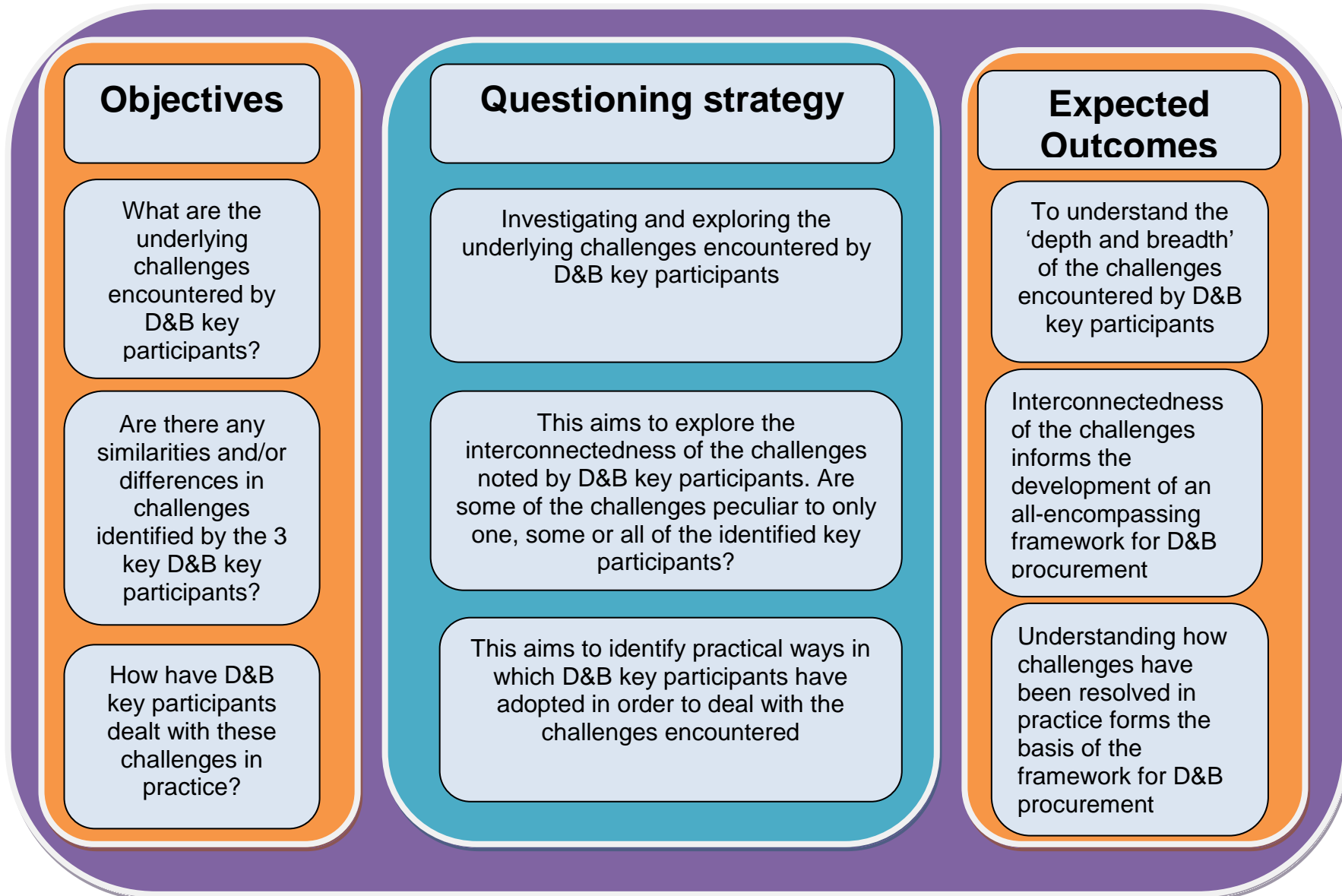




**Figure 4.4: Interview design process adopted in the research**

#### **4.5.8 INTERVIEW DESIGN STRATEGY**

The plan and design strategy of the interview process adopted in this research is shown in Figure 4.5. The purpose and objective behind each of the main areas asked are also included in Figure 4.5.



**Figure 4.5: Framework used to explore challenges encountered by D&B key participants**

#### **4.5.9 AIM OF THE PILOT INTERVIEWS**

As depicted in Figure 4.4 the main aim of the pilot interview stage of the research (stage 1) is to collect background information regarding the research questions in order to inform and adapt the research approach. Following on from the research problem identified in chapter 1 and the challenges highlighted from the reviewed literature in chapters 2 and 3 the focus of the pilot interview aimed to address the research questions as articulated in chapter 1.

In order to answer the research questions 3 pilot interviews were undertaken with each of the targeted respondent category i.e. 1 client, 1 designer and 1 contractor. The 3 pilot interviewees were chosen in order to give insight into the nature of the problem as well as providing useful information for the development of the main interview questions. Contacts were made by telephone calls to the industry bodies representing each of the respondents. The British property Federation was contacted for the client group, the Royal Institute of British Architects (RIBA) was contacted for the architects/design group and the Civil Engineering Contractor's Association (CECA) was contacted for the contractors group.

#### **4.5.10 PILOT INTERVIEWS**

In addition to the above the pilot interviews were also used to test other challenges such as whether the respondents understood the questions, whether there were any ambiguous questions, whether the researcher retained the attention and interest of the respondents throughout the interview process and if not what changes to be made to retain the respondent's interest and whether the interview flowed properly from start to end.

The designer had 27 years of working experience, the contractor had 34 years of working experience and the client had 41 years of working experience in the UK construction sector. The combined value of construction projects the interviewees had managed between them is £475 million and both of them had worked on D&B projects for approximately a third of their working lives. The respondents are all senior managers within their organisations.

#### **4.6 MAIN INTERVIEWS**

This subsection of the chapter articulates the aim of the main interviews, provides details of the surveyed sample of respondents, describes the analytical tool used in the process of analysing the gathered data and specifies the interview design strategy adopted for this research.

##### **4.6.1 AIM OF THE MAIN INTERVIEWS**

It may be recalled from chapter 4 of this research that the research approach is divided into two phases (commencing with the main qualitative phase followed by a quantitative phase). The first qualitative phase is aimed at utilising a purposeful sample followed by a different purposeful sample of D&B key participants in the second quantitative phase. The aim/purpose of the first phase (the exploratory qualitative phase) is to get an in-depth understanding of the experiences and views of those key participants that have rich practical experience of D&B procurement activities, processes, problems, results and

challenges. This is the phase that is covered in more detail in the following sections of this chapter.

#### **4.6.2 SURVEYED SAMPLE OF RESPONDENTS**

The research intentionally focused on senior members within the key participants member organisations such as Contracts Managers, Project Managers, Commercial Managers and Directors (within D&B contracting organisations), Principal Engineers, Project Managers and Directors (within the design consultant organisations) and Project Managers, Directors, Programme Managers and Commercial Managers (within client organisations). In addition the research also focused on those organisations that have been actively involved and engaged in delivering construction projects utilising D&B procurement method in the UK construction industry over the last couple of decades.

By focusing on senior members of key participant organisations the researcher aimed to get insights from key participants who have had significant practical experience of the D&B procurement method. This is in line with the research aim and objective to get deeper insights into challenges that key participants have encountered with the D&B procurement method. By focusing on such experienced respondents the researcher wanted to gain as much information and attributes surrounding the key research questions stated in chapter 1. Contact details of organisations listed as top 50 clients, contractors and designers in the Construction News and Building Magazine were obtained from the internet. Organisations that were willing and able to partake in the research provided the researcher with the contact details of respondents that had the requisite experience with the D&B procurement method.

Top 50 clients, top 50 contractors and top 50 design consultants league tables (based on comprehensive UK construction activity data) produced by the Building magazine and the Construction News (2012) were used to identify the samples. Initially contact was made by e-mails to all organisations listed in

the league tables (i.e. 50 contractors, 50 client and 50 designers). Follow up contact by introductory letters (See Appendices B - D) were then made to those respondents who were willing and able to participate in the research. In total 33 face to face interviews have been undertaken comprising 8 design consultants, 11 D&B contractors and 14 client organisations. Although the numbers of interviewees who took part in the interviews were not the same for the 3 category of respondents this type of research is not about quantitative representation but is about emphasis on depth, nuance, complexity and roundedness in research data rather than broad surveys of surface patterns which quantitative instruments might provide. Instead of superficial analysis of surface comparability between accounts of large numbers of people this research is more inclined to the understanding of depth and complexity in key participants' contextual accounts and experiences.

Figure 4.5 shows further details of key participants interviewed for this research. As stated in earlier sections the assumption that sampling is inherently about empirical representations of a wider universe is not the predominant logic in qualitative sampling. Sampling strategically, as stated above, is all about focusing on a strategic relationship between sample and wider universe. The aim is to produce a relevant range of contexts or phenomena which will enable the researcher to make strategic and possibly cross-contextual comparisons and hence build a well-founded argument. The sample is designed to encapsulate a relevant range in relation to the wider population.

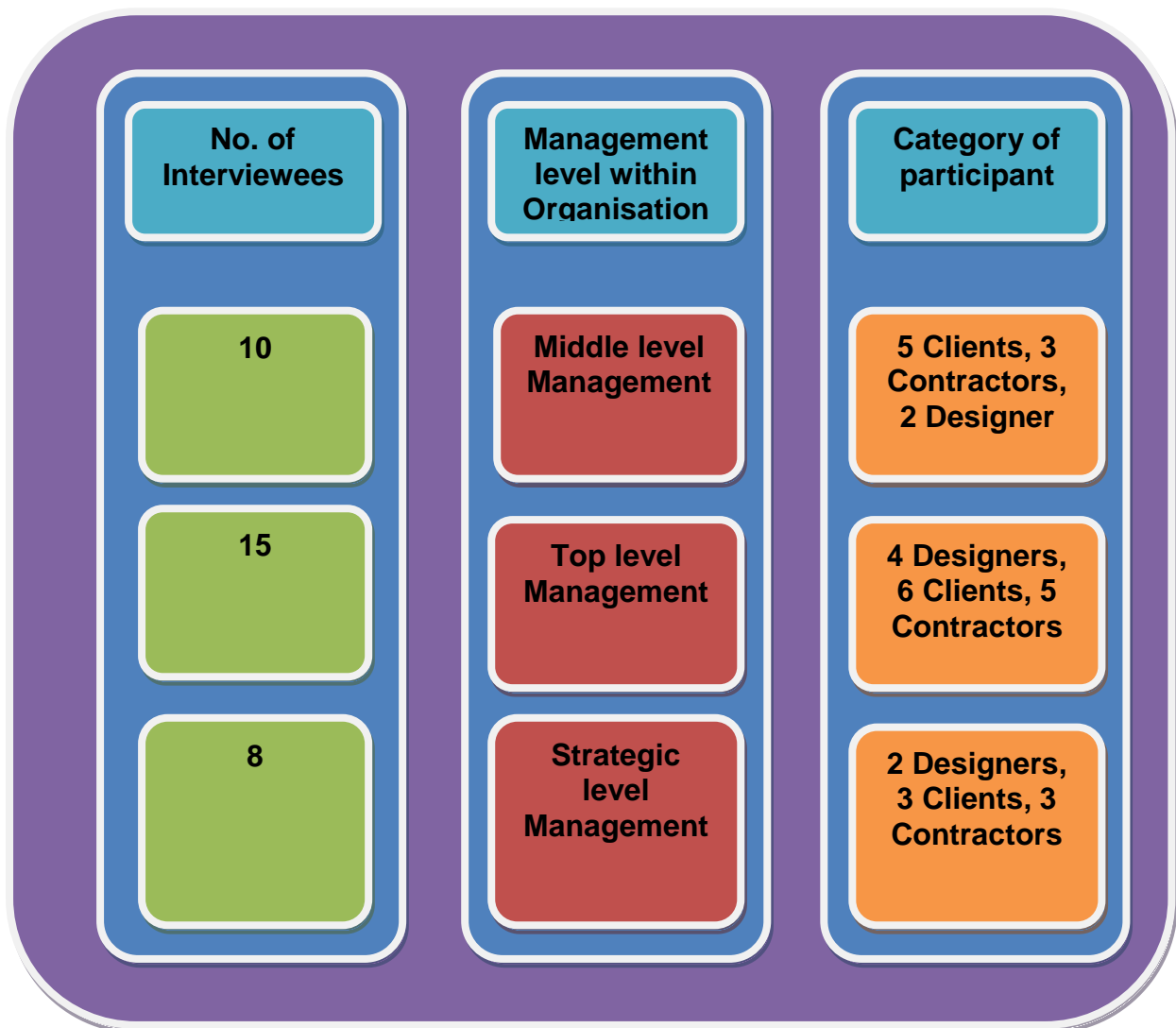
Such a purposeful sample as described above is said to be the most commonly used form of non-probabilistic sampling and their size typically relies on the concept of 'saturation' or the point at which no new information or themes are observed in the data (Guest et al, 2006). Although the basic elements of the themes of this research were observed in the early stages of the conducted interviews, data saturation was achieved after conducting analysis all the 33 interview transcripts. In this process as more and more interview transcripts were analysed using the NVivo qualitative data analysis tool it became apparent after 33 interviews that no additional data were being

found. QSR NVivo data analysis tool was used because of it possesses data mining tools that the researcher would need in analysing qualitative data. NVivo's data mining tools that it possesses would be able to assist the researcher in extracting meaning from the raw qualitative data. Qualitative data mining tools such as data matrix coding queries, analysing and query tools as well as model making functions that NVivo possesses lends itself to be one of the most appropriate tools to use in this kind of research. Similar instances/themes came out over and over again resulting in the researcher becoming empirically confident that the point of data saturation had been reached – i.e. the point when new information produced little or no change to the research questions being investigated.

A similar set of questions was asked to all participants and the assumption was made that the number of participants independently expressing the same idea is a better indicator of thematic importance than the absolute number of times a theme is expressed or coded. In this process, content analysis was adopted to facilitate making inferences about characteristics and meaning of recorded and written data from the interview transcripts. It enabled the researcher to logically analyse large amounts of textual data and to systematically identify its properties such as key words, underlying concepts and to arrive at conclusions.

In this process a combination of deductive and inductive coding was used. Some codes were pre-established from the reviewed literature but emerging codes from the text were also added during the coding of the data set. This process was made easier with the use of NVivo data analysis software. In the end following review of the concepts/themes a thematic coding hierarchical structure was developed. The process was repeated until no new concepts were identified. The use of NVivo data analysis software facilitated a comprehensive and rigorous analysis of the research data.





**Figure 4.6: Interviewee categorisation**

The overriding aim of this phase of the research is about depth, nuance, complexity and understanding of the challenges being investigated. With this in mind the selected sample is expected to give access to data that will allow the researcher to develop an empirically and theoretically grounded argument about the research problem.

In order to anonymise the interviewees the research adopts the use of representative descriptors to represent each of the interviewees who participated in the research. Respondents from client organisations are referred to as MC's for middle level management roles, TC's for top level management and SC's for strategic level management roles. Respondents from contractor organisations are referred to as MCN's for middle level

management roles, TCN's for top level management and SCN's for strategic level management roles. Similarly respondents from designers are referred to as MD's for middle level management roles, TD's for top level management roles and SD's for strategic level management level roles.

The 10 middle level managers interviewed had 145 years combined working experience within the construction sector, 273 years of combined experience for the 15 top level managers and 239 years of combined experience for the 8 strategic level managers. All in all the interviewees had managed a combined turnover of over £12.75 billion construction projects over their combined working experience of which D&B projects formed over 50% of the estimated total turnover of the projects they managed. Between them they have managed over 990 construction projects over their total working experience. The interview phase only came to an end when a point of saturation was reached as demonstrated by analysis of interview transcripts by the use NVivo management software. This respondent data is tabulated in Tables 4.9 and 4.10

**Table 4.9: Respondent coding structure**

<b>Respondents</b>	<b>Management level</b>	<b>Identification code</b>
<b>Client</b>	Middle Level	MC1; MC2; MC3; MC4; MC5
	Top Level	TC1; TC2; TC3; TC4; TC5; TC6
	Strategic level	SC1; SC2; SC3
<b>Contractors</b>	Middle level	MCN1; MCN2; MCN3
	Top Level	TCN1; TCN2; TCN3; TCN4; TCN5
	Strategic level	SCN1; SCN2; SCN3
<b>Designers</b>	Middle level	MD1; MD2
	Top Level	TD1; TD2; TD3; TD4
	Strategic level	SD1; SD2

**Table 4.10: Respondent experience and project details**

<b>Management level</b>	<b>Code</b>	<b>Years of experience</b>	<b>Approximate Value of projects worked on in £ millions</b>	<b>Approximate Nr of projects worked on</b>
<b>Middle Level</b>	MC1	15	175	28
	MC2	12	125	26
	MC3	14	170	18
	MC4	17	230	20
	MC5	13	255	36
	MCN1	10	100	25
	MCN2	20	175	46
	MCN3	12	250	20
	MD1	18	135	25
	MD2	14	155	30
<b>Total</b>		<b>145</b>	<b>£1,770</b>	<b>274</b>
<b>Top Level</b>	TC1	23	275	35
	TC2	15	330	40
	TC3	20	360	25
	TC4	18	345	35
	TC5	16	298	25
	TC6	20	365	45
	TCN1	15	345	36
	TCN2	17	320	32
	TCN3	21	340	25
	TCN4	24	380	38
	TCN5	12	395	25
	TD1	16	300	36
	TD2	19	355	42
	TD3	20	425	25
	TD4	17	340	28
<b>Total</b>		<b>273</b>	<b>£5,173</b>	<b>492</b>
<b>Strategic Level</b>	SC1	26	532	25
	SC2	24	520	30
	SC3	33	695	36
	SCN1	30	620	40
	SCN2	36	945	20
	SCN3	28	1,240	32
	SD1	37	660	20
	SD2	25	600	24
<b>Total</b>		<b>239</b>	<b>£5,812</b>	<b>227</b>

From the above it can be seen that not only does the number of years' experience of the respondents interviewed significant, the cumulative value and number of projects they have undertaken is also varied and significant. What is evident from this analysis is that the respondents have a wealth of experience not only within the construction sector but with the D&B procurement method. Based on these significant attributes of construction projects managed by the respondents it can therefore be inferred that the respondents' views are noteworthy as they are not only from key managers within the UK construction sector but also from very experienced people. This has added significant insights to this research.

#### **4.7 SURVEY METHODOLOGY**

A web based questionnaire was used to gather data from top 100 UK construction companies engaged in construction activities, top 100 construction clients and top 20 consulting Engineers and top 20 Architects (collectively referred to as designers in this research) using activity levels reported for the year 2012. A web based questionnaire was used due to its advantages relating to low cost of data collection, low cost and ease of processing and its ability to reach respondents over a relatively large geographical area.

Published league tables for high volume performing organisations lists such organisations in terms of top 100 construction clients, top 20 consulting Engineers and top 20 Architects hence how such league tables were used as the initial reference point for contact respondents in this research. Initial contacts were done to the individual organisations followed up by contacts to individuals within the organisations. Repetition was avoided as the researcher had contact details of respondents who partook in the interview phase of the research. The link to the survey was not sent to these participants. The researcher also e-mailed separately these respondents not to respond to the survey questionnaire should they be sent the link to the survey by error. The survey was conducted in 2013.

In addition professional bodies of designers such as the Institute of Civil Engineers (ICE) and the Royal Institute of British Architects (RIBA) were also contacted and a further 50 respondents were contacted. A further 20 clients were also contacted through the British Property Federation and a further 45 contractors were contacted through the Civil Engineering Contractors Association.

Distribution involved these 355 UK construction organisations. The selection of the initial 240 organisations was not random but based on a list of top UK construction companies published in Construction News (Construction News, 2013). Gross total annual turnover for the targeted top 100 contractors in 2012 was reported in the league tables as £25.301 billion, that of top 100 clients as £13.949 billion and that of designers as £3.7 billion (Construction News, 2013). Their combined annual turnover for 2012 is £42.95 billion which represent approximately 43% of the estimated total UK construction output.

This is significant as the aggregate total outturn in 2012 for the targeted top 100 contractors listed in the league table represents an estimated 25% of the total estimated UK annual construction output which is estimated to be £100 billion as stated in chapter 1. Similarly the aggregate total outturn in 2012 for the targeted top 100 construction clients listed in the league tables represents an estimated 14% of the estimated total UK annual construction output.

The questionnaires were accompanied with a letter (See Appendices B - D) attached to an e-mail containing a link to the web based questionnaire. The accompanying letter also indicated the objectives of the study and was addressed to the managing partners, managing directors and or Project Managers of the listed companies.

Within a period of 7 weeks of contact 68 questionnaires were completed. Reminder e-mails with another copy of an accompanying letter were sent to respondents who had not replied. In addition postal questionnaires (with self-addressed return envelopes) were sent to respondents in an effort to increase the response rate. This was followed by follow up telephone calls. A further 22 questionnaires were completed within 3 weeks of the reminder e-mails and

follow up postal despatch of questionnaires. In total 14 negative replies were received:

- Company too busy to complete the questionnaire – 4 nr
- Company does not partake in questionnaire surveys as a policy – 6nr
- Recipient not in the office – will reply upon return but further follow on e-mail requests were not responded – 4nr
- The rest of the respondents did not respond.

Overall 90 responses (60 from contractors, 12 from clients and 18 from designers) received representing approximately 25% response rate for the targeted population. Respondents involved in the qualitative interviews were not involved in the quantitative survey part of this research. Although the surveyed sample was not the same for each of the respondent category the manner in which the data was analysed and used in the formulation of the framework prevented bias towards any one of the respondent category. The median of the rankings for each respondent category was used in the assessment of the severity of the challenges noted. The framework was developed on the basis of all key challenges and enablers raised in both the reviewed literature and the interview phases of the research. The outputs from the survey phase were used to highlight the severity of the challenges faced by each of the respondent categories.

It will be recalled in chapter 1 that one of the research objectives is to explore the severity of the challenges encountered by key participants of the D&B procurement method. As part of the first phase of the research (the qualitative phase) key challenges encountered by key participants were identified and explored in order to understand the underlying factors. The second phase of the research (involving the questionnaire survey) was aimed at exploring the severity of the identified challenges in phase one of the research. In order to accomplish this ranking scale questions were used as the principal tool to ask respondents to evaluate by ranking the challenges identified in phase one of the research.

In order to facilitate the uncovering of key participants' views on the severity of the key challenges noted the likert scale or ranking was used in the questionnaire survey. Survey questions were framed around the key challenges that were generated in the qualitative phase of the research.

#### **4.8 CHAPTER SUMMARY**

The chapter discussed the many approaches that are available for researchers to adopt in undertaking research. The chapter shows that the research methodology should be based on the research problem and the researcher's philosophical view point. The existing approaches were discussed and justification for adopting the mixed methods approach has been highlighted with the research problem, aim and objectives shown to be the underpinning factors behind this choice for the research.

Although several research methodologies were identified and discussed several were discounted and justification for the adopted approach was provided. Distinctions between research methodology and research methods were provided.

The chapter also discussed in more detail how the research problem demands the use of a mixed methods approach in order to comprehensively accomplish the research aim and objectives stated in chapter 1 of this research. The adopted mixed design approach has been shown to bring with it several advantages such as; separate phases make the design straightforward to describe and implement and the fact that the design is useful, as in this case, when the need for a second quantitative phase emerges based on what is learned from the initial qualitative phase. Although there are some challenges with the mixed methods approach such as the time it takes to implement and the need to utilise a purposeful small sample in the first phase and a larger sample of different participants in the second phase in order to avoid questions of bias in the quantitative phase, these challenges can be managed as part of the research process.

The next chapter presents findings from the semi-structured interviews undertaken as part of the qualitative phase of the research.



## **CHAPTER 5**

### **ANALYSIS OF FINDINGS: QUALITATIVE DATA ANALYSIS**

#### **5.1 INTRODUCTION**

This chapter is one of two chapters focusing on data analysis. Chapter 5 specifically focuses on interviews and qualitative data analysis from the interviews. As stated in chapter 4 this chapter describes the method of data collection used, the data collected and the analysis of the research results. Given the exploratory nature of this research as stated in previous chapters, in-depth interviews were undertaken with the key parties identified in this research (D&B contractors, design consultants and construction clients). The aim of in-depth interviews with key participants is to explore and understand the 'depth and breadth' of the underlying challenges they have experienced with the D&B procurement method.

In order to explore and understand the 'depth and breadth' of these underlying challenges semi structured interviews were undertaken with designers, contractors and clients. The interview process has been divided into two stages which include initial pilot interviews and the main interview stage involving the identified key D&B participants. In addition to presenting the findings from the interview process the chapter concludes by highlighting how the research objectives have been fulfilled and how this led to the next stage of the research.

#### **5.2 QUALITATIVE ANALYSIS OF FINDINGS FROM THE PILOT INTERVIEWS**

The pilot interview design aim and methodology has been presented in chapter 4. Due to the small nature of the sample (3 respondents) the findings from the pilot interviews were analysed manually. In the analysis that follows words in italics and in quotation marks are direct quotes from the pilot interviewees. The results of the findings are as follows:

**a) What are the challenges with D&B as a procurement method for delivering construction projects?**

All three respondents confirmed that they have encountered numerous challenges with the D&B procurement method. It also emerged from the pilot interviews that some of the challenges that the interviewees encountered with D&B procurement were only unique to this procurement method. When probed further about a possible explanation of this uniqueness in challenges encountered with D&B procurement it would appear that there are several reasons why this is the case. One of the reasons noted by the client interviewee emanates from so much expectation placed on the procurement method itself to *'cure the inherent problems long associated with traditional procurement of construction projects'*.

Asked to elaborate this further the client interviewee stated that there is a perception certainly by some clients that once the D&B contract is executed then there should be *'minimal involvement from the client'*. The D&B contractor should be able to do the rest. The client interviewee also noted that some of the reasons behind this is the way D&B as a procurement method has been perceived in the market place as *'the solution to most construction problems'* previously encountered due to the traditional form of procurement which separated design from construction.

The contractor interviewee highlighted other challenges that the client interviewee had not raised which were almost all related to the commercial risk balance shift from the client to the D&B contractor *'which has caused some challenges with contractor organisations'*. Probed further the contractor respondent stated that some contractors had been used to construction risks associated with the traditional procurement method and could not fully appreciate the risks brought about by D&B procurement which resulted in significant financial risks being borne by the contractor rather than the client. Similarly the designer interviewee also raised the challenge of *'strained relationships'* that appear to develop between designers and contractors in a D&B contracting environment. This, he stated, was probably due to lack of

appreciation of the design risks that the procurement method was bringing to the D&B contractor.

What all this shows is that each of the key parties to the D&B procurement appear to be experiencing different sets of challenges all emanating from D&B procurement method as managed in practice.

**b) In which way(s) are the challenges encountered by the key participants of D&B procurement the same and/or different?**

It emerged from the pilot interviews that while the challenges experienced by the 3 different D&B procurement method key participants appear to be varied they are in many ways not dissimilar in several respects.

Some of the challenges raised appear to be originating from each participant's perceptions about what D&B procurement is all about. The Client interviewee perceived it to be a *'one stop shop'* where the expectation is that once the client has appointed a D&B contractor the contractor has to get on with it and deliver the facility on time, on budget and as per the expected quality requirements. On the other hand the contractor interviewee perceived the D&B procurement as *'just a shift in design responsibility from the client to the contractor'* – everything else associated with client involvement in project development is perceived to be the same. In other words the expectation from the D&B contractor is for the client to be involved throughout the process in *'steering'* the project from inception through to commissioning and handover. This would suggest an active role by the client in the whole delivery process associated with D&B procurement.

Similarly the designer interviewee perceived the challenges with D&B procurement method from his viewpoint as fundamentally emanating from contractors wanting to *'save on construction costs and time at the expense of design'*. This then, according to the designer interviewee, *'is the source of most of the design related challenges associated with D&B procurement'*. The designer sees himself *'sandwiched'* in between producing a design solution

that satisfies the design parameters agreed and set at contract stage and the commercial pressures from the D&B contractor to provide the least cost solution which may conflict with what the designer perceives to be the design intent for the project.

It appears from this that it's the different parties expectations from the procurement method that appear different but fundamentally what appear to be common from both parties is that integration of D&B in practice is very much different to what it is portrayed in theory.

**c) What prevents design and construction to be truly integrated in practice?**

It would appear from the pilot interviews that there are notable reasons that prevent design and construction to be truly integrated. One of the reasons cited by the designer interviewed originates from the *'advent and growth in specialisation'*. He opined that contractors are and remain *'specialists in building and/or constructing the built environment whilst designers specialise in designing the built environment'*.

Over the years this manifested in the *'proliferation of specialist design houses'* that specialised in providing professional design services to the construction industry', he further on stated. On the other hand contractors emerged who *'specialises in undertaking physical construction of the designed facilities'*. *'Here lies the problem'*, opined the design interviewee; who further stated that this specialisation of the two important aspects of construction is *'partly to blame for the non-integration of design and construction'*.

The construction industry itself is *'partly responsible for the non-integration of design and construction'* opined the client interviewee. He went on to state that *'due to the fragmentation of the construction industry'* this has promoted, rather than prevented, the integration of design and construction'. This is in stark comparison to, say, the manufacturing industry, in which the

*'manufacturer of the product is perceived to do everything from design to production within the same organisation'.*

The contractor interviewee pointed out that *'the only way for true integration to happen is for the industry to promote establishment of joint venture type arrangements between the contractor and the designers'*. He did observe that although there are a few mergers that have been witnessed in the UK in the recent few years *'the pace is slow and time will tell on their effectiveness'*.

**d) How have the challenges encountered been overcome in practice?**

The client interviewee stated *'the setting up of a separate project management team within the client's organisation'* as one possible way of getting the client's team actively involved throughout the project delivery cycle. He opined that this *'dedicated client project management team should be appropriately empowered'* with requisite authority to make decisions as and when required in order *'to make things happen'*

The contractor interviewee suggested more *'openness in the whole procurement process'* with parties understanding and sharing the risks and opportunities on the D&B project particularly in terms of design development. This, he stated, is *'another way that creates a spirit of trust and openness between the designer, the client and the contractor'*.

The designer also appeared to echo the same view with the contractor that *'openness and jointly sharing and managing project risks'* goes a long way in preventing development of conflict and strained relationships between the parties. What this pilot interview stage of the research has shown is that whilst D&B procurement goes a long way in addressing problems emanating from the separation of design from construction there appears to be a host of other underlying challenges that the key parties to the process (clients, designers and contractors) are still facing in practice.

From the pilot interviews it became clear that the underlying challenges experienced by key participants of the D&B procurement method related not only to organisational aspects of the process but are also related to the nature of the construction industry itself. The pilot interviews also verified that most of the questions were worded correctly and most importantly that the main interview would not take up too much time.

In addition the pilot interviews also demonstrated that key participants to the D&B procurement method are not only aware of the underlying challenges but have got suggestions and ideas that they believe, from their experience, could help to address the underlying challenges. The pilot interviews were useful vehicles to shape the main interviews and assisted the researcher to modify the main outline agenda for the interview questions. In particular it became clear from the pilot interview responses that the challenges raised by the 3 main participants were interrelated in a way. This prompted the researcher to refine key questions used to explore further the interconnectedness in the challenges raised. Questions on the questionnaire were framed in accordance with the nature of the challenge that each respondent category encountered. Findings from both the reviewed literature and the interviews were used to generate the questions for each respondent category.

### 5.3 ANALYTICAL TOOL USED IN THE PROCESS OF DATA ANALYSIS

In order to ensure validity and reliability in the interview process hard copies of the transcribed interviews were sent to respondents for checking and verification as denoted by Figure 4.4 QSR NVivo version 9 data management software (NVivo) was used to analyse the gathered data. The analysis was a four stage process involving the following:

- Entering interview data sources into NVivo
- Organising and coding the interview data
- Analysing and querying the interview data
- Drawing answers from the interview data

Stage 1 involved entering project details and data into NVivo which entailed entering of participant demographics and interview transcripts into the 'source' section of NVivo as depicted in Figure 5.1.

Stage 2 involved abstracting obvious topics from the interview transcripts. This process involved organising and coding data as well as grouping of related concepts into nodes (by allocating coding stripes and highlighting phrases and sentences which denoted obvious topics that had originated from the formulation of nodes).

Stage 3 of the process involved the initial merging of nodes and the running of queries in order to allow further exploration of more complex aspects of the nodes in line with suggestions from Bryman (2008). This process facilitated the collation of data from the three key participants of D&B procurement. The final nodal structure is shown in Figure 5.2 NVivo screen shot entitled 'thematic coding framework'. The merging of nodes streamlined the study into two main themes: theme 1 - 'negative experiences/challenges as perceived by key participants', and theme 2 - 'how did the participants deal with the negative experiences/challenges?'. The streamlining and arrangement of nodes into a hierarchical order was undertaken to allow the researcher greater analytical coding using queries in NVivo.

Additionally screenshots of NVivo are used wherever necessary through this research to assist the reader in understanding the rigor that went into the qualitative analysis process.

Each of the 33 interviews were recorded, transcribed and then imported into NVivo in word file format. The analysis commenced with creating initial nodes. The initial nodes were then merged into hierarchies. Basically themes of similar contexts were assigned to the same tree node and the result of this process resulted in thematic coding shown in Figures 5.2.

The arrangement of the data in thematic codes as depicted in Figure 5.2 was very useful in organising the gathered data from the main interviews as it made it easier for the researcher to establish the interconnectedness of the data. The thematic coding framework adopted enabled the researcher to extract the richness and contextual meaning of the data.

Models and relationships were also used as powerful visuals to aid in the analysis of the data. The use of queries, running query reports, matrix coding queries and cross case queries were all used in this comprehensive analysis of the interview transcripts.



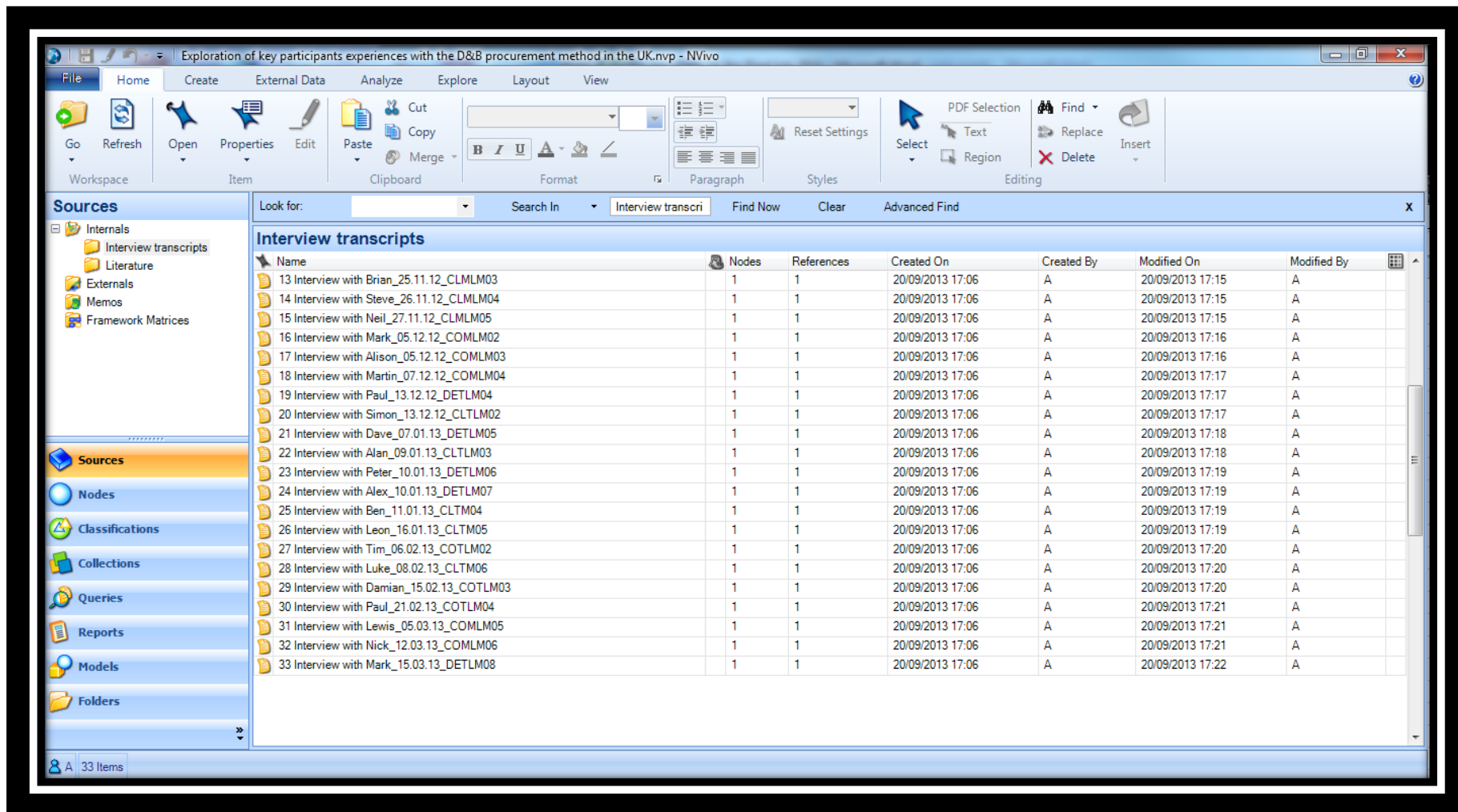


Figure 5.1: First stage of interview data analysis – Entering data sources in NVivo

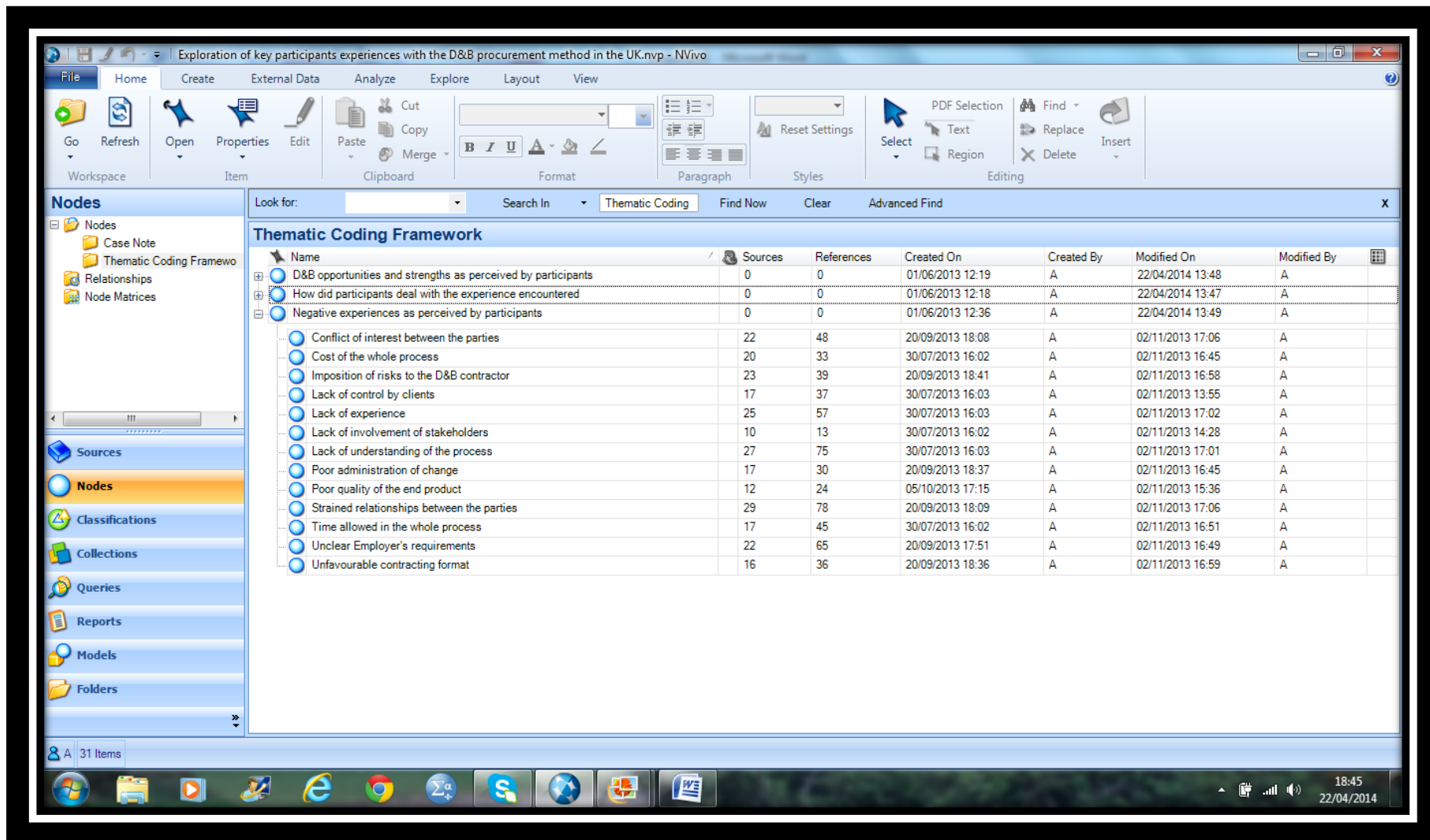


Figure 5.2: Second stage of interview data analysis – Organising and coding data in NVivo

## 5.4 INTERVIEW FINDINGS AND ANALYSIS – THE CHALLENGES

This sub-section of this chapter provides an exploration of the contents of the findings from the main interviews and analyses them qualitatively. Due to the rich laden nature of the qualitative research specific cases and occurrences were considered and identified to avoid reliance on latent content which is a matter for inference or interpretation as noted by Wood (2005). As identified in section 5.1 above the analyses that are performed in this section are focused primarily on gaining insights into the following:

- the challenges that the 3 respondent categories are experiencing in delivering projects through D&B procurement method
- whether the processes of design and construction are really integrated in practice and whether there are any commonality or interconnection in challenges encountered by the 3 category respondents
- How the challenges faced by the 3 category respondents have been dealt with in practice

In order to clearly articulate the challenges coming out of the interviews, views of the key participants will be presented and patterns in findings sought followed by a summary of the main challenges all linked up and tabulated ready for further interpretation in the follow on sections of this chapter. In order to critically extract meaning from the raw interview data matrix coding queries in NVivo were used as a way of exploring patterns in the data as well as gaining access to the content that shows the patterns.

All parts of the interview data were coded and labelled. Codes with the same label were grouped together into themes. The themes identified then served as a basis for further data analysis and interpretation. The approach used centres around the use of summaries of the themes supplemented by matrices and charts. Figure 5.3 is such a matrix used to explore the challenges raised (shown in rows 1 – 13) and the D&B key participant that raised the challenge(s) as shown in columns A, B and C. The resulting matrix

is used to get to the interview data, try to understand the context of the data and interpret the pattern.

By 'right clicking' on each of the cells of the matrix within NVivo the researcher was able to get to the raw data for instance cell A5 indicate that there are 20 references from designer interviewees that contain information relating to 'lack of experience' as a challenge with D&B procurement. By 'right clicking' on the cell A5 all the information raised by designers relating to lack of experience as a challenge were opened up for analysis and interpretation. Similarly by 'right clicking' on cell C7 all the information raised by clients in connection with lack of understanding of the D&B procurement process were accessed for further exploration and interpretation.

The following section provides a detailed exploration of the patterns in the data that came out of the data matrix code shown in Figure 5.3. The analysis that follow in sections below have been derived from the interview data mined using the 'analysing and query tools' in NVivo

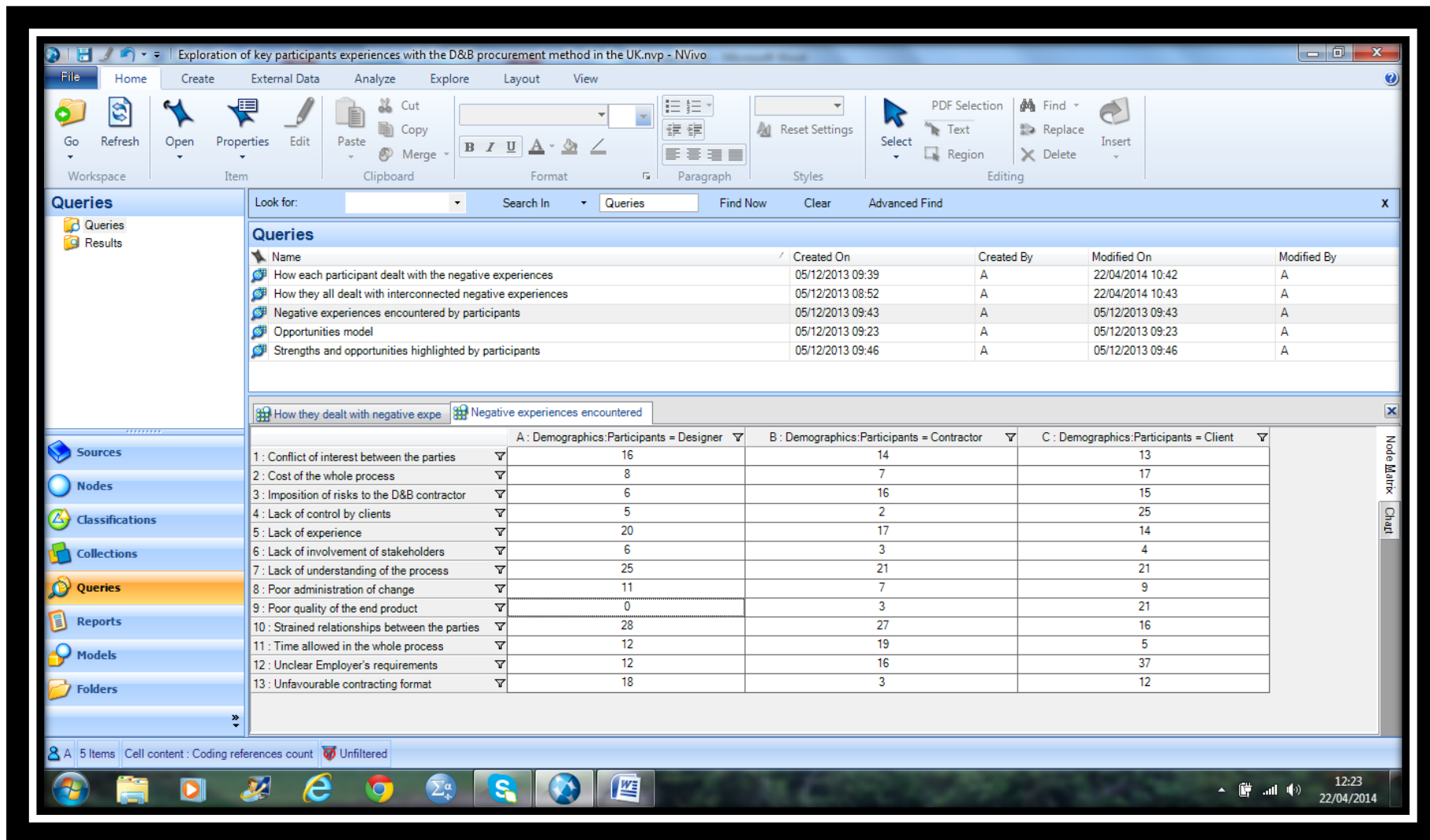


Figure 5.3: Third stage of interview data analysis - Analysing and querying data in NVivo

The key challenges raised by all three participants during the interviews are listed as follows:

- Unfavourable contractual arrangements
  - subcontracting arrangements between designers and D&B contractors
  - contracting arrangements
- Conflict of interest between the parties
- Strained relationships between the parties
- Cost of the whole process – tendering costs
- Imposition of risks to the D&B contractor and designer
- Lack of control by clients
- Lack of experience & understanding of the D&B processes:
  - harnessing buildability
  - management of design and difficulties differentiating scope change from design development
  - design iterative process
- Lack of involvement of key stakeholders
- Poor administration of change
- Poor quality of the end product
- Time allowed in the whole process including approvals
- Unclear employers' requirements

It will be noted from the above list that some of the challenges listed relate to each other and can conveniently be combined, for instance unfavourable subcontracting and contracting arrangements can be combined into contractual related challenges, lack of experience of the design iterative process and management of design as well as harnessing buildability can all be combined into one challenge related to design management under the D&B procurement method. The researcher has however provided an 'exploded version' on this list in order to help in the presentation of the extent and nature of the challenges that all three participants face when delivering projects through D&B procurement.

As discussed in chapter 4, content analysis was used to breakdown the interview data into meaningful categories that allowed the researcher to analyse it using NVivo. Through the analysing and querying data processes in NVivo the researcher was able to explore not only the frequencies but the inter-connectedness of the challenges raised by all three respondent categories. This is displayed in Figure 5.3. The frequency of the challenges was mainly used in the exploration of the inter-connection of the challenges by the three respondent categories. In addition the researcher referred to 'highest mentioned' and 'least mentioned' in the discussions to emphasise the frequencies of the challenge mentions by all three participant categories. From Figure 5.3 and Figure 5.4 it can be inferred that the greatest frequency of mentions and therefore highest mentioned by all three category participants was on the following challenges:

- strained relationship between the parties
- lack of understanding of the process
- unclear employers' requirements
- lack of experience
- conflict of interest between the parties
- imposition of risks to the D&B contractor
- unfavourable contracting arrangements
- time allowed in the whole process

On the other hand the challenges and/or negative experiences that were least mentioned are as follows:

- lack of involvement of stakeholders
- poor quality of the end product
- poor administration of change
- cost of the whole process
- lack of control by clients

Note that the word 'negative experience' is deemed to purport to a challenging experience that key participants would have encountered.

The relevance of this will be explored further in the synthesis of results chapter. To enhance validity and reliability all research results (challenges and enablers), regardless of frequencies, were all reported.

#### **5.4.1 SUBCONTRACTING ARRANGEMENTS BETWEEN DESIGNERS AND D&B CONTRACTORS**

TD2 is of the view that D&B procurement, by its nature, results in designers being '*employed by the contractor in a sub-contractor type of relationship*' resulting in the '*erosion of their professional status*'. In particular SD2 is of the view that the trust that designers had enjoyed by working directly for the client over the years has been '*eroded*' by them working for the contractor organisation '*which has been a source of mistrust by most clients*'. The challenge for designers, he went on to state is '*to maintain trust with the client and at the same time fulfil their obligations as a design consultant for the contractor under the design sub-contract*'. This finding is further corroborated with literature findings in chapter 3 above particularly when the challenge of single point responsibility was explored.

The views of TD2 above is similar to views of the other 6 designers interviewed in that they all appear to have concerns regarding the working arrangements brought about by D&B procurement method. Perhaps this is emanating from the fact that designers have been so used to working directly for client organisations probably influencing decisions at the front end which appear to be non-existent with D&B procurement method. This appears to have resonance with the findings of Tietz (1999) whose research came out with the finding that the D&B contractor, being the principal agent within D&B procurement, tend to result in the D&B contractor's opinion prevailing when quality of the design and construction savings come into conflict. This also appears to be the very reason why the 'mistrust' that TD2 is highlighting in his perceptions above is what he believed to be the origin of the challenge.

In contrast to TD2 perception about the '*sub-contracting challenges*' TCN1 raised a completely opposite view to that of TD2 by stating that '*there is a*



*problem in dealing with this as consultants still feel that they are working for clients directly and sometimes contact clients directly and by-pass contractors'. This, TCN1 goes on to opine, 'results in design decisions being made that are sometimes not reflective of what was contracted'. TCN1 summarised his perception by stating that 'this is a problem to us contractors as the risks associated with pricing D&B projects are high particularly in complex projects'. 'This direct consultation with the client results in designers undertaking design solutions that may not necessarily reflect the contractor's budget leading to budget pressures and strained relations with the client if the design solution that they had separately discussed & agreed with the designer is not adopted.'*

This is an interesting point in that it highlights conflicting views of the same challenge. Design consultants feel that, by working for the D&B contractor direct as opposed to working for the client, this result in perceived mistrust by clients. On the other hand contractors, as highlighted by TCN1's comments above, which have also been repeated by a further 70% of the contractor interviewees, are of the opinion that designers are actually consulting directly with clients and by so doing compromising the contractor's financial position. This is perhaps no wonder that, in an earlier study covered in the literature review section, Moore and Dainty (2001) had highlighted the need for a focus on integrating the D&B team members into the project team in order to engender a single focus and culture of cooperation.

TD4 also echoed the same view raised by TD2 by stating that '*As a designer i feel that D&B procurement brings with it lots of challenges in terms of impacting my ability to produce a design that adequately address the needs/objectives of the client. In the first place contractors appear to view us as sub-contractors and as such feel as if they can dictate and 'push us around' in the same vein as they do to their traditional work package sub-contractors. We are a professional organisation with obligations to undertake professional work*'.

He further on stated that *'contractors on the other hand view our role differently - they expect us in so many instances to stretch the limits and compromise the design intent in return for saving costs and time. This is the underlying problem that we face'*. This is another new finding that was not picked up from the reviewed literature. It would appear that the whole sub-contracting arrangement is a real challenge with some designers as TD4 went on to state that *'Sub-contracting arrangements should be reviewed and jointly agreed with designers in order for any misunderstanding to be explained to remove this perception that they feel as if classifying them as sub-contractors would dilute their professional status as designers'*. He further stated that *'there are standard forms of engagement that professional institutions have established which then can be amended to suit the specific requirements of the project and the services to be provided'*.

If this is clarified and discussed at the time of engagement then, he went on to state that *'it helps to remove any negative perceptions that some designers may have regarding the subcontracting challenge'*. His next view point is significant and in tandem with the reviewed literature when he stated that *'Contractors should ensure that designers are up to speed with the design intent and the drivers on the project in order to remove any perception about designers being forced to amend designs to favour cost and time savings at the expense of all other challenges'*.

It appears from other design consultants interviewed that this may be a problem as more often than not it would appear that D&B contractors have come up with design Agreements that may not be familiar to design consultants. This unfamiliarity with the Agreement documents appear to result in strained relationship from the start as echoed by TD4 as well as other designers interviewed. This is the most significant challenge highlighted by designers as demonstrated by Figure 5.6 which shows that strained relationship between the parties was the highest noted challenge by the designers interviewed with a total of 28 total references made. This was also echoed by contractors who also had the highest reference (27) attributable to strained relationships. Surprisingly clients had only 16 references against this

node. In addition previous research by Barlow et al (1997) and Cox and Thompson (1997) appear to suggest that some forms of subcontracts generated by D&B contractors by nature rely heavily on seeking strict liability and attaching blame to events that occur thereby encouraging non-collaborative behaviour and driving distance between the parties. This appear to be further corroborated by Aulakh and Gencturk (2000) who further expanded on this finding by stating that the effect of such subcontracting, often characterised by D&B procurement methods, on team synergy may lead to inflexibility, conflict and strained relationships.

#### **5.4.2 CONFLICT OF INTEREST AND STRAINED RELATIONSHIPS BETWEEN THE PARTIES – DIFFERENT PRIORITIES**

The views of TD2 and TCN1 above provide further evidence to the findings that Moore and Dainty (1999; 2000) came up with when they stated as part of their findings that an integrated project culture had failed to develop within D&B procurement delivery methods and the fact that roles and responsibilities had continued as if under a traditional design led procurement method.

In a similar vein to TCN1's views TCN2 raised another conflict of interest challenge by stating that *'the other challenge is that contractors often engage outside design consultants to undertake the design on their behalf. Designers in most cases are more interested in their design and professional liability and would not be keen to align their interest to the contractor's budget. In other words they don't actively pursue and challenge themselves to come up with a robust economical design unless there are some incentives built in their professional services contract'*.

He went on to state that *'this creates a problem and potential conflict of interest as the contractor is more interested in a design that generates savings in time and costs as long as the client requirements are met while the designer is more interested in producing a design that not only meets the client's requirements but also satisfies their status as professional designers and protects them from future liabilities'*. It appears that this perception of conflict of interest is relevant as it has been raised by all key participants as

shown in the Figure 5.6. This is perhaps Views of TCN1 and TCN2, which have also been echoed by a further 7 contractors interviewed appear to explain perhaps one of the underlying problem at the root of this challenge. Their views perhaps has filled in the gap in terms of understanding why such conflict of interest in D&B procurement method organisations particularly between the designer and the contractor which builds up from the gaps left by previous reviewed research efforts.

TCN2 views echoes findings from the reviewed literature particularly findings by Moore and Dainty (2001) where they observed that the D&B team (presumably designer and contractor) is composed of a series of strategic alliance and barriers bounded by professional and cultural prejudices of their members which resulted in a workgroup of disparate individuals rather than an integrated team. This appears to echo what TCN2 raised in his view of the existence of a conflict of interest between the designer and the contractor in a D&B procurement environment. However Moore and Dainty (2001) went further than TCN2 and stated the root cause of the challenge by opining that the design team have a clear emphasis on design quality, the commercial team within the contracting organisation had their focus on financial aspects while the construction team of the contracting organisation had their primary focus on delivering the project to programme.

The views of SCN3 are typical of other contractor organisation views interviewed when he stated that *'managing the design process is not an easy task given that designers' main priority is to produce a design that serves the functional requirements as well as the aesthetics requirements of the client which may not necessarily be the same as the contractor's priorities'*. He went on to opine that *'contractors would want a design solution that satisfies the minimum requirements in order to save on costs as the contract is a lump sum contract'*. In addition, he went on to state that *'contractors would want designs that are easily buildable saving on both time and costs and this may not necessarily be in line with the designer's intent'*.

SCN3 brings in an additional dimension to the challenges encountered between designers and contractors in D&B procurement. It would appear from his views that designers and contractors may not necessarily share the same priorities which then lead to the conflict of interest challenges that have been highlighted earlier by both designers and contractors. In addition he also introduced a challenge of the difficulty that contractors appear to face in managing the design process. This challenge is corroborated in the reviewed literature particularly research efforts by Zanedin (2001), Hampton (2001), Chan and Chan (2001) and Chan and Chan (2000) when they all stated, as part of their findings, that design management is one of the biggest challenge to D&B contractors as most of them are not trained to design or to manage the design process. However according to SCN3 the challenge appears to be more emanating from the difference in priorities between the D&B contractor and the designer than it is due to inadequacy in managerial capability of the D&B contractor.

Clients on the other hand had a different perception to this challenge as they opined that, through the views of TC1, supported by similar views of 8 other client respondents, *'as designers are working directly for the contractor there is a perception by us clients that contractors are always encouraging and exerting lots of pressure on the designer to come up with designs that provide value for money to the contractor rather than to the client'*. TC1 goes on to state that *'whole life cost solutions are often not taken into account which results in costly maintenance regimes when the assets are handed over for use'*. TC1's views appear to be contradictory to the theoretical view which states one of the advantages brought about by D&B procurement as single point responsibility. However the view appear to be supported in earlier research by Fahmy and Jeageas (2004) who opined that since clients lose the traditional direct control over the design and the fact that the designer is accountable to the D&B contractor design decisions usually are inappropriately influenced by the D&B contractor.

TC1's views when he stated that *'Contractors tend to exclude us in design review meetings and see us as interfering with their work. We feel excluded*

*from key decisions that are made during the design development stages resulting in further frustrations and conflicts when the resultant product falls short of our expectation. In cases where we are involved in design reviews meetings it would appear that any clarifications and/or comment we make is translated and converted into a change/variation and we end up paying for things that we feel should have been already in the D&B tender', appear to suggest that clients want to be involved in design decisions but they feel that contractors appear not to want them to actively engage in such processes.*

*According to MCN2 and 6 other contractor respondents 'clients want to control and influence designs and at the same time want the contractor to take responsibility for that design which may actually lead to challenges later on should those design decisions fail to comply with certain aspects of the project requirements as set out by clients'. 'In the same vein', he went on to opine, 'some designers are still very much of the view that their allegiance is to the client rather than the contractor especially if the designer is involved with the client in other schemes'.*

This perception appear to complicate the whole functionality of the D&B process particularly the D&B contractor who has been tasked to manage and be responsible for both design and construction process within the contractual limits of budget, specification and time. *'D&B procured projects', he went on to state, 'bring with them some challenges that as a D&B contractor's PM you have to be very much be prepared to deal with them and manage them'. One of the challenges that MCN2 raised is that the D&B contractor's PM should have additional skills to manage the interface between the D&B contractor's designer and the client.*

He also stated that *'more often than not clients want to interfere and take over the design management process and would want to have uncontrolled access to the designer so that they can influence the design as it progresses'. He summarised his views on this by further stating 'I find this frustrating especially when such decisions results in us incurring additional costs and time which may not be recoverable through the contract'. MCN2 felt that the fact that he*

has total responsibility for both design and construction of the project and such perceived interference happens makes him feel '*undermined*' in his role.

MCN2 views have been echoed in a slightly different way by MCN3 when he stated that '*The fact that at times designers were used to working with clients directly complicates this challenge further as sometimes clients communicate directly with designers and influences design through the 'back door' without going through the change management process for fear of avoiding to pay for the additional costs associated with the additional scope that their comments may bring*'. This brings in an additional view point which had not been brought out by other interviewees.

MCN3 appear to suggest that perhaps the motive of such '*back door*' communication between designer and client emanates is driven by pressures to avoid the formal change management process. This is an interesting view from MCN3 as it tends to support the viewpoints raised earlier in the reviewed literature particularly in research efforts by Leite et al (2005) where they lamented the fact that the poor briefing process inherently makes the process open to future changes leading to prolongation in costs and time of delivery. Perhaps MCN3 view point is a manifestation of a problem going back to the briefing process.

Key words that were highlighted by MCN2 on this are '*interference*', '*uncontrolled access*' '*frustration*' and '*undermined*' and these key words resonate in most perceptions held by both contractors and designers alike. On the one hand it would appear designers' perceptions on contractors is that they interfere with professional role when it comes to design and feel that their role is undermined as cost and quality tended to take priority over design and whenever there is a choice to be made contractors appeared to prioritise cost and time over design (TD2, TD4 and 6 others). On the other hand contractors appear to have perceptions on designers having consultations with clients direct often leading to cost and time being compromised at the expense of design (MCN2, TCN1, TCN2 and 6 others). All these opposing views appear to converge and impact on both designers and contractors and the result is

what MCN2 has summarised above i.e. getting '*frustrated*' and '*undermined*' in different ways.

Contrary to all this clients appear to be on the opposite end of this view point where they feel that they are not involved enough during the design development process and are of the view that contractors perhaps exclude them in key decisions (TC1 and 8 other clients). In support of this view point TC1 further opined that '*as designers are working directly for the contractor there is a perception by us clients that contractors always encourage and exert pressure on the designer to come up with designs that provide value for money to the contractor rather than to the client*'.

These different perceptions appear to suggest the existence of conflict of interest between the key participants involved in the whole D&B procurement method/process. Although these are perceptions and opinions of the key participants it is noteworthy and appears to suggest that there is more to be done in order for design and build procurement to work in practice.

MC3's views are in tandem with TC1's views above when he stated that '*Sometimes D&B contractors create a barrier between clients and designers to such an extent that we find it difficult to get involved and partake in meetings with the contractor's designer*'. MC3 went on to state that '*Some contractors don't feel the need to involve us in design review meetings and this often leads to situations in which when it comes to design approvals there is a lot of wasted effort as we identify anomalies that would need changing before approving the designs*'.

MC3 makes a valid point that makes practical sense. If the project team are really integrated and working together as a team then it appears sensible to involve clients as well in the design review process. This view appears to be corroborated by findings from research undertaken by Cecil (1983) who also suggested that clients had a feeling of 'loss of control' of the design when they are involved at the end of the process in most cases when they are requested



to approve designs. It would appear that this feeling of 'loss of control' is emanating largely from the conflicting interests between the parties

In addition to such perception of 'loss of control' leading to strained relationships MC3's view appears to suggest that clients are also bemoaning the wasted effort emanating from their view that they are only being involved at the end of the process when they are required to review and approve designs. Contrast this with TCN1's perception of this view point when he stated *'There is a problem in dealing with this as consultants still feel that they are working for clients directly and sometimes contact clients directly and by-pass contractors'*.

This, he went on to state, *'results in design decisions being made that are sometimes not reflective of what was contracted'*. TCN1 further elaborated on this perception by introducing the challenge of financial risks when he further stated that *'this is a problem to us contractors as the risks associated with pricing D&B projects are high particularly in complex projects'*.

This direct consultation with the client results in designers undertaking design solutions that may not necessarily reflect the contractor's budget leading to budget pressures and strained relations with the client if the design solution that they had separately discussed & agreed with the designer is not adopted.

SD2 brought up another challenge which appear to be an extension to the challenge brought up earlier that the contractor *'rarely engages with the designers in order to promote buildability within the design'*. This is an ironic finding as the very basis of D&B procurement is to harness the contractor's expertise in construction and incorporate it in the design in order to make the design buildable and efficient. This is also somewhat contradictory to findings in the reviewed literature particularly David and Doman (2008), Chan et al (2010), CIRC (2001) and Opfer et al (2002) who all had stated that the integration of design and construction processes results in better buildability of the eventual design. According to SD2 designers lament that *'contractors only tend to come with buildability input when the design development process is*

*complete particularly when they suddenly realise that the design solution offered for construction is going to cost them more money than what they had allowed for in their D&B tender’.*

This situation, according to SD1, results in *‘delays to construction and costly changes to the design as the designers would have to re-design elements leading to waste in both time and money’*. When this happens, SD1 went on to state, *‘in most cases contractors are unwilling to pay for the additional cost incurred by the designer arguing that this is all covered in the lump sum design contract and the fact that, they allege, original design scope had not changed’*. This results in designers incurring additional costs having to re-deploy design resources to account for the changes that the D&B contractor would have introduced at the end of the design stage.

All these challenges and misunderstandings, SD1 opines, *‘leads to adversarial relationships between the designer and the contractor’*. This finding is corroborated with findings from the reviewed literature in chapter 3 particularly Chan and Yu (2005) when they commented that the biggest challenge to D&B contractors is their unfamiliarity with the design process. Adversarial relationships emanating from this has also been corroborated by findings in the reviewed literature in which Barlow et al (1997), Cox and Thompson (1997) and Moore and Dainty (1999; 2000) observed a lack of team synergy and process integration within the D&B project delivery process.

#### **5.4.3 CONFLICT OF INTEREST AND STRAINED RELATIONSHIPS BETWEEN THE PARTIES – LIABILITY FOR DESIGN DEVELOPMENT**

Design development is a massive cause of concern to designers according to SD1 and TD3. They are of the opinion that contractors *‘misunderstand and misinterpret what design development means’* and as a result fail to provide for it within their D&B tenders. According to SD1 and TD3 design development is sometimes wrongly seen by contractors as *‘mistakes by designers’* and therefore any additional cost that the contractor perceives to be coming out of

design development is '*contra charged*' to the design consultant. This is a new finding which did not come out of the reviewed literature.

SD2, as well as other 5 designers interviewed, is of the view point that '*designs evolve over time as more information is fed back to designers*' but this conflict with contractors, SD2 went on to state, '*wanting to receive designs as soon as possible in order to meet programme requirements on site*'. This process may actually involve '*much iteration as comments are made and design reviews progress which may not necessarily be reflected in the contractor's programme resulting in delays and conflicts*' SD2 went on to state.

This, they opined, is a major risk to the design consultant and '*often may lead to breakdown of relationships between the contractor and the designer*'. Although literature reviewed, particularly Gale (1992) and Heide and John (1990), noted the existence of a masculine, crisis and conflict ridden culture within the construction sector they were silent on the root causes of this adversarial culture. In this respect this is a new finding that had not been explored in the reviewed literature as SD2 and TD3 managed to provide a possible explanation as to the potential root cause of relationship breakdown between designer and D&B contractor.

SD1 raised another challenge that is in tandem with SD2's observation above in connection with the existence of limited (or none) input on buildability from the contractor as the design is evolved. SD1 observed that '*in most cases contractors' procurement plan is in conflict with the design processes*'. He explained this as possibly emanating from the fact that '*specialist suppliers input into the design is not harnessed during the critical stages of the design as such suppliers when contacted by designers are unwilling to provide detailed input into the design process before they are contractually engaged with the contractor*'. This appears to be a timing challenge which is a practical challenge in terms of integrating and incorporating specialists and other key supply chain during the design development process.

MCN2 brought another challenge linked with SD2's views but from a contractor's perspective when he stated that *'the other challenge that i have experienced with D&B procurement is the interface between specialist design elements and the consultant's design'*. MCN2 went on to state that *'in most cases the contractor's designer will produce a design and develop it to say outline design for the specialist contractor to further develop into detailed working drawings for construction'*. This, MCN2 went on to opine causes challenges down the line as *'the specialist designer will produce a price and programme on the basis of the outline design and may not necessarily appreciate the interface and interrelationship between the specialist package and other packages leading to waste, conflict and disputes'*.

There is also the complication brought by the interpretation of *'change'* as some specialists tend to *'base their price on the outline design and when the design evolves and develops further any changes that appear are taken as changes leading to conflicts and disputes'*. This typifies the views of other 5 contractors who raised this challenge and when probed to explain their views they traced the origins of this problem back to the design interface of the design consultant and that of the specialist.

On the other hand contractors interviewed are unwilling to enter into contract with such suppliers until scope has sufficiently been developed as they wanted to limit their exposure to financial risks. This compromises the designer's ability to incorporate specialist suppliers' requirements into the design causing problems in the later stages of construction. This is a new finding which has not been captured in the reviewed literature although the manifestation of the problem in terms of adversarial relationships and lack of integrated team culture had been raised by researchers like Moore and Dainty (1999; 2000) and Barlow et al (1997).

SD1 and other 4 designers raised another challenge that is perceived to arise in most cases when designers are requested by contractors to produce a design for submission as part of the D&B contractor's tender. He observed that, *'although this is a big risk to the designer given the challenges observed*

*above in connection with lack of clarity of clients' requirements', he opined that, 'ironically design services are rewarded on a reduced rate basis pending the outcome of the D&B tender'. Although the designers acknowledged that they get a win bonus if the D&B contractor is awarded the contract they are still of the opinion that they 'carry significant risks in this process'. They opine that the major residual risk stems from, once again, a misunderstanding from contractors who misinterprets design development as 'mistakes' of the design consultant leading to counter claims, contra charges and at times litigation between the designer and the contractor once again causing strained relationships between the parties.*

SD1 went on to opine that contractors *'misunderstand the standard and level of care and liability that designers assume when they take on design responsibility'*. Level and limit of design liability, according to SD1 and SD2 as well as other 2 designers interviewed, is that of reasonable skill and care of an equivalent reasonably competent designer and is therefore not an absolute liability. Their design therefore *'should be viewed on this basis and even if there are minor errors in it they should be absolved from responsibility provided they had exercised due skill and care'*. He went on to opine that because of this misunderstanding contractors view any minor errors in design as mistakes and proceed to contra charge the designer for *'these so called mistakes'* leading to adversarial relationships and mistrust. He however opined that this practice *'is particularly common where the contractor is losing money on the D&B contract'*.

However late involvement of clients in the design development process brings with it additional challenges as highlighted by TC6 who stated that *'the other problem that i have experienced is that D&B contractors don't see the need to consult and involve us clients in the design development process which frustrates me a lot as i would want to get involved in such discussions in order to protect my interest when the design is evolving. Even when i get involved sometimes my ideas are misinterpreted as change leading the contractor to make claims for additional payment and time for what i think should be design development challenges'*. This is a new finding that was not raised in the

reviewed literature but it all points to potential areas of conflict that the parties to the D&B procurement method potentially find themselves in. TC6 went further to illustrate this challenge by stating that *'once they are in contract D&B contractors are virtually in control and see me as a hindrance to the process. Typically they are reluctant to share information and do not allow us access to their designers'*

Upon further probing on this point TC6 as well as other 8 clients went on to explain how such *'exclusions'* in design development process could result in potential conflict and breakdown of relationships among the project team members when he stated that *'contractors tend to exclude us in design review meetings and see us as interfering with their work. We feel excluded from key decisions that are made during the design development stages resulting in further frustrations and conflicts when the resultant product falls short of our expectation. In cases where we are involved in design reviews meetings it would appear that any clarifications and/or comment we make is translated and converted into a change/variation and we end up paying for things that we feel should have been already in the D&B tender'*

SD1 brought up another separate challenges which he highlighted as a potential challenge causing strained relationships between the parties when he opined that *'D&B Contractors tend not to want to share financial information with the designer at tender stage resulting in designers unaware of allowances made for certain elements that may well be subject to further design creep during the detailed design stages of the project'*. This creates a problem as *'D&B contractors tend to blame designers for cost growth due to design development related challenges'*

This is a new finding that the reviewed literature did not bring up. It would appear that the lack of transparency in financial information making up the D&B tender creates an atmosphere of mistrust between the designer and the contractor. Not surprisingly this leads to strained relationships between the contractor and the designer.

TD3 brought in another challenge that supports previous comments made earlier by other designers TD2 and SD2 when he stated that the other key challenge that he has encountered with D&B procurement can be summarised as *'erosion of professional status due to removal of contractual link between the designer and the client resulting in loss of trust that used to be enjoyed by designers when they were directly engaged by clients'*. This appears to trace the problem back to the organisation of the D&B procurement method in which there is single point responsibility between client and contractor as the designer is absorbed in the D&B contractor's organisation.

This finding has been widely covered in the reviewed literature as most previous researchers such as Lee et al (2009), Fahmy and Jergeas (2004) and Tietz (1999) highlighted the view point from their findings that single point responsibility may not necessarily bring the advantages that have been reported in previous D&B procurement publications. It would appear that TD3 perceived this challenge as perhaps one of the reasons why there was a perception of lack of trust between the designer and the client.

Perhaps TD3's viewpoints have some bearing to what has generally been reported in literature regarding the historical relationship between some clients and contractors in traditional design led procurement methods. Traditionally, in such procurement methods, there has been a conception that clients mistrusts contractors and since designers are part of the contractor's team in D&B procurement designers view themselves as being caught up in this historical mistrust between contractors and clients.

TD3 also opined that *'the perception that by engaging contractors on D&B procurement delivery method the project should benefit from the ease in which the design is buildable is rarely encountered in my experience'*. He expanded on this by suggesting the following principal reason *'treating professional designers in the same way as contractors treat their trade sub-contractors creates a situation where the designers and contractors are not joined up in their working resulting in conflict and adversarial relationships'*.

This has been raised earlier by SD2 and TD2 and appears to resonate through the viewpoints of the other 5 designers as well.

TD2 brought in a new finding that had not been brought up by other interviewees as well as the reviewed literature when he stated that *‘traditionally there was a Resident Engineer on projects attending to design queries as construction progressed but this resource is no longer available’* This, he opined, *‘result in potential delays to responding to design queries leading to breakdown of relationships between the contractor and the designer’*.

MCN3 brought another new finding in connection with the challenge of strained relationships between the parties to the D&B procurement process when he stated that from his experience *‘the challenge of other stakeholders within the client organisation brings with it another source of strained relationships between the parties’*. Probed further to explain he stated that *‘in most client organisations that are experienced property developers there is the project delivery team on the one hand and the facility user team on the other hand who probably may not necessarily share the same objectives’*. He went on to state that the project delivery team are often tasked with *‘ownership of the budget for the delivery of the project and the facility user team are tasked with taking over the facility after completion and using and maintaining it for the economic life of the facility’*. The focus of the user group, he went on to explain *‘naturally is to get a facility that is aesthetically pleasing and easy to maintain’*.

In most cases, he observed, *‘there is a clash of objectives as the project delivery team will naturally want to deliver the project at the set budget and will resist any attempts by the user team to introduce any preferential engineering requirements’*. This creates a problem for the D&B contractor as in most cases *‘the D&B contractor is caught up in this conflict and sometimes end up with a situation where any ambiguous requirements are blamed on the contractor’* leading to more strained relationships.



MCN3 further went on to suggest that client expectation on D&B contractors appear to be higher than they would expect from traditional design led procurement methods when he observed that *‘when clients award a D&B contract to the contractor for a fixed lump sum they expect the D&B contractor to produce a first class facility that probably would have cost them twice as much and possibly twice as long!’* This is an odd viewpoint since when clients are using the traditional design led procurement method to deliver construction projects they specify standard materials and workmanship elements taking into account the available budget that would have been approved for the scheme.

However from MCN3's and other 6 contractors' perceptions this seems to be not the case as contractors feel that on D&B projects clients tend to pass on all project financial risks. MCN3 went on to state that when requested to approve designs clients often come up with *‘design comments that tend to keep a blind eye on the budget but focus on the highest possible quality standard that can be achieved’* causing further strains to parties' relationships.

TCN1 and 4 other contractors highlighted another challenge that tend to arise in practice particularly relating to design management functions within D&B procurement set up. They highlighted the challenge as emanating from the fact that contractors usually employ their design managers responsible for managing the design information flow from designers to the delivery teams. However instead of resolving the problem of information flow this, they stated, *‘creates its own problems as more often than not ‘grey areas’ and or ‘overlaps’ will surface’* between the management and coordination functions of the whole process in a D&B procurement method delivery environment.

Architects working on a building project, they stated, more often than not *‘take on the role of lead designers’* and this involves managing & coordinating the design with other design team members such as civil, structural, mechanical & electrical engineers. The DB contractor on the other hand engages a design manager to *‘manage the design information flow from the design team members to the DB contractor’*. This arrangement, in practice, he observed

*‘tend to cause potential problems between the design coordination function (undertaken by the lead designer) and the design management function undertaken by the DB contractor design manager’*

A further potential area of conflict and relationship strain was highlighted by MCN1 as well as other 5 contractors. Their views were that in most cases client requirements are expressed in terms of the *‘expected performance of the element rather than specific detailing of the element’*. This, they went on to state is *‘seldom understood by clients’* resulting in more conflict and strained relationships with both parties involved in D&B procurement method/process.

TCN4 brought up another viewpoint when he stated that *‘where there is a lack of trust ambiguities in employers’ requirements may cause challenges in the later stages of the D&B process as some clarifications and confirmation of employers’ requirements after contract award’* may lead to adversarial relationships and costly disputes. Such lack of trust has been viewed by TC3 and other 4 clients who, similar to TCN4’s view point, stated that what tends to happen in practice is that *‘employers’ requirements are interpreted loosely and any inconsistency or ambiguity is seen as an opportunity by the contractor to come up with a product and/or solution of the lowest possible quality’*.

It would appear from the views of the D&B procurement method key participants highlighted in the above that there are areas of potential conflict of interest which leads to strained relationships among and between them. This appears to be emanating from the several areas such as the way the procurement method is organised, the way commercial risks are allocated, the management of the design process, the timing of the involvement of the key supply chain, the historical challenges associated with the relationships between clients and designers and the lack of transparency in the financial make up of D&B tenders particularly between the D&B contractor and the designer. Whilst the nature and extent of the challenges varies from one D&B key participant to the other the majority of the key participants interviewed

identified what appears to be similar type root causes to the challenges.

Table 5.1 summarises the findings from the data analysis in section 5.5.1

**Table 5.1(a): key factors underlying the challenge - conflict of interest and strained relationships between the parties**

<b>Respondent</b>	<b>Key factors underlying the challenge noted</b>
<b>TD2/SD2 + 6</b>	Erosion of professional design status
	Conflict between maintaining trust with clients & delivering for the D&B contractor
<b>TCN1/2 + 7</b>	Designers by passing D&B contractors
	Direct consultation between designers and clients
<b>TD3</b>	Lack of contractual link between designers and clients
<b>TD4</b>	Sub-contracting arrangements that are viewed as onerous
	Dilution of professional status
	Cost and time pressure imposed on designers by contractors
<b>SCN3</b>	Differing priorities of D&B contractors and designers
<b>TC1 + 8</b>	Comments/Clarifications made be clients wrongly interpreted as change
	D&B contractors exerting pressure on designers
	Exclusion of clients in design review meetings
	D&B contractors creating barriers between clients & designers
<b>MCN2 + 6</b>	Designers showing allegiance to clients as opposed to D&B contractors
	Clients wanting to control designs
	Clients interfering with the design management process
	Clients communicating directly with designers
<b>SD1/SD2/TD3</b>	Late introduction of buildability advice to the design process
<b>+ 5</b>	Misunderstanding/misinterpretation of design development
	Misalignment/conflict between D&B contractor's procurement plan and the design process
<b>MCN2</b>	Interface between specialist design elements and consultant's design

**Table 5.1(b): Key factors underlying the challenge - conflict of interest and strained relationships between the parties**

<b>Respondent</b>	<b>Key factors underlying the challenge noted</b>
<b>MCN2</b>	misinterpretation of definition of change
<b>SD1</b>	Lack of clarity of Employers requirements
	Lack of recovery of full design costs in the case of unsuccessful tenders
	Misunderstanding associated with standard and level of liability that designers assume
	Lack of information sharing between designers and contractors
<b>TD2</b>	Slow responses to Technical queries raised during construction
	Differing client stakeholder objectives and priorities
	High expectation by clients on D&B contractors
	Client comments on design as it progresses adding costs to the process
<b>TCN1 + 4</b>	Overlaps/grey areas associated with interface between design management and design coordination functions
<b>MCN1 + 5</b>	Misunderstandings originating from performance specifications
<b>TCN4</b>	Ambiguities in Employers' requirements
	Loose interpretation of Employers requirements leading to poor end products

This challenge was the highest mentioned by all three participant categories (See Figures 5.3 and 5.4)

#### **5.4.4 COST OF THE WHOLE PROCESS – TENDERING COSTS**

MD1 raised a challenge that the researcher had not come across in the reviewed literature. He stated that '*tendering costs for D&B procured projects are relatively higher than those in connection with other build only procurement methods*'. This was also corroborated by SCN3 who said '*D&B procurement demands more resources from the contractor's organisation to*

*review the client requirements, interpret them and come up with a solution that satisfies these requirements'. 'All this is required to be done during the tender stage which forces the D&B contractor to employ not only a designer to come up with a compliant design but a bidding team to come up with a methodology for undertaking the works within the constraints of the project'. Most of the information required in order to come up with Contractor's Proposals, SCN3 went on to state 'is at best sketchy and nonexistent in some cases which means the contractor has to have a team of 'experts' that have to come up with a solution that is both competitive and buildable'*

This viewpoint raises key challenges that appear to affect both designers and D&B contractors in terms of costs and risks that they carry when tendering for D&B procured projects. It would appear, from the comments above, that not only does it cost the D&B contractor much more to produce a D&B tender the contractor has to come up with a competitive D&B tender and a design solution that is buildable as well. SCN3's comments about the information provided by clients during the tendering process being 'sketchy' and 'non-existent' appear to suggest that employers' requirements are perceived to be unclear and ambiguous. This has been corroborated in findings from the reviewed literature particularly research efforts by Kumara (1999), Newman et al (1981), Goodacre et al (1982), CIT (1996), Smith and Love (2004), Othman et al (2005) and Yu et al (2007) which all appear to point to the fact that the failing of the D&B procurement method can be traced back to the inadequacy of the employers requirements.

SCN3 expanded on his view point by stating that *'tendering costs for D&B procured projects are relatively higher than those in connection with other build only procurement methods'*. He went on to state that *'by its nature D&B procurement demands more resources from the contractor's organisation to review the client requirements, interpret them and come up with a solution that satisfies these requirements'*. All this, he went on to state, is undertaken during the tender stage which forces the D&B contractor to *'not only come up with a compliant design but with a methodology for undertaking the works within the constraints of the project'*.

However SD1 comments appear to be looking at this challenge from a different angle as it is his view as well as other 4 designers that although D&B contractors incur additional costs in managing the D&B process they feel that design management provided to manage the design process '*tend to focus more on churning out design information to the construction teams on site without necessarily focusing on the more important elements such as coordinating comments, coordinating reviews, managing supply chain input into the design as well as managing other stakeholders' input into the design as it develops*' post contract. This, they opined, tend to result in designers managing the design process themselves leading to '*additional unrecoverable costs*'. This is another new finding that had not come out of the reviewed literature.

TCN4 came up with another interesting viewpoint that led him to perceive that D&B procurement results in additional costs to the D&B contractors. He stated that some clients may include as part of the contract requirements that may be construed as '*fitness for purpose obligation*'. This is a problem to contractors as some of them do not want to take on this risk which they claim is '*not insurable*'. In order to ensure that this obligation isn't covered in the contract documents TCN4 opined that '*contractors end up employing legal experts to review D&B contracts*' just to make sure there isn't anything in the D&B contract that may be misconstrued as fitness for purpose obligations. This all adds up to the cost of the process which may not have been incurred had the contract be on the basis of the design led traditional build only contract. The whole tendering process is costly to the D&B contractor as '*he is not only required to produce a tender design but also the construction costs and programme for the works*'.

Another perspective to this whole costly process has been highlighted by SC2, who opined that the main challenge that he has encountered in the public sector particularly in road construction projects is relating to the challenge of site investigation information. He observed that '*in most of our enquiries that we send out to D&B contractors there is inadequate provision of site investigation survey information that will assist the D&B contractor to*

*come up with a design solution that works'*. This means all D&B tenderers are forced to do their own survey leading to duplication of effort & costs. This lack of survey & site investigation information at the start of the process is also, to some extent, self-defeating to clients since without any knowledge of the nature of the ground conditions and the topography *'they would not know how much land to buy for the proposed public sector development particularly road construction jobs'*. Without this information clients are *'forced to buy more land than what they may require to allow for, say, road re-alignments should the contractor encounter unsuitable ground conditions'*.

In addition to avoiding duplication of effort from D&B tenderers by providing site investigation information and data *'it also helps in reducing costs incurred by D&B tenderers as they do not have to undertake such surveys during the tender process'*, SC2 went on to say. SC2 provided caution to this as he further stated that *'this must be done with care as it may lead to claims from D&B contractors should the site investigation information be proven to be not correct post contract when the D&B contractor is on site undertaking the works'*.

MC2 highlighted another challenge particularly encountered in public sector procurement for D&B contracting services. He stated that the prequalification questionnaire process adopted and used to narrow down and search for D&B contractors who are perceived to be competent for the work is seen as *'costly and time consuming'* resulting in D&B contractors incurring unnecessary costs which end up being *'ultimately passed on to clients somehow'* as part of winning D&B tenderers' overhead costs. This is another new finding that had not come out of the reviewed literature.

TC3 and 6 other clients introduced another challenge that they have encountered in practice related to the tendering process associated with D&B procurement. TC3 stated that the process itself *'imposes significant strains on client resources'* as they have to *'engage with several stakeholders'* in order to come up with client requirements. Even when such requirements are put together, TC3 went on to say, *'clients have to get a team together to manage*

*the tender documentation, evaluation analysis and award*'. He went on to state how difficult it was to *'evaluate tenders that are based on different design solutions'*. This appears to mirror findings from the reviewed literature, in particular research findings by Masterman (1996), Opfer (2002) and Fahmy and Jergeas (2004) who all raised the challenge of the great difficulty that clients face in evaluating D&B procurement method tenders especially if the owners' requirements and brief are ambiguous and does not communicate clients' precise wishes to the D&B contractor.

In support of TC3 comments above MC4 opined that due to its complexity and nature of the D&B procurement method *'clients always tend to put in additional resources to manage the tendering process as well as the delivery'*. This can be a strain in organisations particularly those that are inexperienced in construction. Due to this demand in internal resources *'the quality of the information, especially in some inexperienced client organisations'*, that goes out may be compromised leading to challenges with articulation of client requirements.

TC2 provided further aspects of this challenge by stating that the production of the tender documentation therefore *'calls for skill sets that some clients don't have and end up out sourcing costing clients more money'*. The fact that there are many different ways to deliver construction projects means that clients find themselves possibly accepting what they have been provided as a solution to their requirements rather than the optimum solution that maximises their requirements. A finding that has been corroborated by earlier research efforts of Masterman (1996), Opfer (2002) and Fahmy and Jergeas (2004) as stated above.

TC2 further opined that contracts for D&B procured projects are *'relatively more complicated to prepare'* as so many *'other considerations and legal challenges'* needs to be considered compared to traditional forms of contract. Some clients expect D&B contractors' responsibility to *'extend and cover for fitness for purpose'* as they view the D&B contractor in the same way as a manufacturer of a good. Because of these *'additional responsibilities and*



*expectations*’ that clients expect from D&B contractors contracts for D&B delivered projects *‘often attract the use of legal advisors which adds more costs to the process’* than they would incur had the contract be for, say, a build only procured contract.

SC3 echoed TC2 viewpoint by adding that preparing D&B tender documentation *‘requires a skill set that may not be readily available within the client’s organisation resulting in significant amounts being spent on procurement experts, solicitors and other advisory teams’* – a cost which was not normally incurred by clients when using the traditional design led procurement method. He went on to state that *‘evaluating D&B tenders is another challenge that can cause problems to clients particularly the inexperienced ones’* as they are faced with *‘not only assessing/evaluating the tenders on the basis of price, health and safety, programme duration, methodology, and such other elements but also assessing the suitability of the designs provided’*. Evaluating tenders on the basis of the design provided, he went on to state *‘is a skill that is possessed by relatively few individuals within some client organisations’* such that *‘outside expertise may be necessary’* again costing clients additional money compared to other design led traditional procurement methods in which the *‘evaluation process doesn’t include evaluation of designs’* as every tenderer is required to price on the same design.

TC3 provided an additional dimension to this challenge by stating that in his experience with D&B procurement clients are *‘short changed as D&B contractors appear to focus their attention not on designing and constructing what we need in terms of project requirements but lowest cost solutions that end up costing clients a fortune in terms of whole life costing’*. What this appear to suggest is the challenge of misalignment between initial costs and *‘cost-in-use’* – a perception that has been raised earlier by contractors in section 5.5.1 where it was stated that in some client organisations there appears to be a mismatch between the objectives of the project delivery team and those of the maintenance team. This mismatch was said to be as a result of the project delivery teams being focused on budgetary constraints

associated with the delivery of the project whilst the maintenance team were more concerned with the '*running costs of the asset*' leading to friction between the parties. This was said to result in constrained relationships between the parties as contractors felt that they ended up incurring the cost due to this problem

SC2 brought another challenge that is a new finding which the researcher did not come across in the reviewed literature. He opined that small to medium size D&B contractors are '*marginalised*' as they sometimes chose not to partake in some D&B procurement projects due to costs involved in tendering for such schemes. This he went on to say '*curtails such D&B contractors' development and growth*' as they find themselves tendering only for '*relatively small to medium sized D&B projects*'. This also '*limits competition*' in a way as clients do not necessarily get the most out of the potential competition that may be available on the market as some possible D&B contractors do not partake in the tendering process due to prohibitive costs involved.

In summary the challenge of costs associated with the whole process appears to be impacting on all key participants of the D&B procurement method. From the data analysed it appears that this challenge emanate from several sources including the inherent nature of the procurement method, risks that are peculiar to the D&B procurement method, the relative skill and expertise that the process demands and what appears to be a misalignment of objectives within the client organisation teams (project delivery and maintenance). Table 5.2 provides a summary of the main findings from the section analysis

**Table 5.2: Key factors underlying the challenge - cost of the whole process**

<b>Respondent</b>	<b>Key factors underlying the challenge noted</b>
<b>MD1/SCN3</b>	High tendering costs
	High resource demands to manage the process
	Experts required to review sketchy tender documents
<b>SD1 + 4</b>	Design management not adequately addressed by D&B contractor resulting in designer carrying out the role by default
<b>TCN4</b>	Legal experts required to draft the complex contract
<b>SC2</b>	Lack of key information at tender relating to site conditions
	Limitation to competition as small/medium size D&B organisations are marginalised
<b>MC2</b>	Costly pre-qualification process
<b>TC3 + 6/MC4</b>	High resource demands from clients' perspective
	Outsourcing skill sets required to cope with the requirements of the contract from the client's perspective
	Costly maintenance regimes as whole life costs are sometimes not taken into account

What this translates to in reality is that contractors and designers, faced with such challenges, will end up incorporating within their overheads such costs and clients will end up paying for these additional costs. This was the least mentioned (jointly with lack of control by clients challenge) challenge when compared to all the other challenges that have been raised by all three participant categories (See Figures 5.3 and 5.4).

#### 5.4.5 IMPOSITION OF RISKS TO THE D&B CONTRACTOR & DESIGNER

MCN1 highlighted another new challenge that the researcher did not come across in the literature reviewed in terms of risks brought about by the D&B procurement method. He stated that *'the other challenge that we face as designers on a regular basis is exposure to external parties and stakeholders that have interests in the project, for instance, Environmental Agencies, English Heritage, and other public bodies whose consents may well be required in order to get the project underway'*. He went on to state that *'this is a challenge that introduces risks and costs to the D&B contractor particularly in terms of delivery times'*.

*'Exposure to such risks to the project'* he went on to say *'is an additional risk to the D&B contractor that build only contractors do not necessarily have to deal with'*. This also brings with it *'additional skill sets on the D&B contractor in terms of being able to negotiate and manage'* such bodies within the project constraints. This means that if the D&B contractor is not well versed and/or knowledgeable in managing these external bodies and stakeholders then *'there will be knock on effects on the design and construction of the project'* potentially resulting in delays and cost overruns and possible disputes. The impact of these challenges on smaller jobs is potentially *'significant'* MCN1 went on to state

MCN1, in a view that has been shared with other 7 contractors, went on to state that another challenge that he had experienced in his capacity as Design Manager for a D&B contractor is the *'difficulty in managing design creep'*. The focus of designers is to *'produce a design solution that fulfils the requirements of the design intent'* established in the tender design he went on to state. As more information and details particularly relating to the site is made available some of the *'assumptions made at tender stage may not hold forcing the designer to further model and develop the design to reflect the latest information'*. He went on to state that this further *'development of the design'* results in design creep which means construction costs *'may likely to*

*increase*' as *'elements of the design are developed'*. It is the *'extent of such changes'* which is a problem to design managers as highlighted by MCN1 and 7 others. Although allowances may have been made at tender stage to take into account these factors such allowances *'are not always enough to cover the full extent of the entire design development process'* due to the *'competitiveness of the tendering process'*.

The more *'allowances that you put in the tender'* the more likely that the D&B tender *'is going to be uncompetitive'* which sometimes appear to *'force D&B contractors to put in allowances that are lower than what they should have been'*. Design creep, as a result of additional and better information being available post award when the actual ground and site investigation information is made available, will end up *'costing the D&B contractor probably much more and therefore putting pressure on design managers and designers'*.

Another related challenge raised by designer MD2 and 3 others is that designers are requested to *'provide lump sum price offers for design services'* at tender stage when there isn't much information available upon which to base the lump sum fee. It would appear then from these viewpoints that D&B procurement brings with it risks to designers in that they are *'requested to forecast the design services required on the basis of scant information'* and in most cases *'end up spending more than the lump sum Fee'* without any recourse to the additional costs incurred.

This is a new finding coming from designers which appear to suggest that the risks imposed on them to provide a lump sum Fee based on *'scant information'* result in them making a loss in some cases when undertaking professional services through the D&B procurement method.

MD2 further puts this challenge in perspective when he stated that in lean construction periods when there isn't much construction work around it means because of *'increased competition'* their ability to add additional sums to cater for contingencies is *'fairly limited or nonexistent'*. This, he further stated, is *'complicated by the fact that design services provided at tender stage, in most*

*cases, is only payable in full after the D&B contractor has been awarded the D&B project'* otherwise designers in most cases only get half of the fees they would have actually quoted for.

TD2 also highlighted another risk that designers encounter with D&B procured projects which is related to stakeholder approvals. TD2, together with other 5 designers, opined that approvals from all stakeholders are *'not feasible at times resulting in the design progressing without their 'buy-in''* which in itself is a risk that the DB contractor may be forced to take in order for the construction programme to progress as planned. This appear to be in tandem with the findings in the related literature, particularly research findings of Kujala et al (2005) and Odeh and Battaineh (2002) who all found that only a limited number of stakeholders are allowed to be involved in the process and even where they are involved they are often involved late leaving little room for alterations. In particular decision making by end users has been found to be time consuming which poses difficulties to D&B contractors in capturing their needs promptly and on tightening the project schedule.

MD2 further expanded on the subcontract agreements that have been raised in section 5.5.1 above by opining that the design services agreements that D&B contractors challenge for execution are sometimes *'onerous and put most of the design creep risk on the designer'*. This appears to emanate from the viewpoint that D&B contractors *'want to protect themselves'* by incorporating terms and conditions that *'puts all design risks on the designer regardless of whether they are able to control and manage them'*. He went on to state that some D&B contractors would want designers to *'carry risks that their professional indemnity insurance cover will not be able to cover'* resulting in more risks to the designer.

TD2 appear to suggest that the D&B procurement process is used by some clients as a *'convenient way to pass on project delivery risks; however they may be, to the DB contracting organisation'*. TCN4 further corroborated TD2 views by saying that *'such transfer of risks results in the whole supply chain of the construction industry feeling the pain'* of the risks transferred by the client

as each party in the hierarchy try to pass it on down the supply chain. This approach to risk transfer results in adversarial attitudes developing leading to conflicts and disputes that the construction industry has had over the years when the traditional procurement method has been the main procurement method in use.

TCN4, as well as other 7 contractors, expanded further on the challenge of risk allocation within the D&B procurement method which he felt was '*dumped on the D&B contractor*' by some clients. This is particularly so during '*economic downturn periods*' when the market is effectively a '*buyer's market*' rather than the '*seller's market*'. Clients basically, he went on to say appear to '*take advantage of market forces of demand and supply and 'play' the game*'. What happens in practice, he elaborated further his earlier point, is that when '*demand for construction is low*' and there are '*fewer construction projects being built out there*' clients are perceived to be '*pushing all risks on to the D&B contractors*' who are left with no option but '*accept the onerous risks*'. As a result, TCN4 said, '*there are a few examples of contractors and their supply chain i have seen going into liquidation*' partly as a result of taking such risks without the capacity to deal with them. This came across from several contractor respondents which appear to suggest that risk transfer in D&B procurement is one of the significant challenges affecting contractors.

TCN2 echoed the same views opined by TCN4 above when he stated that '*the main challenge that the D&B procurement method has on us contractors is to do with risks associated with design development*'. He traced the origins of the challenge at the beginning of the tender process by saying '*at tender stage clients do request us to take on design development through to construction*'. The problem, he went on to opine, '*is we sometimes don't have the resource and competence to interrogate the tender documents and understand fully how this is going to develop*'. He further stated that what tend to happen in practice is '*we tend to use gut feel based on previous experience on other similar type projects and put in a contingency sum in the tender, say 10% of costs, based on the information that we are able to decipher from the tender enquiry provided*'. The main challenge with this 'gut feel' assessment of

risk is that the contingency sum may not necessarily be adequate enough to cover design development and creep that have been raised in earlier sections by contractors and designers alike.

The above stated design development risk is also compounded by TCN2's further viewpoint that *'designers also may not be able to advise on this as they also lack enough information at tender stage to be able to have the knowledge of how the design may turn out to be'*. At tender stage, TCN2 went on to state, *'there will be so many unknowns that it's almost impossible to get someone who can be able to advise with any greater degree of certainty'*. The contingency sum that is ultimately incorporated within the D&B tender is also impacted by *'the level of competition on the market place'*. He further elaborated on this point by stating that *'the higher the level of competition the lower the contingency sum incorporated and the lower the level of competition the higher the amount of contingency incorporated within the D&B tender'*.

TCN2 went further to explain his view points by saying *'the contractor at tender stage may not be in possession of key information that will dictate how design development is going to pan out'*. This is a challenge that has been raised previously by client respondents in section 5.5.2 when it was stated that in some cases D&B tenders may not have ground investigation information which means the contractor has to make assumptions. Such assumptions, TCN2 further explained *'may turn out to be wrong when the actual site investigation is carried out'*. The lack of accurate ground/site investigation information *'affects key elements of the project such as foundations, programme duration and costs'*. He went on to state that *'there are so many instances in my experience where we got several surprises and actually lost significant amounts of money due to wrong assumptions being made on certain critical elements of the project'*.

The challenge of risks perceived to be imposed on the D&B contracting organisation has been summarised by TCN5 when he stated that *'Design & build procurement method's main challenge to us contractors is the amount of risk that it imposes on us which demands a high level of experience and*



*knowledge from the contractor's team*'. On the basis of this comment, which also came up from a majority of other contractor respondents, It would appear that D&B contractors take on risks that demands both resource and experience to manage them when they contract to deliver projects through the D&B procurement method. Previous research efforts by Chan and Yu (2005) attempted to highlight such risks perceived to be imposed on the D&B contractor by tracing some of it to design liability that is imposed by both statute and standard forms of contract in use.

In continuation of this challenge from a designer's perspective SD2, and 5 other designers shared the same view, provided some insight into how such risks may also impact the designer by stating that *'D&B contractors typically calculates what it will cost them to design and build the project'* based on the client requirements provided at tender. The designer may have been involved in the early stages of the design but the challenge that usually crops up, he stated, is *'responsibility for design development'* with some contractor, on the one hand, viewing it as a *'risk that should be covered by the designer'* in the design fee and designers, on the other hand, viewing it as a *'design and build contractor's risk'*. SD2 went on to state that *'in my experience this is a main challenge with the design and build procurement process'* leading to potential conflict and disputes.

TD3 went on to explain this risk, from a designer's perspective, through the construction phase of the D&B project by stating that *'traditionally there was a Clerk of Works and his/her time was recovered on a time basis'* which was not a problem but with the D&B procurement method contractors would want to engage designers on a lump sum price for both design production and construction support deliverables as identified in the earlier section 5.5.1. This, TD3 went on to state, *'causes us problems as we would have difficulty in interpreting and pricing the extent of the contractors' requirements and this creates a major risk for us'*.

Surprisingly clients also raised viewpoints that appear to suggest that they are in agreement with D&B contractors' views on risks brought about by the D&B

procurement method. SC2 in particular stated that *'the D&B contractor is also compelled to take many risks that can probably be better able to be managed by clients'*. Probed further it appears that SC2 main challenge was the consequence of the D&B contractor being *'compelled'* to take on risks as a result of the way D&B procurement is. SC2 bemoaned that fact that this results in tenders being possibly *'unrealistically high as a result of contractors making contingency allowance in their bids to cater for these unknowns'*. This was further corroborated by SC3 who stated that *'the construction process is a risky undertaking and contractors make their own assessments of these risks and make allowances within their tenders for dealing with such risks'*. He went on to suggest that in D&B procurement method additional risks are *'imposed on the contractor as not only is he required to take on construction risks but design development risks as well'*. Such additional risks, as highlighted by SC2 above, will attract a *'cost premium'* which the client has to bear

It would appear from the above that the lack of information on the site itself coupled with other risks that D&B contractors are forced to take all contribute to D&B contractors having to take risks that contractors would not normally take in other procurement routes. SC2 brought up a controversial viewpoint when he stated that *'there is a tendency by some clients to view D&B procurement as an opportunity to pass on all risks to contractors without any consideration of their ability to manage them'*. Based on his own experience he further stated that *'this may appear to be astute procurement but can be the seeds of future adversarial relationship between contractor and client and the project will ultimately suffer'*. This is an interesting point particularly coming from someone occupying a strategic position in a client organisation.

The challenge of planning approval as a source of further D&B procurement risks has been raised by TD4 when he stated that *'since client sometimes gets outline planning approval at the time of engagement of the D&B contractor it is then left to the D&B contractor to get final planning approval after the contract award'*. This, he went on to say, *'can cause delays in construction should the final approval process encounter problems that may*

*have been overlooked in the outline planning approval'. The above stated appears to suggest that there is a myriad of risks that D&B contractors, designers and to some extent clients take which can be attributable to the D&B procurement method. This appears to be in tandem with Oztas and Okmen (2004) research findings when they concluded that D&B procurement turns out to be a risky procurement method for both owners and contractors unless the risks are identified, analysed and managed throughout the tender preparation and project execution stages. Table 5.3 summarises the main risks highlighted by key participants to the D&B procurement method.*

**Table 5.3: Key factors underlying the challenge - Imposition of risks to the D&B contractor and designer**

<b>Respondent</b>	<b>Key factors underlying the challenge noted</b>
<b>MCN1 + 7</b>	Interface with external parties & stakeholders
	Design creep management
<b>MD2 + 3</b>	Pricing professional services on a Fixed Lump Sum basis
<b>TD2 + 5</b>	Delayed approvals from key stakeholders
	Design creep risk imposed on designers
	D&B risks passed through the whole supply chain by onerous sub-contract forms
<b>TCN4 + 7</b>	In economic downturn periods most project risks passed on to the D&B contracting organisations
<b>TCN2/TCN5</b>	Design development risks
	Demands on D&B contractor's resource & experience to manage the process
	Lack of key information to inform the D&B contractor at tender
<b>SD2 + 5</b>	Design development risk passed on to the designer through the sub-contract
<b>TD3</b>	Difficulty in interpreting & pricing Contractor's Requirements
<b>SC2</b>	Costly tenders due to risks imposed on the D&B contractor
	Unilateral passing of project risks to the D&B contractor
<b>TD4</b>	Delays in getting Final Planning approvals post D&B contract award

Imposition of risks to the D&B contractor and designer is the sixth highest mentioned challenge as graphically portrayed in Figures 5.3 and 5.4.

#### **5.4.6 LACK OF CONTROL BY CLIENTS**

Clients, as perceived by MC3 and 6 others, are of the opinion that the lack of an independent checker on the ground to check that what's being constructed is in line with the specification *'creates a problem as designers who used to undertake this function are now directly employed by contractors'* and therefore are perceived to be *'unable to perform this function on behalf of the employer'*. This may lead to situations, MC3 went on to opine, in which *'some defects may get covered and therefore unnoticed for a long time'*. He went on to state that *'in this current economic climate in which some companies are going bankrupt this may impose a big risk to clients who are left with a building to maintain that is potentially laden with latent defects that will become apparent a long way into the future'*. MC3 comment is also connected to the other sub-theme on perceptions highlighted by other clients pertaining to what they view as the poor quality control inherent with this procurement method.

MC4 and 4 other client respondents expanded on MC3's viewpoint by also stating that the challenge of lack of supervision of the workmanship as the construction progresses *'results in some defects being hidden'* which they said may not be apparent until the later part of the building life span when the *'D&B contractor's limitation period in liability would have long expired'* resulting in clients rectifying defects at their own expense. An interesting point which again one would trace it back to the robustness of the control measures that have been put in place at the time of engagement of the D&B contractor. One can only opine that the more robust the specifications and approval process the more likely that such challenges may be encountered. It goes back once again to the challenge of experience and knowledge of the D&B procurement process.

To drive home his view point MC3 further states that *'as a PM my keen interest is to manage and deliver projects within the set time, cost and to the required standard but i find it difficult to control the standard aspects of a D&B procured project'*. Probed further to expand on his view he went on to say that he often end up *'arguing with the contractor over what is acceptable or not'*. From his experience D&B contractors will *'go for the cheapest materials in order to save on costs'*. From his experience it is *'very difficult to get contractors to opt for high quality materials which are relatively expensive when they can get away with cheaper products that fulfil the same function'*

MC4 brought up another challenge associated with the way D&B procurement is perceived by some public sector clients when he stated that *'due to its inherent characteristics D&B procurement creates a massive problem for us public sector clients in that we fail to demonstrate 'value for money'*. He expanded on this by stating that this is especially so *'where the contractor is submitting both the whole design of the project and a price for undertaking the construction of that design'* which is what happens in most typical D&B procurement method arrangements.

In the public sector the pressure is always on clients to save money and therefore, in his view *'it's very difficult to justify awarding the D&B contract to a contractor whose design may be advantageous in the long term but very costly on the basis of the initial price/contract sum presented as part of the D&B tender'*. Although this has been raised specifically by public sector clients it appears to be a challenge affecting clients in the other sectors as well. Literature reviewed, in particular, research undertaken by Nahapiet and Nahapiet (1985), Masterman (1996) and Opfer (2002) appear to have raised the same challenges that MC4 have raised. Part of their finding pointed to the fact that due to the need to evaluate both price and design from different D&B tender proposals clients feel lacking in controlling this process even before the D&B contractor is engaged.

MC1 expanded further the theme that has been raised by MC4 by tracing this 'lack of control' perception to some of the methods used to assess D&B

tenders. In traditional contracts, he stated, contractors are requested to price the approved detailed design and clients do not have to consider additional variables that they would have to consider when contractors are not only providing a price for undertaking the works but providing a design as well. MC4 further elaborated on some of the challenges raised in earlier sections by bemoaning the fact that D&B contractors exclude them in design review meetings and perhaps view clients as *'interfering with their contractual obligations'*. According to MC4 clients feel excluded from key decision making at critical stages of the design development stages resulting in further perceptions of lack of involvement. This resonates with what has been reported in sections above where some clients, just like MC4, are of the view that even where they are involved in design reviews meetings it would appear to them that any clarifications and/or comments made is translated and end up being viewed as a change/variation by D&B contractors.

This perception is also linked to challenges highlighted earlier in connection with what is perceived to be change in the D&B procurement method. It appears from observations and views expressed in earlier sections that the whole challenge of change definition under the D&B procurement appears to be blurred. Some participants appear to interpret 'design development' as change while some interpret client clarifications and comments on design as change. No wonder why some clients, as expressed by MC4 above, feel they are not in control. All such interconnectedness of challenges surrounding design management and design development raised by key participants to the D&B procurement method appears to have the potential of perpetuating the perception of lack of control in the whole process by D&B clients.

Another challenge/perception that clients have on D&B procurement relate to the emphasis on initial costs that D&B contractors are perceived to have at the expense of whole life costing. TC2 highlighted this by stating that *'once appointed the D&B contractor appear to be more interested in design and construction costs of elements rather than whole life costs of elements'* This, TC2 further stated result in clients having to *'folk out above the norm additional costs to maintain the completed building'*. This would suggest that,

had clients had more control in the process, they would have addressed it and ensured that optimal design solutions that address both initial costs and whole life costs were implemented. This perception opens up some other additional questions associated with knowledge and experience of the parties in the whole D&B procurement process. One would think that surely if the Employers' Requirements were as robust and unambiguously articulated then this balance of initial costs and whole life costing would be established pre-contract stage before the D&B contractor is appointed.

TC5 expanded further on the challenge raised by MC4 above when he stated that *'tender design solutions proposed by D&B contractors are different and the question is which one of them has the potential to give greater value for money?'* *'Without details on whole life costing'*, he went on to opine, *'it is very difficult to assess and analyse different design solutions'*. It would appear that this perception emanates from the fact that in D&B procurement clients have to evaluate the design solution that the contractor has provided in addition to evaluating the price as well.

The main problem associated with this challenge is evaluating what TC5 referred to as the *'worthy'* of the different designs provided by different tendering D&B contractors. Inexperienced clients, he went on to opine *'may be tempted to accept the lowest price without evaluating the design provided which may not be the right solution for what they require'*. He further stated that *'some design solutions may appear to be attractive in terms of low initial capital costs, or quick delivery in terms of buildability but may not be the right solution in the long term due to high maintenance costs they bring to the end user'*. *'To get this balance right and evaluate both the design solution proposed and the price provided may be a challenge to particularly inexperienced clients'* he commented further.

The above stated perceptions of the D&B procurement from clients point to the perceived difficulty that some clients face in justifying and demonstrating how value for money has been achieved at the end of the tender assessment process of a D&B procured project as there appears to be a host of other

considerations to take into account when evaluating D&B tenders. The different design solutions proposed would also have different initial costs which compounds the problem since the basis of comparison in terms of cost on its own is difficult to make. Analysis of D&B tenders appears to be difficult to undertake in practice as the traditional evaluation criteria alone will not yield the desired result. Coming up with a rigorous evaluation mechanism that captures the variable elements of the D&B tenders appears to be a challenge faced by clients based on perceptions highlighted by most clients in this research.

TC6 views summarises the views of a majority of other clients interviewed when he stated that *'the major challenge that i have encountered with this procurement method is difficulty in getting what i want as a client'*. Probed further to expand on this it would appear from his explanation that this challenge can be traced back to the robustness of the Employers' requirements. According to TC6 it would appear that each time he tries to get contractors to provide him with what he believes to be included in the contract specification he is met with *'loads of excuses'* most of which appear to be *'hiding behind the loose definition and discretion offered by the performance specification'*.

The performance specification in his view is there to provide the contractor with a *'guide as to the aspirations of the client in terms of the materials and workmanship required'*. He went on to opine that the D&B contractor is expected to *'come up with a design that fulfils not only the requirements in the performance specification but a design that fulfils the highest quality standards'*. From his experience what tends to happen in practice is that the D&B contractor will choose *'the lowest standard materials which are usually the cheapest'* and *'as long as they can fulfil the criteria set in the performance specification then as far as the D&B contractor is concerned he would have fulfilled their obligations under the D&B contract'*.

It would therefore appear to suggest, from the above client perceptions, that the challenge of apparent lack of control by clients on D&B procured projects



runs deep and transcends various stages of the project delivery stages. It appears that the challenge emanates from the definition of requirements, evaluation of the D&B tenders, design management process leading up to the construction phase, quality control during construction, change management, defects correction after the defects correction period and even going further into the limitation liability period. This highlights the complexity of the problem emanating from the perception of lack of control by D&B clients. Table 5.4 summarises the challenges raised.

**Table 5.4: Key factors underlying the challenge - Lack of control by Clients**

<b><i>Respondent</i></b>	<b><i>Key factors underlying the challenge noted</i></b>
MC3 + 6	Lack of Client's independent Checker during construction
	Difficult to control workmanship
MC4 + 4	Defects covered & unnoticed for a long time long
	Difficult to demonstrate value for money for D&B tenders
MC1/TC5	Clients excluded in design review meetings
	Clients excluded from key decisions made during design process
	Comments/Clarifications made in design review meetings wrongly interpreted as changes in scope
TC2	Emphasis on initial cost at the expense of whole life costs
	Difficulty in getting the quality clients want
	Wide definition/interpretation of Performance Specifications

Lack of control by clients is the fourth least mentioned challenge (jointly with cost of the whole process) based on the interview results portrayed in Figures 5.3 and 5.4.

#### **5.4.7 LACK OF EXPERIENCE / UNDERSTANDING OF THE D&B PROCESSES – HARNESSING BUILDABILITY**

Analysis of references linked to this theme - 'lack of experience/understanding of the D&B processes' generated several patterns that are explored in further detail below.

To demonstrate the perception that some key participants of the D&B procurement method lack the experience and knowledge of the D&B processes TD3 opined that *'what tend to happen in practice is that contractors react to design situations at the end of the process'* when the design is complete and ready to be built leading to time and cost overruns and further conflict with designers. He further explained that this may be instigated by a realisation of how costly the design solution may be when the D&B contractor engages with the supply chain. This challenge has resonance to the challenge raised in earlier sections when the challenge of buildability and timing of specialist supplier involvement was brought up. One would think that with the relevant knowledge and experience at their disposal such D&B contractors would surely have managed the situation better as this is one of the major advantages that is said to be brought about by D&B as a procurement method. However this challenge appear to have been raised in the reviewed literature by Mitchell et al (2011) when they stated that the design development process is the most extensive and complex stage of the construction process. They went on to state the reasons why this is the case by saying this complexity is brought about due to the volume of information produced by the design team and the degree of detail produced.

The late reaction to the design solution at the end of the design process sometimes lead to what SD1 referred to when he stated that *'harnessing the D&B contractor's buildability input into the design is not always forthcoming at the right time when it's really required'* as the contractor's delivery team are said to be *'busy with their day to day delivery processes on site'*. At times when this 'buildability input' is received it is said to be *'late and has the tendency to delay the design process'* which has the potential to result in

conflicts and disputes between the designer and the contractor. Once again this challenge appear to have connection with the reviewed literature particularly research findings by Chan and Yu (2005), Zanelidin et al (2001), Hampton (2001), Chan and Chan (2000), Chan and Chan (2001) when they observed that D&B contractors face a major challenge in design management as most of them are not trained to design or to manage the design process.

The challenge noted by SD1 and further corroborated by the reviewed literature have been highlighted in a different way by MD2 and 5 other designers when they made comments on perceptions some D&B contractors attributed to design evolution. According to their viewpoints the problem arises when after tender award the design process further evolves and *'assumptions that may have been made at tender stage are found to be incorrect'*. They went on to opine that contractors tend to *'interpret this as design errors'* and as such all design and construction costs emanating from the amended design are expected to be borne by the designer. MD2 went on to state that *'this is the main source of the challenge that i have experienced in connection with design development and i put to lack of appreciation of the development of design through passage of time as more information and details emerge'*. This perception is deeply connected with the other challenges highlighted in previous sections particularly when designers bemoaned the challenge of lack of transparency in the financial allowances made by the D&B contractor in the D&B tender.

#### **5.4.8 LACK OF EXPERIENCE / UNDERSTANDING OF THE D&B PROCESSES – MANAGEMENT OF DESIGN**

SD1 brought up one of the key challenges that probably bring to light some of the perceived short comings of some design managers in D&B contractor organisations. According to SD1 D&B contractors provide design managers that tend to *'focus more on churning out design information to the construction teams on site without necessarily focusing on the more important elements such as coordinating comments, coordinating reviews, managing supply chain*

*input into the design as well as managing other stakeholders' input into the design as it develops*'. When this situation happens, SD1 went on to say, *'designers end up managing the process themselves*'. SD1 views on poor design management by D&B contractors corresponds with Love et al; (1999)'s research findings that traced back the perceived poor quality of D&B projects to poor design management. These views are further complemented by Chan & Kumaraswamy (1997)'s research findings who also argued that poor design management by D&B contractors is a primary factor that contributes to not only poor quality but time and cost overruns.

TD4 provided further insights into the challenge of *'lack of experience in design management by contractors' design managers*'. This, according to TD4, is another challenge that is not so well managed by contractors as they *'lack a general understanding of what design development entails*'. The Contractor's design manager tends to be experienced more in information flows between the parties but the actual *'coordination and management of the process appear to be lacking*'. TD4 further explained that design management is a skill that needs an understanding of the *'iterative process of design*' and *'making decisions at the right time*' to ensure timescales are met and commitments made at the right time. SD2 raised a key factor underpinning this whole problem by stating *'D&B contractors keep the risk pot associated with design development close to their chest and rarely does this get shared with the designer*'. Sharing the contents of the risk pot is another aspect of the perceived problem but, according to SD2, *'the key prior to sharing is getting the design input into the computation and preparation of this risk pot*'. It would appear then from this view by SD2 that without the 'buy in' of the designer into the design development risk allowance determination it is difficult for design development to be a shared risk between the D&B contractor and the designer.

TD4 as well as 5 other designers came up with a different aspect to the problem by stating *'design reviews and comments emanating from such reviews*' are another element of the problem that they have encountered. As further elaboration to the problem they stated that at times comments are

received late and *'may involve revisiting models and other sections of the design that would have been completed to satisfy client and other stakeholder requirements/comments'*. They did clarify, however, that this was *'prevalent particularly in situations where client requirements are loosely worded and open to misinterpretation'*

Similarly TD2 observed that in his experience, *'even where there are client appointed Agents/PM in the process decisions are not made quickly and concisely enough as some such Agents haven't got enough delegated authority to make decisions'*. This he further explained result in such Employers' Agents referring all requests to other people within the client organisations, but outside the project team, *'for decisions and answers to queries and or requests for approvals'* This, he explained further, *'result in late design approvals'*

In continuation of the challenge TD2 went on to say *'on some bespoke projects like infrastructure projects the problem is compounded by the fact that there is a general shortage of skilled resource in such projects'*. However TD2 was quick to clarify that some clients and contractors have come to *'understand and appreciate the design and build contract over the years this challenge appear to be less of a problem with experienced parties'* but more of a problem with less experienced parties.

As another example of lack of knowledge and experience of the D&B process SD1 came up with another insight into the problem by opining that *'late input into the design from specialist contractors is another challenge as design changes are made later than when they should have been made'*. This, according to SD1, causes delays to finalising the design and/or retrofitting on site which again causes disruption to the construction process and leading *'some contractors blaming designers for the late changes'*.

In addition to the challenge of the late input into the design by specialist contractors SD2 highlighted another challenge relating to design information coordination. He opined that some D&B contractors *'don't generally facilitate*

*the coordination of information from works package specialist designers with that of the main elements undertaken by the principal designer*'. This, he went on to state, causes problems in design assurance, scope gaps and professional indemnity insurances. Design managers typically employed by contractors are mainly focused in getting design information out to the delivery teams and *'spend relatively less time in doing the coordination of design'* which is the crucial element that underpins the success of a design and build project.

TD2 raised a viewpoint that appeared to suggest that contractors' expectation of design deliverables from designers in a D&B procurement environment appear to be greater than the level that designers are used to design led traditional procurement. This resonates with what D&B contractors highlighted in the above sections when they were commenting on the level of expectation that D&B clients expect from D&B projects. In the comments made it appears from D&B contractors' perspective that D&B clients expect much more from them compared to what they would expect on a traditional design led procurement method.

MD1 traced the origins of the knowledge and experience of the D&B procurement method by going back to the Scope definition and formulation of Employers' requirements. He suggested that the project definition as encapsulated in the work scope or client's requirements *'brings with it challenges to the D&B contractor as some clients over specify their requirements'*. This, he further elaborated, *'limits the D&B contractor's ability to come up with alternative design solutions'* since these *'prescriptive requirements'* forces D&B contractors into coming up with preferred design solutions as dictated by the work scope/client requirements This view was further supported by SCN1 when he opined that *'in some cases clients are so prescriptive in their requirements which limit the D&B contractor's ability to come with alternative designs that are economical in both cost and time'*.

Such views by MD1 and SCN1 appear to contradict what other key participants to the D&B procurement method had opined in the earlier

sections, in particular TC6, when they made reference to the ‘loosely worded’ performance specification.

SD1 brought up a new finding in an attempt to explain the challenge of lack of experience and knowledge in the whole D&B process by stating that *‘D&B contractors in my experience commit to delivery times that are unrealistic without consideration of the design processes that we have to go through in terms of design iterations, reviews and approvals’*. This, he stated, is one of the major challenge that designers face which sometimes leaves them with no option other than *‘accelerating the design process which may result in sub-optimal designs’*. According to SD1 D&B contractors expects designers to come up with *‘cost effective designs but without allowing adequate time for the iterations to take place’*. Compounded with this inadequacy in time to undertake designs properly TD2 appears to suggest another added problem to the process when he opined that *‘rarely does the design period get lengthened to accommodate the full effect of changes along the way’*

TCN5 raised another challenge from the perspective of team experience in both the D&B contractor’s and the client’s organisation when he stated that *‘lack of experience on the part of some of the contractor’s team preparing the design and build tender also result in misinterpretation of the client’s requirements’*. According to TCN5 this *‘lack of experience may also escape the through the client’s evaluation team if they are equally inexperienced with the design and build procurement method’*. This, he stated, can also lead to waste when at a later stage inconsistencies, ambiguities and inaccuracies eventually come to the surface.

#### **5.4.9 LACK OF EXPERIENCE / UNDERSTANDING OF THE D&B PROCESSES – DESIGN ITERATIVE PROCESS**

In addition to TCN5 comments regarding inexperience that may be apparent in some D&B teams TCN3 highlighted the challenge of communication and lack of openness as another by product of the lack of knowledge by the D&B team. He explored this theme further by stating that in some cases there is a

*'lack of communication and openness between contractors and designers during the tender stage'*. During this critical time when the contractor's designer is exploring the client's requirements and coming up with a tender design for the contractor TCN3 opined that *'the apparent that lack of communication between the two parties often results in misunderstanding of the project scope, its complexity and cost to build'*.

He went on to state that what tends to happen in practice is that *'the designer will produce a tender design which is very high level and therefore open to further exploration, investigation, checking and verification in the later stages of the process and D&B contractors would invariably take this as a basis for computing their tender and construction programme'*. During this stage *'allowances for further development in design are assessed on the basis of the contractor's opinion'* of the design development risk. This, it would appear from TCN3 view, is the root of the problem as design development risk is unknown until the design is further developed.

SCN3 appear to support TCN3 observations when he also highlighted the fact that some D&B contractors tend to price *'what they see in terms of Employers requirements and do not appreciate that over and above what they see in the requirements they have to allow for the 'big picture'*". SCN3 went on to state that D&B clients expects the contractor to interpret the requirements as presented and make any additional provisions for the *'unknown'* and in most cases this is not necessarily shown in the documents. The fact that this is coming from a contractor provides much more insights into the challenge.

To illustrate his point SCN3 said, for instance *'if the client states his requirements as a 4 bed roomed house that's what he expects to get at the end unless of course he changes his mind by giving variation orders'*. The D&B contractor is therefore expected to make adequate provisions for anything (within the performance specification) that is required for the type of the 4 bed house that is required. SCN3 went on to state that *'the detailing on how the house is going to be built will not necessarily be available at the time of tender'*. This is where the problem starts as some contractors *'tend to price*



*what they see from the sketch drawings provided and forget to appreciate that detailing and design development coming out of the initial design provided will be required and will not constitute a change to employer's requirements'.*

To further amplify his point SCN3 went on to state that *'designs evolve over time as more information is fed back to designers'* and this sometimes *'conflicts with D&B contractors wanting to receive designs as soon as possible in order to meet programme requirements on site'*. This process, he went on to state, may involve much iteration as comments are made and design reviews progress which may not necessarily be reflected in the contractor's programme resulting in delays and conflicts.

TC1 observed that from his experience D&B contractors *'fail to control and manage designers during the design process'* He went on to state that, based on the design mistakes that they come across when designs are submitted for client review *'it clearly shows that contractors are just passing on the designs without properly checking'*. This has led to some D&B clients, he further opined, harbouring the opinion that they are *'doing design review functions that should be done by D&B contractors'*. Using a different approach to this challenge but nonetheless complementing the underlying challenge raised by TC1 and others is Chan and Yu (2005)'s research findings that also raised to the fore issues concerning design liability and contractual provisions for design management between the designer and the D&B contractor.

TC4 bemoaned the fact D&B contractors at times are accorded limited involvement with the design process since client designers would have undertaken design through to RIBA stage D. The D&B contractor's innovative ability is said to be therefore limited due to the limited time that the D&B contractor has had with the design process. MC1 appeared to echo TC4's comments by stating *'this halfway house type of D&B procurement process is known to result in compromises to constructability and innovation'*.

These findings appear to resonate with previous research findings undertaken by Chang et al (2010) who observed that the inconsistent application of the

design and construction processes and infrequent feedback are two major problems found to have high influence on D&B project execution. Latterly these observations appear to be supported by research findings by Xia et al (2012) when they provided a comprehensive list of key competencies that both contractors and clients had to have. For contractors they observed that the emphasis should be on D&B experience, corporate management capability, building and design expertise, financial capability and enterprise quality and reputation. Similarly for clients they observed and noted that the key competencies are ability to clearly define the project scope and requirements, financial capacity, contract management capability, adequate staff, effective coordination with the D&B contractor, and D&B experience. Table 5.5 summarises the key findings from the examination of this theme

Lack of experience/understanding of the D&B processes is the second highest mentioned challenge based on the analysis of the interview data portrayed in Figures 5.3 and 5.4

**Table 5.5: Key factors underlying the challenge - Lack of experience/understanding of the D&B processes**

<b>Respondent</b>	<b>Key factors underlying the challenge noted</b>
TD3/SD1	Contractors reacting at the end of the design process
	Late harnessing of buildability into the design process
MD2 + 5	Evolution of design wrongly interpreted as 'design errors'
SD1/TD4 + 5	Late input into designs by specialists
	Lack of management capability by D&B contractors
	Lack of appreciation of design durations in programme formulation
	Lack of experience in managing designs
	Late receipt of comments from design reviews
SD2	Lack of transparency to the contents of the design development risk pot
	Lack of coordination of design information from specialists
TD2	Lack of authority in PM teams
	Shortage of skilled personnel
	Unreasonably high expectations from the D&B contractor
	Lack of full appreciation of full impact of change on designs
MD1/SCN1	Over-specifications of requirements
	Too prescriptive requirements limiting innovativeness
TCN5	Lack of experience in D&B process by D&B project teams
TCN3/SCN3	Lack of communication and openness between designers and D&B contractors
	Lack of appreciation of the 'big picture' when pricing D&B tenders
TC1	Failure to manage the design process by D&B contractors
TC4	'Half way house' designs offering limited opportunity for D&B contractors to come up with alternative designs

#### **5.4.10 LACK OF INVOLVEMENT OF KEY STAKEHOLDERS**

As stated in previous sections by TD2 when commenting on risks imposed on the D&B contracting organisation it appears that getting approvals from all stakeholders is at times not feasible. This result in designs progressing without stakeholders' 'buy-in' which in itself a risk that the DB contractor may be forced to take in order for the construction programme to progress as planned. This view has been corroborated in the reviewed literature by Odeh and Battaineh (2002) when they commented that end users are not fully acquainted with requirements management practice leading to slow response rates. This, they went on to opine, poses difficulties to the D&B contractors in

reflecting and taking account of users' needs promptly while at the same time complying with the ever tightening construction programme.

It would appear from both the reviewed literature and the interview data that key stakeholders are those organisations or individuals who have got an interest in the project. They can be internal or external. Internal stakeholders can be people and different departments within an organisation. External stakeholders can be the community, the end users and others who regulate project development. They are all impacted to different levels by the project being delivered and therefore they need to be identified and consulted early and continuously through the development cycle.

SCN1 highlighted the fact that the D&B contractor is '*not involved in putting together and collating such requirements is also a handicap*'. This is apparent in some situations particularly where, according to SCN1, the client has other '*stakeholders within his organisation who may not have been consulted during the identification and listing of the project requirements*'. Comments emanating from such stakeholders during the design development process and design approvals are said to result in '*slowing the process and at times leads the D&B contractor to be entangled in inter-departmental conflicts and disputes*' within the client's organisation. This comment by SCN1 appear to resonate with findings from the reviewed literature especially findings by Othman et al (2005) whose findings suggested that only a limited number of stakeholders are allowed to be involved in the brief preparation as clients are reluctant to put resources to the briefing process.

Table 5.6 provides a summary of the findings from the analysis of this theme. Based on the analysis of the interview data portrayed in Figures 5.3 and 5.4 lack of involvement of stakeholders is the least mentioned challenge by all three participant categories.

**Table 5.6: Key factors underlying the challenge - Lack of involvement of key stakeholders**

<b>Respondent</b>	Key factors underlying the challenge noted
<b>TD2</b>	Lack of involvement of some stakeholders
	Not feasible to getting stakeholders 'buy-in' with the design process and the 'programme'
<b>SCN1</b>	Non involvement of the D&B contractor in the formulation of the Requirements
	Late comments from stakeholders slowing the process
	Conflicting objectives/priorities from different stakeholders within client organisations

#### **5.4.11 POOR ADMINISTRATION OF CHANGE**

TD2 and other 5 designers are of the view that D&B contractors do not respond to change requests during the design development process and in most cases when this is allowed to continue it affects design delivery and consequently construction. This is perhaps a manifestation of the challenge raised earlier which suggests that some D&B contractors do not effectively manage the design process due to several reasons some of which relate to lack of experience and general understanding of the D&B process.

TC3 summarised the view that has been raised by a majority of clients when he stated that '*clients feel that they are constrained to make changes when they want to due to a lack of a robust basis to evaluate the cost and time impact of the proposed change*'. This inflexibility which can be traced back to the inherent nature of D&B procurement is said to result in some '*genuine changes that may have benefited the project to be put aside*' which in turn is said to compromise the client's satisfaction with the end product of the D&B procurement method.

In addition to TC3's comments TC6 further views this *'inflexibility of the procurement method in terms of introducing change'* as the origins of another challenge since some contractors, in TC6's views, appear to *'view this as an opportunity to make money'*. He further opined that *'in most cases what i get off the D&B contractor is heavily loaded with time and costs associated with the change'*. Without contract rates to help clients assess the change they feel that this leaves them with no choice except to negotiate with the D&B contractor *'who in most cases holds the trump card in such situations'*.

MC5 continued with TC6's viewpoint by opining that *'introducing change is a challenge when the project is delivered using D&B procurement as some D&B contractors try to take advantage of the introduced change and claim unrealistic prolongation of contract and costs'*. Without a good basis/benchmark to make equitable assessments of the consequences of change as provided by the traditional type contract, he went on to state that *'this leaves the client exposed to such hefty assessments of change thereby limiting clients to introduce change and hence lose the flexibility that other clients utilising traditional procurement enjoy'*.

Contrast this with TC5 views when he stated that *'the fact that it's difficult to introduce change in D&B procurement should be viewed as a positive attribute of this procurement method'*. He went on to elaborate this by stating that *'because in most cases the flexibility to make changes sometimes affords some clients and other stakeholders with the opportunity to introduce changes some of which aren't warranted and sometimes appear not to bring any value to the end product'*.

SC3 appear to be in support to TC6 comments above when he stated that *'although the D&B contract may allow clients to introduce change it is difficult to make an assessment of the change'*. Probed further to expand on this point he highlighted the fact that *'most D&B contracts are on a lump sum basis and there isn't much transparency in terms of quantities and granularity of rates'* that was previously a common feature of traditional forms of contract. Such transparency in the makeup of the contract sum *'made it easier for clients to*

*understand and evaluate change*’ he went on to opine. Key findings from this theme are tabulated in Table 5.7. Based on the analysis of interview data displayed in Figures 5.3 and 5.4 poor administration of change is the third least mentioned challenge.

**Table 5.7: Key factors underlying the challenge - poor administration of change**

<b>Respondent</b>	<b>Key factors underlying the challenge noted</b>
<b>TD2 + 5</b>	D&B contractors do not respond timeously to change requests
<b>TC3</b>	Lack of a robust basis to evaluate change
<b>TC6/MC5</b>	Changes viewed by some D&B contractors as opportunities to make money
	Change quotations heavily priced
	Lack of flexibility to introduce change
<b>TC5</b>	Inflexibility to make change in D&B construction prevents unnecessary changes being made
<b>SC3</b>	Difficult to assess changes as there is no transparency and granularity to the D&B tender make up

#### **5.4.12 POOR QUALITY OF THE END PRODUCT**

MC5 echoed the views raised by a majority of clients interviewed when he stated that *‘the main problem that i have observed over the years is that D&B contractors, once appointed, appear to focus more on cost/time reduction agenda to maximise their profits at the expense of upholding the quality aspects of the project’*. This appears to be a big challenge with a majority of clients as they feel that they have been ‘short changed’ by the D&B contractor.

The D&B contractor is in most cases appears to be seen as positively embarking on choosing materials and plant/equipment for the project that result in generating cost savings *‘whatever and however this may impact the*

*quality aspects'* MC5 went on to say. According to clients there appears to be no '*conscious methodical process that is targeted at enhancing the quality aspects of the D&B project*'. Instead the cost and time elements appear to take '*centre stage and dominate all the decision making process*' without an attempt to '*balance it out with the quality aspects that clients aspire on the project*'

MC5 elaborated further this point by stating that D&B contractors '*seem to ignore the quality aspects and concentrate on those elements that create time and cost savings for them*'. When probed further MC5's explanation appears to purport that the root of the problem can be traced back to the definition of employer's requirements. According to MC5 some employers' requirements gives much flexibility to the D&B contractor to choose materials and plant/equipment for the project that are relatively cheap and in most cases the chosen materials/plant are perceived to be of lower quality standard. He summarised his views by saying '*they seem to try it on when it comes to these matters and whatever they can get away with they will try it*'.

This appears to result in disgruntled clients as their expectations aren't met when the project is ultimately handed over for use. As can be noted from the previous sections the wording of some of the clients' requirements is partly to blame for this as they tend to be performance based rather than prescriptive thereby giving the D&B contractor some flexibility to adopt whatever materials, plant/equipment they need as long as they meet the performance criteria stated in the requirements.

The other problem that MC5 and other clients raised is that although the chosen materials, plant/equipment may meet all the requirements set in the performance specifications they may not necessarily be what the client wants. This introduces another unexplained dichotomy in terms the extent and content of specifications to be adopted for D&B procurement. The challenge is how would one specify requirements in a D&B procured project which would give the D&B contractor the latitude to innovate and 'think outside the box'



and at the same time making allowing adequate controls to ensure that clients get what they want?

Performance specifications can be fulfilled by a wide spectrum of quality standards and out of this spectrum of quality standards perhaps only a few are preferable to the client. Contractors on the other hand, it is felt, have an inclination to opt for those quality standards that are at the bottom end of the scale in order to save on costs. Functionally the elements designed using the lower cheaper quality materials would perform as per the performance criteria but fails short in fulfilling the preference of the client and/or the end user.

MC1 and 8 other clients brought up another perspective to the challenge raised by MC5 by highlighting the challenge of *'inadequacies of the employers' requirements'* as perhaps one of the challenges that generate the perception of the poor quality of the end product in D&B procured projects. MC1 stated that *'due to the inadequacies in the definition of employers' requirements different D&B contractors would naturally interpret the requirements differently'*.

This then, he went on to opine, could compromise the quality of the end product as some D&B contractors would go for the most basic products which may not necessarily be the preferred choice of the D&B client. This then may lead to clients *'getting what they did not want'*. MC1 expanded further on his views by stating that the problem is compounded by the fact that in D&B procured projects there is no independent consultant to check on quality and making sure that the constructed product is compliant with the requirements of the client.

MC3 as well as 6 other clients pursued the challenge of lack of an independent checker in the D&B procurement process by stating that *'the lack of an independent checker on the ground to check that what's being constructed is in line with the specification creates a problem as designers who used to undertake this function are now directly employed by contractors and therefore are unable to perform this function on behalf of the employer'*.

This, he went on to elaborate, may lead to situations in which some construction defects may go unnoticed and get covered up. This will potentially cause problems to clients and their end users during the maintenance period of the facility. The challenge of whole life costing gets impacted resulting in many disgruntled end users and clients who would have inherited these defects.

MC4 traced back this challenge from the perceived client exclusions in design review meetings where perhaps some quality considerations are discussed by stating that *'some contractors tend to exclude us in design review meetings and see us as interfering with their work'*. MC4 feels excluded from key decisions that are made during such review meetings in the design development stages resulting in further problems at the end of the delivery process when the project is handed over for use and the resultant product is perceived to fall short of client's expectations. The problem appears to be further exacerbated when, according to MC4, even where they are involved in design reviews meetings their input in the review meetings in terms of clarifications and/or comment they would have made are sometimes wrongly translated and interpreted as changes to the scope with clients feeling that they are made to pay for challenges that should have been included and taken care of already in the D&B tender.

TC4 introduced another different perspective to the challenge by stating that in cases where there is mistrust between the parties TC4 opined that *'some D&B contractors may take advantage of the loose wording in the employers' requirements and come up with products of the lowest possible quality prompting clients to amend and clarify requirements leading to change and amendment of project costs and time.'*

Views of MC1, MC2 MC5 and others on this challenge confirm what has been raised in the reviewed literature, in particular research findings by Gransberg and Molenaar (2004) who identified that majority of employers' requirements they have reviewed in their research have not been successful in fully communicating employers' quality expectations. In a related research study

that supports these findings undertaken in Singapore by Ling and Chong (2005) found that D&B contractors did not meet clients' expectations in all dimensions of service quality which translate to the perceptions that D&B contractors are not giving clients the satisfaction that they hope for. Interview findings from this theme are summarised in Table 5.8. Poor quality of end product challenge is the second lowest mentioned challenge based on the interview result analysis portrayed in Figures 5.3 and 5.4.

**Table 5.8: Key factors underlying the challenge - poor quality of the end product**

<b>Respondents</b>	<b>Key factors underlying the challenge noted</b>
MC5 + majority	Focus on cost/time reduction at the expense of quality
	Key consideration in decisions tend to be cost savings rather than quality enhancements
	None existence of methodical process to enhance quality aspects of projects
	Flexible employers' requirements
	Performance based specifications as opposed to prescriptive specifications
	Products chosen not necessarily the preferred choice for clients
MC1 + 8	Inadequacies in Employers' requirements
	Different interpretations of Employers' requirements
MC3 + 6	Lack of an independent checker
MC4	Exclusion of clients in design review meetings
	Loose wording in Employers' requirements

#### **5.4.13 TIME ALLOWED IN THE WHOLE PROCESS**

MD2 and 5 other designers raised the challenge of inadequacies in the time that they are given by D&B contractors to come up with a design for incorporation in the D&B tender. MD2 stated that '*as designers we would*

*prefer working for the client as this makes it easier given the way design evolves over time*'. Working for the D&B contractor, he went on to state, *'brings with it some further constraints particularly as clients tend to be involved in the review and approval process of our designs'*. This, he felt, brings in another 'filter' to the process and delays the design process. During the tender stage, he went on to say, designers are sometimes given limited time to review client requirements and *'at best offer limited advice to the D&B contractor who in turn uses that information to come up with a D&B tender that covers not only detailed design but the construction stage as well'*. MD2 further opined that designers often *'get caught in between the infighting between clients and D&B contractors particularly on the interpretation of client requirements especially during design reviews and comments made by clients'*. This, he went on to say, delays the sign off of the design and prolongs the design process which in turn affects the construction phase of the contract. In traditional forms of contract, MC2 noted, designers had to deal with a single party, the client, for review and approval of designs but the D&B procurement method has introduced another 'filter' in the process as design deliverables are subject to reviews by both clients and D&B contractors.

TD2 raised another related point to MD2's observations by stating that *'there isn't much time left to undertake the design properly'* and interface challenges with other stakeholders impose further strains on the time set aside for design.

SD1 raised a point that is related to earlier comments made in the preceding sections regarding the perceived lack of experience and knowledge by some D&B contractors. He explained his point by stating *'in my experience D&B contractors commit to delivery times that are unrealistic without consideration of the design processes that we have to go through in terms of design iterations, reviews and approvals'*. This appears to be one of the major challenges that have also been raised by 4 other designers. They went on to state that at times they are left with no option other than accelerating the design process which may result in sub optimal designs. At the same time, SD1 explained, *'D&B contractors expects us to come up with cost effective designs but without allowing adequate time for the iterations to take place'*.

What this perception show is that in practice there is limited chance for cost effective designs to be produced.

From the D&B contractor's perspective SCN1 and 8 others opined that the tender period that is sometimes set by clients is inadequate to engage with the supply chain, to examine alternative designs and adopt a design that corresponds with the client's requirements. In this period there are also several tasks which the D&B contractor has to undertake such as planning and programming. SCN1 opined that *'this is too much for most if not all D&B tenderers to comprehend and come up with a robust design as well as a competitive D&B tender'*. He summarised his views by stating that *'the main challenge with D&B procurement is that we can never get it right in terms of allowing adequately for design development within our bids given firstly the amount of time allowed for producing a D&B tender (in most cases 6 weeks) and secondly given that we don't manage well the design process after the D&B award'*.

TCN3, in his analysis of the problem, initially highlighted the consequence of the lack of time to the D&B contractor's 'bottom line' by saying *'D&B procured projects bring with them significant risks to the company that no matter how much we try to understand and analyse the risks we end up spending significant amounts of money'* This, he went on to state, result in such D&B projects being unprofitable to undertake.

From a purely financial perspective D&B projects, he went on to state, *'almost always cause us financial grief as we end up spending more than we can recover from the project either because of some risks that we could not effectively manage and eradicate or because of loosely worded client requirements that are open to different interpretations'*. Probed further to explain the origins of these challenges that he had raised TCN3 went on to state that *'the problem originates from the period that is allowed for the tender'*. Given that there is limited time to explore and understand the project more, he went on to say, *'it is always difficult for D&B contractors to fully*

*appreciate the risks posed by the scheme resulting in so many surprises down the line when the project is in the construction phase’.*

SCN1, as well as 5 other contractors, brought up the challenge of lack of time during the tender period to engage more meaningfully with the supply chain by stating that *‘this causes us to lose a lot of money as the eventual design built end up costing us more than the allowances that we would have provided at tender stage’*. Asked to expand on his comments he stated that *‘the tender period that is set is inadequate to engage the supply chain’* leading to costly unrecoverable changes post contract when the supply chain are fully engaged.

MCN1, in support of the comments made by other contractors above also lamented the lack of adequate time by saying that the problem, from his perspective is exacerbated by the fact that the tendering period is often not long enough to enable D&B contractors to review and develop an understanding of the client’s requirements and at the same time develop a competitive tender design that adequately responds to client requirements. He opined that in most cases *‘the tendering period is 4-6 weeks long’* – a period he stated is not long enough for the D&B tenderer to understand client requirements, engage with the market and come up with a lump sum fixed price for the design and construction of the project.

MCN1 further expanded on this by stating that *‘the result of all this is that the contractor’s proposal and tender is ‘rushed’ leading to key challenges and elements of the project being overlooked resulting in future overruns in cost and time as well as disputes’*. He went on to state that another outcome that may result from the relatively short tender period is that *‘clients may not necessarily get an economically advantageous solution from the construction market since D&B tenderers would have spent less than optimal time evaluating the submitted requirements’*. *‘The opportunity to coming up with well thought out design solutions that are economically advantageous to the client’*, he explained further, *‘is therefore lost’*.

To drive home his point in terms of time scales allowed MCN1 said *'in my experience the more the time that is allowed to the D&B contractor to tender for a D&B contract the higher the probability of the D&B contractor to understand the client requirements and come up with a design that correspond with the requirements of the client'. 'The converse is true when there is not enough time allowed to tender for a D&B contract'* he went on to explain. In his view *'the more the complexity of the project the more the time that should be allowed for the D&B contractor to review the requirements and come up with a design, programme and cost for the project'*.

SCN2 offered a different analysis to the challenge from a design manager's view by stating that *'one main challenge for us as design managers working for the D&B contractor is that of timing – by this i mean the fact that at tender stage there is limited time for engaging effectively with the designer in order for a tender design to be provided'* It would therefore appear that the lack of time is not only affecting the D&B contractor and his supply chain used in the delivery of the works but also impacting on the D&B contractors design managers to adequately engage with the designers for the production of an optimal tender design solution.

SCN2 further highlighted other practical challenges that this may cause by stating that *'this timing challenge starts with identifying an appropriate designer who is willing and able to produce a tender design within the time scales set by the client'*. The challenge boils down to, he further explained *'can i go to a single designer or may be go out to the market and get a competitive tender for design services?'* In most such cases, he went on to state, *'there isn't enough time in the tender period for going out in the market and get designers to tender competitively which leaves me with the only option to approach and negotiate with a single designer'*. This therefore appears to limit D&B contractors' ability to get designers to competitively bid for D&B projects. Summary of the findings on this theme are tabulated in Table 5.9.

Based on the analysis of interview results displayed in Figures 5.3 and 5.4 time allowed in the whole process is the seventh highest mentioned challenge.

**Table 5.9: Key factors underlying the challenge - time allowed in the whole process including approvals**

<b>Respondents</b>	<b>Key factors underlying the challenge noted</b>
<b>MD2 +5</b>	Involvement of Clients in design reviews and approval process introduces another 'filter' in the design process.
	Infighting between D&B contractor and client regarding interpretation of requirements causes late design approvals and delays to the process
	Interface with other stakeholders
<b>SD1 + 4</b>	D&B contractors tend to commit to unrealistic time scales
	Inadequate time allowed for design iterations
<b>SCN1 + 8/TCN3</b>	Inadequate time to tender & to undertake design development
<b>SCN1 + 5</b>	Inadequate time to engage with the supply chain
<b>SCN2</b>	Limited time to engage with the designer during tender
	Inadequate time to competitively tender design services

#### **5.4.14 UNCLEAR EMPLOYERS' REQUIREMENTS**

TD4 raised an interesting point that, as a result of lack of clarity in employer's requirements, design review process and comments administration process are sometimes prolonged and may involve revisiting design models and other sections of the design that designers would have completed. This, he stated, is prevalent particularly in situations when client requirements are loosely worded and open to misinterpretation.

MCN1 highlighted the same challenge that purport to resonate with comments made by TD4 above by stating '*one of the main challenges with D&B*



*procurement is the difficulty faced by us D&B contractors in interpreting and understanding the client scope of work'. He went on to state that D&B contractors often find themselves spending a significant amount of time going through the scope document trying to get an understanding of what the client really wants. The difficulty is compounded by the fact that 'in some cases the wording used is so general and difficult to zone in on what exactly the client wants out of the proposed project'.*

In support to the D&B contractors' opinions above designers, in particular, TD3 and 5 others opined that the challenge emanates from the *'performance related specification which usually accompanies the initial design requirements from clients'*. He stated that, in his views, this is difficult to price from a design service provision point. He went on to state that *'in most cases the client's requirements are not clear and are not defined clearly in order for us designers to understand what level of service is required'*.

MCN1 brought in an interesting point that had not been raised before relating to the challenges of change from the perspective of D&B contractors. It may be recalled that in earlier sections clients were bemoaning the fact that D&B contractors appear to approach change from a profit maximisation perspective. However this has been contradicted by MCN1 when he stated that *'due to the inadequacy of the requirements clients tend to introduce change during both the design development stage as well as the construction stage of the project life cycle'*.

He went on to say that *'while some changes can be accommodated without much impact on both cost and time there are some changes that heavily impact on project time and cost and these are the ones that result in conflict between not only the D&B contractor and the client but also strained relationships between the D&B contractor and the designer'*. This is a fascinating point as it purports to state that, contrary to previously stated views that D&B contractors welcome change in the D&B process so that they can make money out of it, this view clearly paints a different picture as it appears

to suggest that D&B contractors tend not to want change as it affects their plans as well as causing conflict with their clients and designers.

TCN4 went further to explain in a different way the consequences of lack of clarity in employers' requirements by stating that *'some of the employer's requirements are difficult to understand leading us to spend lots of times analysing and reviewing them sometimes forcing us to engage external reviewers just to make sure that we understand what the clients really wants to put across'*. Given the limited time given for producing the tender as highlighted in the previous sections what this appears to mean is that valuable time is spent analysing and reviewing tenders instead of concentrating in developing a solution that is cost and time effective.

MCN3 raised a similarly connected challenge emanating from the perceived lack of clarity in employers requirements by saying *'managing clients' expectations is a major constraint that i have encountered over the years'*. Probed to explain how he meant by this MCN3 stated that *'clients expect a lot from the D&B contractor and sometimes the expectations are unrealistic and difficult to fulfil given the quality and comprehensiveness of the requirements'*. This appears to suggest that the difficulty that D&B contractors face in terms of managing clients expectations emanate from the lack of clarity in employers requirements.

MCN1, in further support to MCN3's point above stated that *'one of the challenges that i have encountered with the D&B procurement method is the fact that client requirements are rarely comprehensive and adequately set out for contractors to fully understand what is required'*. In the absence of such a comprehensive requirement schedule some D&B contractors find themselves filling the gaps with what they assume to be required and this result in conflicts in future when it comes to handing over the completed project.

It would appear that clients shared the same views as D&B contractors and designers particularly TC2 and 8 others who opined that defining requirements is one of the most prevalent challenge that they have

encountered in D&B procured projects. They stated that this is clearly demonstrated by the volume of questions that they get asked through tender queries by D&B contractors. They went on to say that the wording of the requirements, the technical terms used and some terminology adopted appear not easily understood by D&B contractors resulting in D&B tenders received being a mismatch between employers requirements and contractors proposals submitted at tender. Observations by TC2 and others on this challenge appear to be in tandem with findings from the reviewed literature particularly research findings by Lim and Mohamad (2000) and Hassan (2009). These researchers found that failings of the D&B procurement emanate from unclear client brief, specification and statement of needs; insufficient time allocated for the briefing, tender documentation and evaluation processes.

It would appear that this is what MC2 was also alluding to when he stated that *'without a clear articulation of their requirements it is difficult for the D&B contractor to understand what is required and therefore would end up guessing what those requirements are and sometimes what has been guessed is not necessarily what the client wants'*. This challenge has been raised in previous sections particularly in the section dealing with the perceived poor quality of the end product of the D&B project delivery process.

TC3 perhaps brings to the fore the apparent paradoxical situation in which clients appears to find themselves in when he stated that *'clients also feel that the other challenge with this procurement method is the difficulty to get what they want'*. Probed on this he expanded on his point by stating that *'clients find themselves in a situation in which if they are too prescriptive in their requirements they are constraining the D&B contractors in coming up with innovative ideas that may be ideal for their needs'*. On the other hand, he went on to say, *'if they provide loosely defined requirements then D&B contractors take advantage of the loose definition and provide solutions that are at the bottom end of the quality scale'*.

TC3's views above have been somewhat highlighted in a different way by SC3 – when he was commenting on the challenge of employers requirements and the level of specification to provide D&B contractors at tender stage. He stated that *'providing a developed schematic design to the D&B contractor to price brings with it other challenges as well'*. *'Firstly'*, he went on to explain, *'the innovativeness and creativity of D&B contractors is severely limited by providing them with a developed schematic design to such an extent that the D&B contractor is left with no option but adopt and develop the provided design through to construction of the required facility'*. *'Secondly'* he further explained, *'if there are mistakes in the developed design that may probably go unnoticed and probably resurface at some point when probably it's too late to change this creates a potential dispute between the client and the contractor'*. *'Thirdly'*, he elaborated further, *'this process is a contradiction to the ethos of D&B procurement as valuable time is lost undertaking the initial design with a professional design house which may not necessarily suit the construction methodology of the D&B contractor resulting in potential waste and loss of valuable time'*.

SC3 summarised his views by stating that *'although the D&B procurement gives you as the client certainty in costs and possibly time provided there aren't significant changes it is doubtful if it provides the client with the product that he wants'*. SC3 appears to express doubt in how this (a quality product) can be achieved without compromising the innovativeness of the D&B contractor when he further commented by saying *'Challenges with this are mainly the difficulty it is to provide the D&B contractor with requirements that are unambiguous without necessarily providing a developed design'*.

The problem highlighted by TC3 and SC3 above have been put in a different context by MC4 when he stated that *'contractors appear to take advantage of the wording within the employer's requirements'* which he went on to say may potentially lead to the production of design solutions and products that are at the lowest end of the quality scale provided they satisfy the performance specification. This, he went on to explain *'is a big challenge with us as we find ourselves with a project that isn't exactly what we were expecting'*.

MC2 traced the origins of the challenge with employers' requirements by stating that *'definition of client requirements is one of the main problems that i have encountered with the D&B procurement method'*. He opined that the root cause of the challenge lies with the lack of resources in some client organisations. He opined that *'clients without the necessary expertise and personnel to manage the process of articulating their requirements will encounter problems with the D&B procurement method as the method depends very much on what is included in Employer's requirements documents'*.

In support to MC2 comments above MC4 also highlighted the challenge of resources as one of the challenges that may compromise the quality of the employers' requirements by stating that *'due to its (D&B procurement) complexity and nature we always tend to put in additional resources to manage the tendering process as well as the delivery of the project'*. *'This can be a strain in some organisations particularly those that are inexperienced in D&B procurement'* he went on to say. Due to this demand in internal client resources he opined that the quality of the information that goes out to the tendering contractors may be compromised leading to challenges with articulation of client requirements.

MC1 provided a view point that, surprisingly, contradicts other clients' views raised in the above sections when he stated that *'employers' requirements that are produced by clients sometimes state in general rather in specific terms and that's where the problem lies'*. *'This'*, he went on to state, *'leads to yet another problem which is common in D&B procurement – quality of the end product'*.

TC4 appears to suggest that although employers' requirements may be perceived as inadequate and loosely defined according to him the biggest challenge that he has encountered with D&B procurement is trust. In his view *'if there is no trust between clients and contractors then the result is a catalogue of problems which end up with adversarial relationships and costly*

*litigation*'. Where there is a lack of trust, he went on to explain, what tends to happen is that employers' requirements are interpreted loosely and any inconsistency or ambiguity is viewed as an opportunity by the D&B contractor to come up with a product and/or solution of the lowest possible quality. Similarly, he went on to explain, where there is a lack of trust some clients are perceived to cunningly putting together ambiguous requirements only to clarify and confirm requirements after contract award and expect the D&B contractor to absorb the time and cost impact that may emanate from this. Table 5.10 summarises the main challenges analysed from this theme.

Unclear employers requirements is the third highest mentioned challenge based on the analysis of interview results portrayed in Figures 5.3 and 5.4

**Table 5.10: Key factors underlying the challenge - Unclear Employers' requirements (ER's)**

<b>Respondents</b>	<b>Key factors underlying the challenge noted</b>
TD4	Inadequacies in ER's manifest in prolonged design reviews
MCN1	Too 'general wording' used in ER's
	Difficulty in understanding/interpreting ER's
	Inadequacy in ER's leading to unnecessary change impacting in project delivery targets
TD3 + 5	Unclear ER's making it difficult for designers to price for design services
TCN4	D&B contractors spending a lot of time analysing/reviewing ER's due to their lack of clarity
MCN3/MCN1	D&B contractors finding it difficult to satisfy clients' expectations due to lack of comprehensiveness in ER's
TC2 + 8/SC3	Client face difficulties in defining ER's
MC2	D&B contractors are forced to guess what clients require due to lack of clarity in ER's
TC3	Clients face practical difficulties in achieving the right balance when formulating ER's as too much detail compromises the D&B contractor's innovativeness
MC4	D&B contractors taking advantage of wording in ER's
	D&B contractors forced to put additional resources in their bidding teams to deal with unclear ER's
MC1	ER's specify requirements in general rather than specific terms
TC4	Lack of trust between the parties resulting in misinterpretation of ER's

#### **5.4.15 UNFAVOURABLE CONTRACTING ARRANGEMENTS**

The challenge of contracting arrangements appear to be prevalent between the D&B contractor and the designer as highlighted by TD3 and other 6

designers when the comment appears to be relating to the contracting pricing format. TD3 commented on this by stating that *'preference for us designers would be to price on the basis of a Target cost but then contractors demand us to provide a lump sum fixed price/Fee which leaves us with significant amount of risk should our interpretation of the client requirements is found to be inadequate during the later stage of the D&B project'*.

MD2 purport to be in support of TD3's views above by appearing to imply that the challenge of providing a lump sum fixed price for design services is further compromised by perceived inadequacies in employers' requirements. He bemoaned the fact that this is interpreted by designers as the D&B contractor passing on the risk to the designer. He stated that *'the other challenge is that designers are requested to provide lump sum price offers for design services at tender stage when there isn't much information available upon which to base our lump sum fee'*. According to TD3 D&B procurement therefore brings with it risks to designers as they are requested to forecast cost for design services required on the basis of scant information and *'in most cases we end up spending more than the lump sum fixed price without any recovery of the additional costs incurred'*.

MD2 further raised another point that designers face in some of the D&B procured projects by stating that *'the design services agreements that D&B contractors challenge us for execution are onerous and put most of the design creep risk on to the designer'*. It would appear from MD2's perspective that D&B contractors want to protect themselves by *'incorporating terms and conditions that puts all design risks on the designer regardless of whether we are able to control and manage them'*. In addition, he went on to opine, some D&B contractors would want designers to carry risks that their professional indemnity insurance policy will not be able to cover resulting in more uninsurable risks to the designer.

TD3 brought up another challenge that came up in several themes covered in earlier sections. He raised the challenge of problems emanating from the way the D&B contractor contractually engages with the supply chain particularly the specialist contractors. He further expanded on this challenge by saying



*'there is another challenge created by the way D&B contractors procure their sub-contractors not only specialist sub-contractors'. He went on to say that, from his experience, specialist subcontractors appear to be unwilling to provide specialist advice to designers in the early stages of the D&B process particularly when they themselves have not yet been procured by D&B contractors. This, he explained, result in designers being left with no option but 'make assumptions on design elements that they have got little knowledge of resulting in potential future problems when the specialist subcontractor has been formally procured by the D&B contractor and is on board'.*

TD2 is of the opinion that contractual arrangements between contractors and designers should be on the basis of professional services appointments that designers use when they are engaged by construction clients. This appears to be a legacy brought about by the traditional design led contractual arrangement in which most designers were procured on the basis of standard design services agreements based on model terms and conditions mostly drafted by their representative professional bodies.

SD2 brought another interesting point that had not been raised neither in the reviewed literature nor in the above sections when he seemed to imply that some designers are of the view that design contracts should be drafted in a way that introduces some incentivisation to the designer. He brought this point by stating that *'it is also difficult to get the designer's buy in into all this if there isn't any incentivisation mechanism into the design contract with gains coming out of the design reviews all ending up in the contractor's pot and none being shared with the designer'*

He further elaborated on this by purporting to suggest that coming out of alternative design solutions that save on both time and money demand the deployment of resources by the designer. If this is not expressly provided in the design contract and supported by appropriate incentivisation mechanism then it will not be able to generate the required benefits. This therefore appear to imply that design agreements that do not encompass these mechanisms

may not be able to achieve the result that D&B contractors would want to achieve when engaging designers in a contractual relationship.

In continuation of the challenge with the contracting arrangements between the D&B contractor and the designer SCN2 raised another practical challenge emanating from perceived onerous design agreements by saying '*most D&B contractors have their own set terms and conditions which they would want designers to sign up to*'. Unfortunately SCN2 went on to state that '*designers don't generally accept these terms and conditions and what tends to happen is that there will be a lengthy period of negotiations between the designer and the D&B contractor before the design services contract is agreed*'.

This will probably impact on the delivery of design deliverables as a lot of time will be wasted discussing and reviewing terms and conditions of engagement. A similar view to SCN2 views above has been provided by Love et al; (1998) and Yogeswaran et al; (1997), who like SCN2 combines the challenge of the perceived onerous design agreements and the lengthy negotiations that tend to follow with the resultant poor contract documents and commercial practices between design team members and D&B contractor teams invariably leading to claims.

MC1 raised a further controversial point which had not been raised before in both the reviewed literature and the sections above when he stated that '*there have been reports of some clients getting good design solutions from D&B contractors without necessarily intending to award the contract and using it to get tenders from other contractors who they believe can be able to deliver the design solution at economical prices and short delivery programmes*'. This is clearly an abuse of the process and not really fair to the D&B contractors who would have spent enormous amounts of time and resources in putting together D&B bids. Table 5.11 provides a tabulated summary of the findings from this theme.

**Table 5.11: Key factors underlying the challenge - Unfavourable contracting formats/arrangements**

<i><b>Respondent</b></i>	<i><b>Key factors underlying the challenges noted</b></i>
<i>TD3</i>	Challenges with the basis of pricing for professional services on a Lump sum Fixed basis considering the lack of detail at tender stage of some D&B contracts
	Late procurement of specialists by D&B contractors leading to late design changes delaying the process
<i>MD2</i>	Lack of a robust basis to determine the level of Fee required to deliver the design services required
	Non recovery of over spends in Fees as most design agreements are on the basis of Fixed lump sum Fees
	Onerous design agreements that put most design risks on the designer
<i>SD2</i>	Mismatch between design risks that D&B contractors pass on to the designers and the payment mechanism in the contract that ignores sharing of benefits emanating from mitigated risks that designer may well have risked out by his designs
<i>SCN2</i>	Lost time and effort in reviewing/agreeing terms and conditions for design services
<i>MC1</i>	Potential misuse of the D&B tender process by some clients who utilise the process to obtain several design options from the market with the intention of letting the D&B contract to their preferred D&B contractor on a develop and build basis

In summary the above stated interview data analysis section has generated a lot of key challenges that key participants to the D&B procurement have come across in practice. The results of findings of these challenges have been extracted using the NVivo analytic software and are portrayed graphically in Figure 5.4. Unfavourable contracting formats/arrangements challenge is the eighth highest mentioned challenge by all three participant categories.

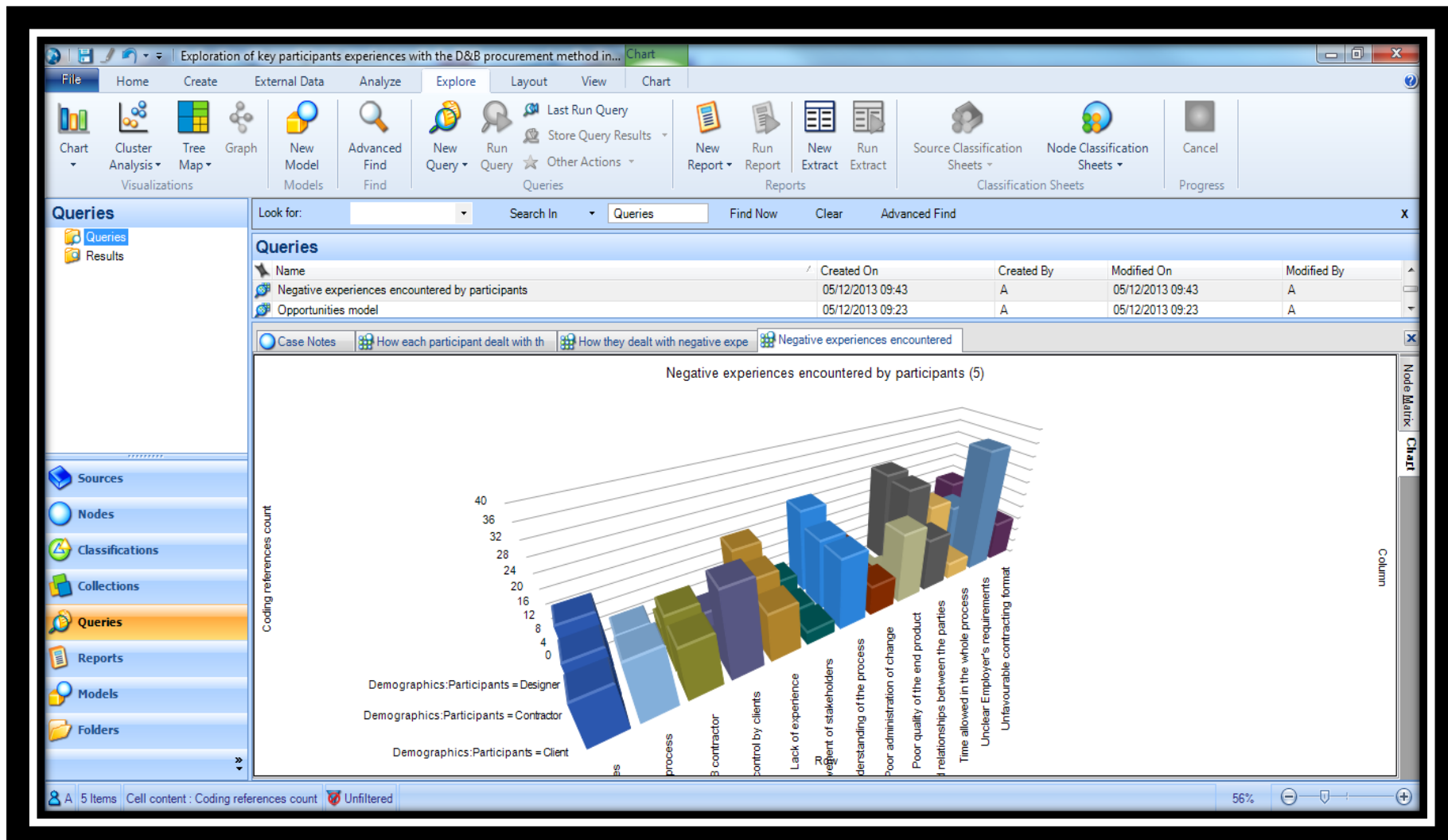


Figure 5.4: Negative experiences encountered by key participants of the D&B procurement method

## **5.5 INTERCONNECTEDNESS OF THE CHALLENGES FACED BY KEY PARTICIPANTS**

Using the matrix coding queries function in NVivo the interconnectedness of the challenges faced by the identified 3 key participants of the D&B procurement method were able to be explored. Although there are numerous interconnected challenges that have been raised by all three participants and reported in sections above the following section only highlights the key interconnected challenges deciphered through the use of NVivo matrix coding query function.

In order to explore this interconnectedness between the challenges faced by clients, designers and contractors a matrix coding query was created as shown in Figure 5.3. Each cell in the matrix represents a node containing the content coded at the intersection of the row and column. By opening each of the cells the researcher was able to explore the interconnectedness of the challenges faced by the key participants.

The results from this analysis of interview data displayed in Figure 5.3 indicate that strained relationships between the parties, unclear employers' requirements, lack of understanding of the process of D&B procurement, lack of experience and conflict of interest between the parties are the main interconnected challenges that key participants interviewed in the research have raised.

Exploring the strained relationship challenge reveal that its origins can be traced back to several factors including contractual set up between the parties, communication between the parties and the administration and management of the contract by the parties. As tabulated in Tables 5.1 (a) and (b) clients are allegedly at times communicating directly with designers and therefore influencing designs that way which is perceived by contractors as problematic and challenging. Similarly designers are bemoaning the fact that specialist input into the design is late or even non-existent until later on in the design process which may lead to waste and design re-work with follow on

consequences on cost and programme. Clients on the other hand are alleging that they are being excluded in design review meetings leading to development of design solutions that they may well not have preferred.

In a similar vein unclear employers' requirements has been raised as a challenge impacting all three respondents. Clients find themselves having difficulties in formulating requirements; contractors and designers find themselves having difficulties in interpreting and understanding the requirements (See Table 5.10).

Lack of experience and understanding of the process is one of the key challenges that has been highlighted by all three participants. The issues underpinning this key challenge are that, through lack of experience and knowledge some clients over specify designs which offer limited opportunity for D&B contractors to come up with innovative designs. Similarly some contractors do not appear to have the necessary experience to manage the design process effectively leading to problems like lack of appreciation of design durations in programme formulation and late harnessing of buildability into the design process (See Table 5.5), all of which is a challenge that designers face with D&B procurement method. Figure 5.8 portrays this interconnectedness of the key challenges identified.

The next section highlights how key participants of the D&B procurement method have dealt with the challenges that they have encountered. Whilst the above section has been concentrating in 'WHAT' the D&B procurement method challenges are from the perspective of D&B procurement method key participants the following section is concerned with 'HOW' such challenges have been dealt with in practice.

It would appear from the analysis of the challenges highlighted in this section that integration of the design and construction processes within the D&B procurement method are seriously compromised. It is clear from some of the challenges highlighted that some of the working practices, methods and behaviours experienced by the participants appear to create a culture that

does not create a culture of efficient and effective integration of design and construction processes. In most of the challenges examined it would appear that there is commonality across all the perceptions and experiences raised by the key participants interviewed. Perhaps this emanates from the fact project risks are passed on from one party to the other down the contractual chain leaving a trail of challenge knock on effects to all parties as the challenges are passed on.

## **5.6 INTERVIEW FINDINGS AND ANALYSIS – HOW THE CHALLENGES WERE DEALT WITH IN PRACTICE**

One of the objectives of the research is to get an understanding of how the D&B procurement method key participants have dealt with the challenges they have encountered. With the help of NVivo data analysis software, the matrix coding queries, the researcher was able to interrogate and find patterns and pursue responses from participants. Patterns in the data were explored using the matrix coding query function. The results from this analysis are shown in Figure 5.5. Each cell in the matrix represented a node containing the content coded at the intersection of the row and column. The researcher was then able to open up the cells and explore and interpret the data contained in each of the nodes in the matrix. The following sections present the results from this analysis.

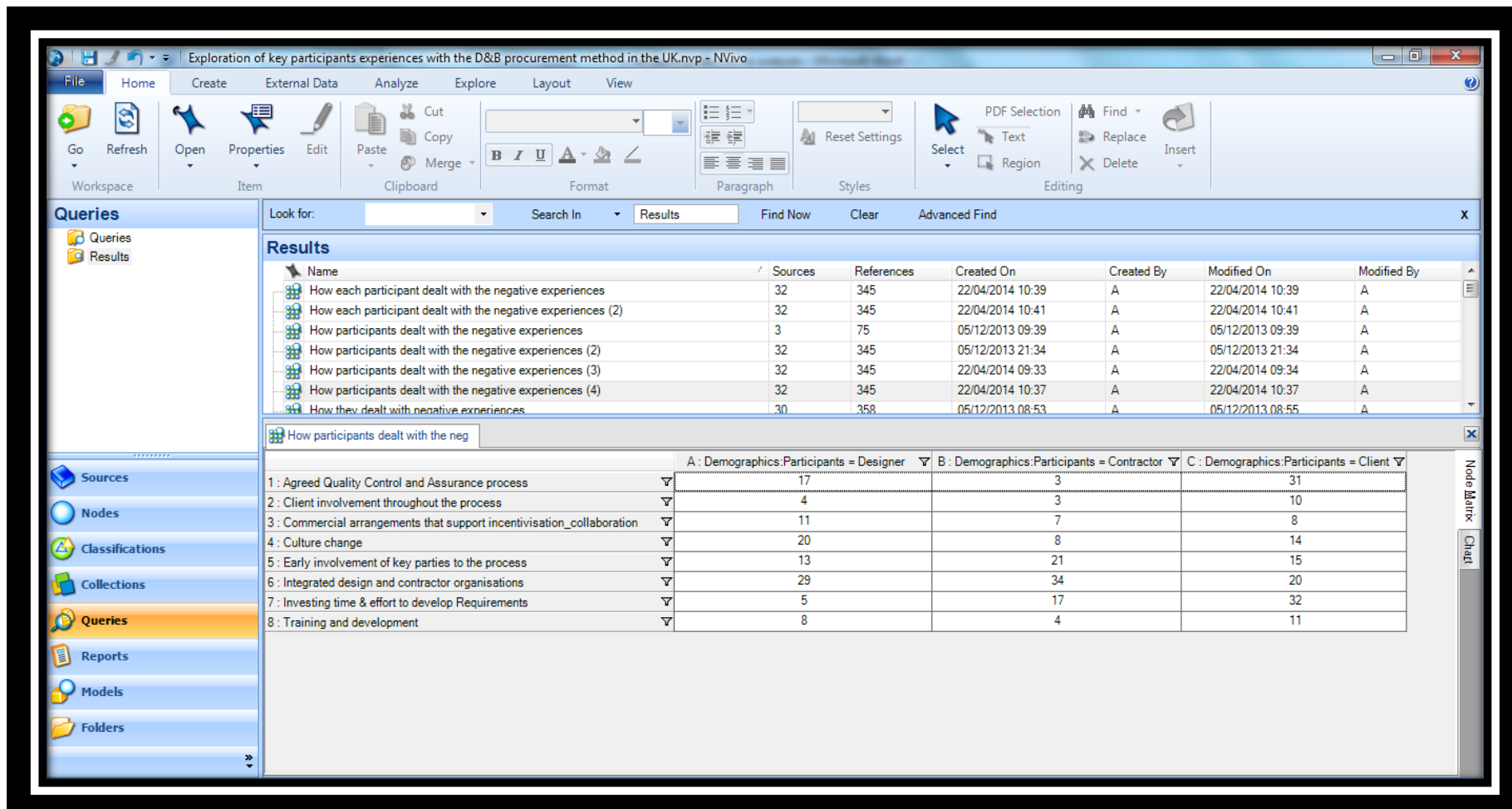


Figure 5.5: How key participants to the D&B procurement method dealt with the negative experiences



How key participants to the D&B procurement have dealt with the challenges that they have encountered has been summarised in Figure 5.5 and the patterns from the responses that emerged were grouped into 8 themes. These are:

- Quality control and assurance processes embedded in all stages of the process – fourth highest mentioned
- Client involvement throughout the process – first least mentioned
- Commercial arrangements that support collaboration – third least mentioned
- Culture change – fifth highest mentioned
- Early involvement by key parties to the process – second highest mentioned
- Integrated design and contractor organisations – first highest mentioned
- Investing time and effort in developing employers' requirements – third highest mentioned
- Training and development – second least mentioned

Each one of the identified theme is explored in the following sections

#### **5.6.1      QUALITY CONTROL AND ASSURANCE PROCESS EMBEDMENT IN ALL STAGES OF THE PROCESS**

It will be recalled that one of the main challenges that has been raised by key participants particularly clients was the perception that D&B procured projects end up giving them what they did not want and that the quality of the product was often of a poor quality. Linked to this challenge was the perception that D&B contractors excludes clients in design review meetings and therefore clients find themselves with no control over decisions made in these meetings.

In addition contractors were of the perception that it's the employers requirements that are not clear which result in misinterpretation of the requirements and therefore a mismatch between what clients wanted and what has been delivered at the end of the process. Similarly designers and

clients had previously raised the challenge of conflict of interest leading up to delivery of perceived poor end product by stating that some D&B contractors are more concerned with cost and time savings at the expense of other quality aspects of the project. They further opined that when faced with a choice to make between cost/time savings on the one hand and quality enhancement aspects some D&B contractors appear to prioritise on the former rather than the latter.

In order to address the above stated challenges in practice key participant suggested several practice based enablers that appeared to have worked on D&B projects that they have worked on. TC4 was of the view that a robust D&B tender enquiry, requesting the D&B contractor to submit detailed submissions in support of their ability to deliver successfully a D&B procured project will provide a significant enabler for an '*end to end robust quality control and assurance process*'. This was the same view shared by 7 other client respondents. Similarly TD3 expressed the view that '*joint collaborative planning from inception to completion*' for the D&B procurement method processes are a potential enabler that may address the quality control and assurance process challenges. TD3 views were also raised by 4 other designers. A similar view was shared by TC1 and 7 other client respondents when he stated that '*D&B contracts should have clearly articulated protocols dealing with design reviews and enable the involvement of the client in the design review and management processes*' Table 5.12 provides a summary of how quality control and assurance processes were implemented in practice.

MCN1 and 3 other contractor respondents, on the other hand suggested a different enabler altogether when he stated that 'the underlying solution to the challenge is to get the employers requirements articulated clearly from the start' He went on to state that '*key stakeholders, particularly within the client organisation must be involved early in putting together the requirements*'

**Table 5.12: Quality control and assurance process**

<b>Respondent</b>	<b>How the enabler was implemented in practice</b>
<b>MCN1 + 3</b>	Developing robust Employers' requirements (ER's)
	Investing in time and effort in the early stages of the Briefing process
	Involvement of key stakeholders in the development of ER's
<b>TC2</b>	Requesting D&B tenderers to submit, as part of their tenders, detailed verifiable performance data sheets for the design proposals underpinning their tenders
<b>TC1 + 5</b>	Incorporating robust design review and management protocols within the D&B contract
	Ensuring that D&B programmes including tender programmes incorporate identifiable design review periods that allow sufficient time for design reviews
	Active involvement of the client team throughout the process
<b>TC4 + 7</b>	Setting up and implementing a robust D&B tender evaluation process that focus on both Price and non price criteria
	Evaluating designers proposed by D&B contractors based on experience, quality specific qualifications on both the design and construction members of the D&B contractor organisation team, performance on similar type projects, and skill sets at their disposal
<b>TD3 + 4</b>	Designer's planner and D&B contractor's planner jointly developing programmes
	Principal designer coordinating and managing design information flow
<b>SC1</b>	Provision of samples prior to approval of key products

A review of the suggested enablers that appeared to have worked in dealing with perceptions of poor end product of the D&B procured project suggest that quality control and assurance processes are key to project delivery regardless of the procurement method used. This also suggest that quality and assurance processes will need to be embedded in the whole D&B procurement process commencing at the formulation of the requirements, tender documentation, evaluation of tenders, formulation of the D&B contract, appointment of the D&B contractor, design management, construction and handing over of the project.

This is perhaps not surprising as the challenges in connection with perceptions of poor quality of the end product have been seen by participants

to have links to several other main challenges of the D&B procurement process.

### **5.6.2 CLIENT INVOLVEMENT THROUGHOUT THE PROCESS**

Several challenges raised by participants in section 5.4 above pertain to the extent of the client involvement within a D&B procurement method environment. From the responses obtained it appears that the extent of the client's involvement may be different from one project to the other but what is clear is that all participants agreed that the client should be driving the process, without necessarily interfering with the duties of the D&B contractor, from project inception to completion.

According to MC4 and views of other 8 clients this process starts with the establishment of a dedicated client project management team equipped with sufficient authority to manage the whole project life cycle from the start to completion and handover of the facility. *'Timeous decision making is key to the process and a high performing client team will be able to facilitate this and by so doing addressing some of the challenges that have been raised in connection with the D&B procurement method'*, MC4 went on to state. SC3 and 5 others went on to state that the client team made up of *'staff that are experienced with the D&B procurement method appear to have worked really well in driving the process seamlessly'*. Such a team will have clear roles and responsibilities that are shared with the others involved to avoid any misunderstanding of who does what within the client team. Incidences of interference with one another's roles and responsibilities will be minimised when such clarity is established and communicated to the team.

SD2 and 3 other designers also share the same view as MC4 above when they stated that, from their experience, they have managed to address many of the challenges raised in section 5.4 above where the client has taken an active role and involved the whole delivery team from the start of the process. Challenges associated with unclear employers' requirements, strained relationships between the parties, lack of involvement of stakeholders and

time allowed in the whole process, from their experience have been addressed by clients who have taken an active role from the start and engaged with key parties to the process at an early stage. This appears to suggest that the client team organisation should not be seen as a standalone team but should be embedded within the project team organisation for transparency and clarity of how roles interlink and relate.

Such early engagement by the key parties has meant that designers, contractors and clients (including key stakeholders) are aware of the project drivers from the start of the process. Each of the parties have the opportunity to gain more insight into the other's requirements and how each one's contribution fit in for the success of the project. From MC4's experience, supported by other 9 clients, the management and coordination of all this is to be driven by a strong client team with clear roles and responsibilities that the whole team share. In his experience MC4 stated provided the client has got a project management team that has got enough authority to drive and manage the process most of the challenges that have been raised in section 5.5 will be addressed. TC2 and 9 others stated that from their experience such a team organisation will entail '*sharing of project objectives and drivers which should help participants in making key decisions as the project develops*'.

TCN3 brought another enabler which he suggested has worked so well on projects that he has been involved with. He explained that some of the confusion and ambiguities in the client team's roles and responsibilities can be addressed through the contract. From his experience, a contract that clearly articulates rights and obligations of the parties makes it easier particularly for the client team to manage the process.

Table 5.13 provides a summary of how client involvement in the process as an enabler was implemented in practice to address some of the challenges raised in section 5.4.

**Table 5.13: Client involvement in the process**

<b>Respondent(s)</b>	<b>How the enabler was implemented in practice</b>
MC4 + 8	Dedicated Project management team with Authority to make decisions
	Clear roles and responsibilities shared by the team
SD2 + 3	Client team engaging early with the delivery team and other stakeholders
TC2 + 9	Client team sharing project objectives/priorities/drivers with the rest of the team to ensure common understanding
	Client team managing the process rather than interfering with the process
SC3 + 5	Client team composed of experienced professionals who understand the D&B procurement process
TCN3	Use of standard forms of D&B contracts that articulates clearly the obligations of the main D&B parties

### **5.6.3 COMMERCIAL ARRANGEMENTS THAT SUPPORT COLLABORATION AND INCENTIVISATION**

Some of the challenges that have been raised in section 5.5 such as strained relationships, conflict of interest, imposition of risks to the D&B contractor, poor administration of change, unfavourable contracting format and lack of control by clients have been said to have been resolved through the use of commercial arrangements that support collaboration and incentivisation mechanisms.

SD2 and 6 other designers suggested that, from their experience, commercial and contracting arrangements that are based on target cost contracts with a mechanism to share gains and losses have worked to address most of the challenges to do with relationships and risks. In their experience this works even better if it is transferred across the whole supply chain including designers.

SC1, in support to SD2 above, suggested the use of joint project risk and opportunity workshops to be used throughout the delivery process. This, he suggested will help address the challenges that tend to emerge as surprises to the project team and if not addressed will end up affecting relationships and quality of the product at the end.

SC3 stated that, in tandem with the establishment and use of Target cost contracts as stated by SD2 above most of the challenges to do with relationships, risks, lack of control by clients, conflict of interest between the parties have been addressed through the use of a development of a project cost plan that each of the parties has 'bought into'. In his view *'the joint establishment a project cost plan removes one of the key sources of non-collaborative behaviour by the parties'* The agreed cost plan will then form the basis upon which the design is managed. In his experience this process is even better managed particularly where a log of over and under spends is kept and tabled for review by the parties. SC2 also stated that he found that where such project costs plans are used the use of cost benchmarks have helped to ensure that the client isn't getting short changed in the process. He went to state that *'benchmarking of cost/time data with other similar type completed projects will encourage parties to focus on delivering value and efficiencies to clients rather than defending project costs that are not supported by previously completed similar projects'*

SCN3 stated that using standard forms of contract that support collaboration from the key parties to the process has helped to facilitate the process of collaboration through the team. In a way of elaborating his point he stated that *'standard forms of contract are mainly balanced in terms of risk profile allocated to the contracting parties'*. He went on to state that *'changing such standard forms may result in one party having to bear more project risks than the other and this causes problems further down the project delivery process'*. Open book accounting has been used as another way to promote collaboration among the project teams as stated by SC2. The open book accounting type arrangement has been used effectively where target cost contracts and framework type contracts have been adopted by clients

according to SC2. Table 5.14 provides a summary of some of the methods that practitioners have come across in the industry which appeared to have worked in addressing some of the challenges raised in connection with risks, conflicts, client control of the process, poor quality of the end product, strained relationships and contracting formats that have been deemed to be unfavourable in section 5.4.

**Table 5.14: Commercial arrangements that support collaboration and incentivisation**

<b>Respondents</b>	<b>How the enabler was implemented in practice</b>
SD2 + 6	Target cost contracts with gain/pain share arrangements
SC1	Joint project risk/opportunity management workshops
	No surprise culture
SC3	Use of Project bank accounts
	Joint establishment and management of project cost plan
SC2	Benchmarking costs
SCN3	Use of forms of contract that support collaboration
SC2	Open book accounting
	Sharing and buy-in of project objectives by the team
	Use of framework type contracts

#### **5.6.4 CULTURE CHANGE**

The challenge of culture change has been highlighted as one of the key enabler that practitioners have found to work in addressing most of the challenges raised in section 5.5 above. Respondents have highlighted that through culture change challenges such as conflict of interest particularly between the designer and the D&B contractor, lack of involvement of stakeholders, imposition of risks to the D&B contractor, strained relationships and unfavourable contracting format can be effectively addressed. They identified several enablers that, in their opinion, have worked.



MD1 and 3 other designers are of the view that setting up project board management teams comprising key personnel from the delivery teams has been seen to work in addressing culture change. They went on to state that the project board members will ensure that culture change disseminates across to the teams and at the same time allow and encourage feedback from project staff. This will allow a culture of openness to prevail and has been seen to encourage change in behaviours.

The one team approach stated above has been seen to be effective particularly where all the team members are co-located. Improved communication has been reported as emanating from this. In MD1's view *'co-location of key project staff encourages the formation of high performing teams'*. This in turn, is said to provide a good basis for culture change.

SD1 and 5 other designers added to MD1's view by stating that joint team forums at project level encourages team synergy which in turn helps to break barriers bounded by professional and cultural prejudices of their members that have been perceived to be prevalent in D&B procured projects as per Moore and Dainty (2001)'s findings reported earlier in the reviewed literature.

TC5 as well as 6 other clients brought up another enabler that helps to create culture change by stating that, from their experience, staff temporary exchange programmes involving staff from one organisation temporarily assigned to work in another organisation has been seen to work in the long term. In particular, they stated that, designers working in a contractor's organisation and vice versa will assist project staff to appreciate what the other does and help to remove the barriers that have been referred to above by SD1.

SC2 and 4 other clients also raised another enabler for promotion of culture change by stating that having lessons learnt at each project gateway go a long way in promoting change in culture as *'parties are encouraged to openly discuss and review what went wrong and what went well which then would help inform the team in future processes'*.

Another completely radical way of promoting culture change is what SCN3 and 7 other contractors have suggested in terms of organisational change. They suggested that most of the challenges to with the D&B contractor and the designer within a D&B organisation environment are addressed by the designer and the contractor merging to form one organisation as opposed to the D&B contractor engaging the designer as a sub-contractor.

Table 5.15 tabulates the key enablers that have been raised by D&B participants as promoting culture change within the D&B procurement method environment.

**Table 5.15: Culture change**

<b>Respondents</b>	<b>How the enabler was implemented in practice</b>
MD1 + 3	Setting up joint project board management teams comprising key personnel from the designer/client/contractor
	Setting up co-located project offices in which most of the key project teams will be located
SD1 + 5	Joint team forums to openly discuss project challenges
TC5 + 6	Temporary placement of resources from one delivery team to the other
	Sharing project objectives/drivers
SC2 + 4	Sharing lessons learnt
	Knowledge share
SCN3 + 7	Joint share and resolution of problems
	Designer and contractor organisation merger

#### **5.6.5 EARLY INVOLVEMENT BY KEY STAKEHOLDERS TO THE PROCESS**

As reported in section 5.4 one of the challenges that has been perceived to have caused problems to projects procured through the D&B procurement method has been the late or lack of involvement by the key stakeholders to

the process resulting in cost and time overruns as well as mismatch between the delivered project and the aspirations of the end user.

According to TCN4 as well as other 7 contractors the process of engagement should commence with the formulation of the employers' requirements. This will enable the key parties to the process to address any ambiguities before it's too late. The involvement of, in particular, the D&B contractor and the designer at this stage will, as suggested by TCN4, *'promote the production of requirements that are understood by the key parties'*

SCN1 and 4 other contractors suggested that early contractor involvement engagement of the contractor with his key suppliers and designer has been effective where it has been applied. They suggested that such early engagement in a formal way has helped to address some of the challenges that have been identified as affecting the D&B procurement process.

Project budget formulation checking and verification prior to decision to build has been said to have worked particularly in cases where there is a formal early contractor involvement contract with a contractor according to SC3. The checking and verification process would involve *'market testing the project cost proposals and where necessary adjustments are made to the budget early in the process'*, he further explained.

TD1 and 6 other designers suggested that bringing in the end user or maintainer of the project early in the process will allow *'early interaction between the designer and the end user in order to avoid challenges down the line when approvals are delayed due to comments that sometimes take time to incorporate when the design has so much developed'*

Similarly MCN1 and 5 other contractors suggested that suppliers of key materials and plant require for the project will need to be engaged with early to establish key aspects such as lead in periods, whole life costing and other technical characteristics before key decisions are made along the way.

SD2 and SCN3 suggested that design development allowances should be jointly set by both the designer and the contractor. They suggested that where this is implemented most of the challenges in connection with designer/client/contractor conflicts and strained relationship appear to be addressed. In addition SD2 stated that designer involvement in the finalisation of some of the critical elements of the D&B tender has worked in addressing some of the challenges raised.

MD2 and 3 other designers suggested that joint risk/opportunity workshops involving key parties to the process help to capture key parties' assessment of key risks on a project and therefore assist the client in getting the right level of allowances in the budget to deal with the unforeseen.

In order to ensure that adequate provisions, particularly the design iterations associated with design development, TD1 stated that involvement of the designer in the preparation and periodic review of the programme budget has worked well and appeared to have addressed the challenges with time allowances made in the programme for design deliverables.

Table 5.16 provides a summary of the enablers that key participants have implemented in practice to advance the early involvement of parties to the process. This enabler has resonance in reviewed literature particularly research efforts by Chan et al. (2010) who, in analysing the critical success factors of target cost contracts, asserted that if a proactive contractor is involved at the pre-construction stage with advanced works, programme planning and materials procurement, the buildability of project design will be enhanced.

**Table 5.16: Early involvements by key parties to the process**

<b>Respondents</b>	<b>How the enabler was implemented in practice</b>
TCN4 + 7	Engaging and involving the designer, the contractor and key stakeholders in the formulation of employers' requirements
SCN1 + 4	Engagement of key parties (including supply chain) under a separate 'Early contractor involvement' capacity
SC3	Involvement of key parties in checking/verifying project budgets prior to decision to build
TD1 + 6	Getting End users' input into key project gateways
MCN1 + 5	Obtaining key suppliers' input in discussions about availability of materials, lead in periods, whole life costs and other technical characteristics of their products
SD2/SCN3	Engaging and involving designers in the determination of allowances for design development risk
	Designers involvement in finalisation of D&B tenders
MD2 + 3	Joint risk/opportunity workshop at the start of the project involving key parties
TD1	Joint development of project master programme taking into account all key processes involved & showing key milestones

### **5.6.6 INTEGRATED DESIGNER/CONTRACTOR ORGANISATIONS**

One of the challenges that have been raised as impacting on key participant to D&B procurement is that roles and responsibilities had continued as if under a traditional design led procurement method leading to a failure to the creation of an integrated project culture. TD4 and 3 other designers have suggested that the creation of framework agreements between the D&B contractor and the designer have been seen to have addressed the non-integration of these two key parties. They suggested that the framework design agreements would capture high level common challenges that deal with most of the challenges that designers and contractors often find themselves disagreeing on.

SD2 and SCN1 similarly suggested the use and adoption of target cost contracts between designers and contractors instead of fixed lump sum contracts that have been highlighted causing challenges with designers resulting in them not fully recovering their costs. This, they suggested, is an enabler for integrating the designer and the contractor as they will be jointly constructing the target costs as well as helping them to share cost information.

Incentivisation mechanisms have been suggested by SD1 and MCN3 as another way to encourage the designer and the contractor to integrate as they will be working towards a common goal promoted by the incentivisation mechanism. Having such a common goal has been seen to '*promote and advance integration of teams*' as stated by SD1.

SD1 came up with even a grand idea that in his view has worked on previous schemes that he has worked. He stated that '*the ultimate integration is brought about when the design house and the contractor merge and become one organisation*'. In his view this works well as the contractor and the designer are accountable to the same holding company and share both liabilities and profitability on the project.

SD2 and SCN3 similarly advised that some consortia composed of designers and contractors directly promote integration as both parties in the consortia will have to work together as they will be sharing the same objectives. TC3 and 5 other clients suggested the undertaking of regular team building events and the setting up of early exchange of ideas within the consortia as another way to promote integration of these organisations.

Table 5.17 is a tabulation of the enablers that have promoted integration of designer and contractor teams.

**Table 5.17: Integrated designer/contractor organisations**

<b><i>Respondents</i></b>	<b><i>How the enabler was implemented in practice</i></b>
<i>TD4 + 3</i>	Setting up framework agreements with designers
<i>SD2/SCN1</i>	Setting up target cost contracts with designers
<i>SD1/MCN3</i>	Incentivisation of the designer and the contractor – sharing financial gains and pains
<i>SD1</i>	Merger of design houses and contractors
<i>SD2/SCN3</i>	Setting up of project delivery consortiums consisting of designers and contractors
<i>TC3 + 5</i>	Regular team building events & forums to exchange & share ideas

#### **5.6.7 INVESTING TIME AND EFFORT IN PUTTING TOGETHER EMPLOYERS' REQUIREMENTS**

It has been suggested in both the reviewed literature and in interviews undertaken that most of the failings of the D&B procurement method emanate from unclear client brief, specification and statement of needs. Kelly et al (1992). Latham (1994) and Murray (1996) both argued that the challenge is not only restricted to D&B procured projects but extends to cover the wider construction industry.

Key participants to the D&B procurement method identified several practice based enablers that they perceive to have worked in addressing this challenge. SD1 and 10 other designers stated that clients who set up a dedicated team of people who have the requisite skill, knowledge and experience in D&B procurement to draw up employers' requirements have been seen to have addressed this problem. They went on to opine that such a team to be effective '*must have the requisite authority and support to achieve the necessary deliverables associated with employers' requirements*'.

SD2, SC1 and MCN3 similarly stated that such a team should be adequately resourced and should comprise key stakeholders representatives *‘in order to get their ‘buy-in’ from the start’* In addition to the key stakeholders in this process TCN5 and SD1 stated that designers and contractors should also be involved to ensure clarity in the wording used. Sufficient time for undertaking the formulation of employers’ requirements should be allowed in the overall programme for the project as suggested by TCN3 and 7 other contractors.

TC1 and 6 other clients suggested the adoption of a sign off process by key stakeholders as the employers’ requirements pass through the programme gateways. Table 5.18 provides a summary of the enablers that have been used in practice to address the challenge of inadequacies in employers’ requirements.

**Table 5.18: Investing time and effort in putting together employers’ requirements**

<b>Respondents</b>	<b>How the enabler was implemented in practice</b>
SD1 + 10	Set up a team with the requisite skill and experience to draw up employers’ requirements
TCN3 + 7	Allow sufficient time in the overall programme for this process to be adequately addressed
TC1 + 6	Sign off by key stakeholders at each gateway/milestone
TCN5/SD1	Involve designers and contractors in the process or market test to establish correct interpretation and understanding
SD2/SC1/MCN3	Involve key stakeholders including users in the formulation of employers requirements



### 5.6.8 TRAINING AND DEVELOPMENT

One of the challenges raised in both the reviewed literature and the interviews undertaken appear to point to a lack of understanding of the D&B procurement method processes by participants. Several enablers to facilitate training and development of the D&B process have been highlighted.

SC3 and 4 other clients suggested the use of regular project workshops facilitated by experienced D&B practitioners as one of the ways in which training and development in the practical use of D&B as a procurement method has been used to disseminate training and development of project members.

Similarly SD1 and SCN2 stated the use of lessons learnt on completed D&B projects being documented, disseminated and applied in future D&B projects. This helps to ensure the promotion of what SCN2 referred to as '*good D&B practice and avoidance of bad D&B practice*' SD1 went on to suggest the use of regular 'tool box talks' aimed at topical D&B challenges to ensure the dissemination of D&B knowledge amongst the teams.

TC5 and 6 other clients suggested the use of regular targeted staff exchange programmes particularly between the engineering staff of the contractor and the designer. This, he stated, can help to promote an understanding of what happens in both the design office and the contractors' site.

On the job training is one of the enablers that TD4 and MCN2 suggested for D&B management staff particularly design managers. MCN2 suggested that if this is done properly design managers in particular will benefit and will be better prepared to deal with the challenges associated with design management within a D&B procured project environment.

TCN1 and SC3 suggested the adoption of non-price D&B tender evaluation criteria that incorporates training and development of staff. What this would

bring is *'the promotion of staff training and development in D&B procurement'* as explained by SC3.

With the advent of IT applications (apps) SCN2 suggested that Question and Answer apps accessible to all project participants is another enabler that teams can access and share good practice in D&B procurement.

Table 5.19 tabulates a summary of the highlighted enablers that can be implemented to promote training and development in D&B procurement use.

**Table 5.19: Training and development**

<b>Respondents</b>	<b>How the enabler was implemented in practice</b>
SC3 + 4	Undertake regular project workshops facilitated by experienced D&B practitioners
SD1/SCN2	Undertake lessons learnt on completed D&B projects, document, disseminate & apply on future D&B projects
	Undertake regular tool box talks on D&B topical challenges
TC5 + 6	Undertake regular targeted staff exchange programmes between designers and contractors
TD4/MCN2	On the job training and mentoring for key D&B management staff
TCN1/SC3	Clients identifying training and development of D&B contractor staff as one of the key criteria in D&B tender evaluation
SCN2	Setting up Q&A apps dedicated to D&B challenges which are accessible by all project participants

Findings on practice based enablers that have been used or being proposed to deal with the challenges highlighted in sections above are summarised and graphically portrayed in Figure 5.6 using the modelling tool in NVivo.

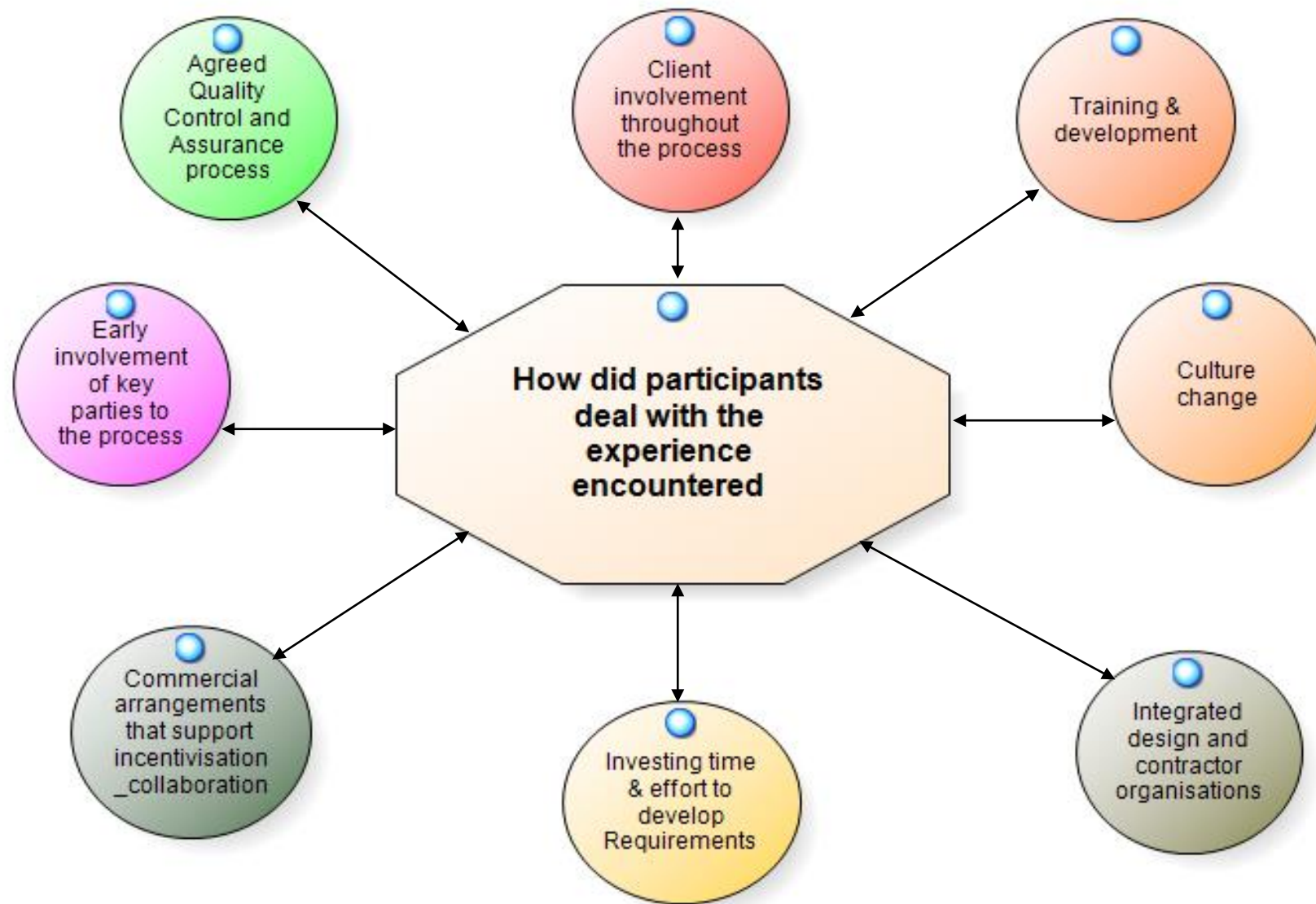


Figure 5.6: NVivo model - How Participants dealt with the experience encountered

## **5.7 CHAPTER SUMMARY AND KEY FINDINGS**

Key findings from the reviewed literature as summarised in Figure 3.2 and augmented with additional and new findings from the interviews undertaken are summarised and depicted in Figure 5.7.

From the data analysis undertaken in this research practice based key enablers that key participants to the D&B procurement method have highlighted can be seen to fall into 4 main key categories. These are people, process, project risks and contractual.

The contractual category encapsulated key challenges and enablers to do with the contract. For instance one of the main challenges that designers raised during interviews was the challenge of design agreements raised by D&B contractors that were perceived to be onerous. This key challenge was then categorised under 'contractual' matters. Challenges that have been raised pertaining to the way in which the process of drawing up employers requirements, process of D&B contractor engagement, evaluation process and such like process challenges were similarly categorised under 'Process'.

In the same vein any challenges relating to how key participants viewed each other in terms of experience, understanding of the procurement method, managerial aspects and the way participants communicate in practice were categorised under 'People'.

Similarly any challenges relating to risks and how they were perceived to be shared and managed in the whole procurement process were categorised under 'project risks'. The results of this analysis culminated in Figure 5.7 depicted below which shows the 13 key challenges identified by all three participants and how they can be dealt with in practice. The interconnectedness of the challenges raised by all three key participant categories have been covered in subsection 5.5 and is graphically portrayed by Figure 5.8.

## D&B Procurement method: key challenges and related enablers

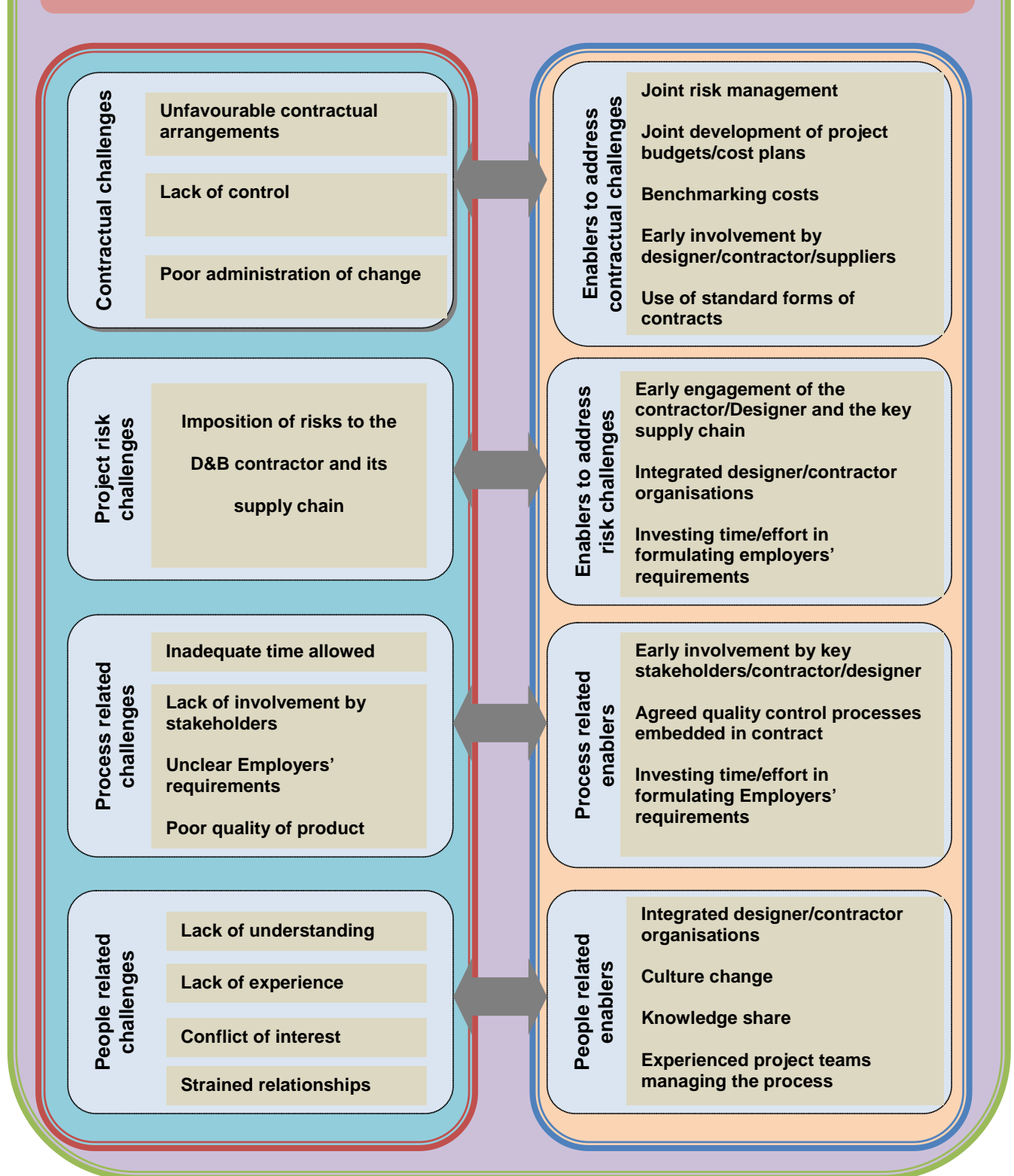
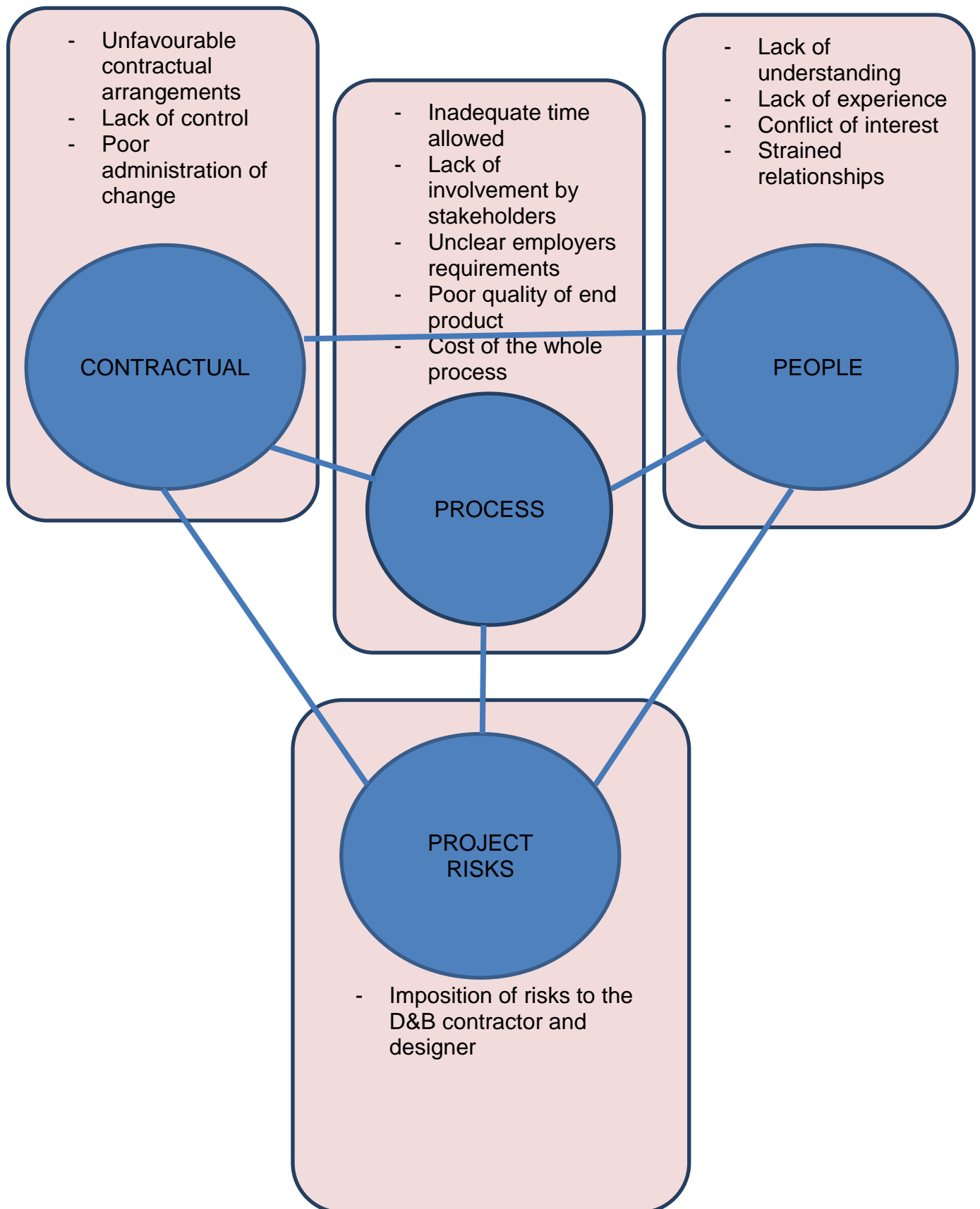


Figure 5.7: D&B procurement method: Key challenges and related enablers



**Figure 5.8: Interconnectedness of key challenges**

From the interviews undertaken it is evident that there is some interrelatedness in the key challenges encountered by all three key participant categories. For instance contractual arrangements are perceived to allocate significant design and construction risks to the D&B contractor which in turn result in such risks being passed on to the designer and other supply chain parties. Such 'passing on of risks' from one party to the other in the chain is perceived to result in strained relationships among and between the key parties causing conflict and disputes which could have been avoided. In addition such risks are perceived to be instigated from process related key challenges such as unclear employers' requirements and inadequate time allowed in the whole D&B procurement method processes.

Lack of involvement by key parties and key stakeholders is also said to result in this 'risk dumping' from one party to the other. Lack of understanding and/or lack of experience in the D&B procurement method is also perceived to contribute to the formulation of unclear employers' requirements, poor set up of contractual mechanisms to manage the contract, poor management of the design and build processes resulting in further strained relationships and conflicts. This shows that the key challenges are all inter-related and they impact each other in so many different ways.

The introduction to the chapter reiterated the main research proposition as the development of a framework to address and enhance better integration leading to the achievement of desired results associated with D&B procurement method. To achieve this aim initially pilot interviews were conducted followed by semi-structured interviews with 33 targeted key participants of the D&B procurement method in the UK construction sector. The chapter presented a comprehensive analysis of the main findings of both the pilot interviews and the main interviews.

The findings from the data analysis are summarised as follows. There is a myriad of challenges that key participants to the D&B procurement method have encountered in practice which mostly, ironically, suggest that integration of design and construction may be a long way to achieve in the construction

sector in spite of the reported increased usage of the D&B procurement method in the UK construction sector over the last couple of decades. Although the interview section highlighted several new findings in connection with challenges faced by key participants of the D&B procurement method there is no broad dissimilarity to the key findings generated and reported in the reviewed literature as presented and summarised in chapter 3.

This chapter also highlighted that despite the challenges encountered key participants of the D&B procurement method have come up with practice based enablers that have assisted them to deal with some of the key challenges they have encountered. Based on the responses from the face to face interviews undertaken the chapter also condensed these findings into 4 main categories viz; people, process, risks and contractual arrangements against which the identified key challenges and practice based enablers were assigned as depicted in Figure 5.7.

The next chapter presents the results of the survey that has been undertaken as part of this research process in order to understand further what the wider audience had to say about the severity of the key challenges and key enablers raised by D&B practitioners in the interviews section of the research.



## **CHAPTER 6**

### **ANALYSIS OF FINDINGS: QUANTITATIVE ANALYSIS**

#### **6.1 INTRODUCTION**

The chapter presents the quantitative part of the research. It addresses the data collection process, the sample size, responses to the questions and presents inferences and conclusions where appropriate. Although data saturation was achieved in the qualitative section of the research questionnaire surveys are used to gain further views from other different respondents in order to compliment the research findings presented in chapter 5.

In addition to gaining further understanding of the underlying challenges experienced by a wider and different population of respondents to the ones used in the interview phase of the research It may be recalled that one of the research question was to get more insight into the severity of these. The chapter intends to address these 2 main research questions. The challenges raised by key participants of the D&B procurement method in the qualitative phase of the research as outlined in chapters 2, 3 and 5 were used as the basis of the survey questions in the quantitative phase of the research.

It may further be recalled that one of the objectives of the research as stated in chapter 1 is to undertake an assessment of the severity of the challenges raised by key participants of the D&B procurement method. The output of such an assessment will be used to inform and provide focus for the formulation of some of the key aspects of the framework proposed by the research to facilitate better integration of design and construction processes when D&B is used as a procurement method in construction of the built environment.

Although surveys as a research method has advantages in obtaining large amounts of data from a large number of individuals and is said to be value

free it is not without its own problems one of which is response rates. The problem was adequately addressed in the sampling method used as discussed in chapter 4. The response rate of 25% is well within the norm for surveys within the construction industry which are said to be between 20 – 30% (Akintoye and Fitzgerald, 2000).

Although there are two branches of statistics namely descriptive statistics and inferential statistics as stated by Nadim (2009) the researcher mainly used the descriptive statistics as the purpose of the survey was mainly concerned with how the respondents rate the challenges that have been raised in the interview stage of the research. The questionnaires used in the research are included as Appendices E-G. The findings are presented and a concise chapter summary is provided at the end of the chapter.

## **6.2 QUESTIONNAIRE OVERVIEW**

The first set of questions targets specific information about the respondents' experience within the construction sector, the respondent's period of involvement in the UK construction sector, the approximate annual outturn that the respondent's organisation achieves and the proportion (in value terms) of projects that the organisation has delivered using D&B procurement method over the last 10 years. The aim of this part of the questionnaire is to get some background information about the respondents' experience within the construction sector as well as their involvement with D&B procurement method.

The second set of questions looks at gaining insights into the challenges that respondents have come across when they were delivering projects through the D&B procurement method. The aim of this section is to investigate the perception of respondents to some of the key challenges that have been raised in the interview section of the research. Although the qualitative phase of the research highlighted 13 key challenges it was found from the interview section of the research in chapter 5 that 3 of them shared the same underlying factors. The formulation of questions followed an amalgamation of related key

challenges. This resulted in the amalgamation of lack of understanding and lack of experience challenges into one challenge. Conflict of interest and strained relationships were similarly amalgamated into one related challenge. Similarly lack of control and poor quality of the product were amalgamated into one related challenge. This resulted in the formulation of 10 key questions on the basis of 10 amalgamated key challenges (1. Unfavourable contractual arrangements; 2. lack of control/poor quality of the product; 3. poor administration of change; 4. imposition of risks to both the D&B contractor and to the designer; 5. inadequate time allowed; 6. lack of involvement by stakeholders; 7. unclear employers' requirements; 8. cost of the whole process; 9. lack of understanding/lack of experience; 10. strained relationships/conflict of interest).

Each of the respondent category questionnaire questions were drafted around the amalgamated 10 key challenges in order to provide answers to research question 3 and to accomplish the requirements of research objective 2 set out in chapter 1. As noted in the reviewed literature and interview section of the research each of the respondent category encounters the noted challenges in a different way (e.g. the challenge in connection with employers' requirements – for clients, on the one hand, the challenge is mainly to do with formulation of robust requirements and at the same time leaving room for the contractor to come up with innovative ideas. Designers and contractors, on the other hand, find it difficult to interpret employers' requirements).

Hence the questions were drafted to reflect the way in which each respondent category is impacted by the challenge. The last section of the questionnaire looks at gaining insights into the severity of the challenges that have been raised in the qualitative survey section of the research and therefore addresses the 3<sup>rd</sup> research question of the research.

## 6.3 QUESTIONNAIRE ANALYSIS

### 6.3.1 RESPONDENTS PROFILE

This section describes the sample space and the general profile of the respondents in terms of who they are, their job title, years of experience within the construction sector and their organisation's approximate annual turnover.

The objectives of these questions are three-fold:

- To gain an understanding of the respondents' experience in the construction sector in general
- Respondents' organisations involvement in the construction sector over the last 5 -10 years
- To gain an understanding of the proportion of respondents' organisations' annual turnover in the last 5 -10 years that is attributable to D&B procurement.

Table 6.1 provide a categorisation of the respondents based on whether they work for designer, contractor or client organisation.

**Table 6.1: Participant categorisation**

	Frequency	Percent	Valid Percent	Cumulative Percent
<b>Client</b>	12	13.3	13.3	13.3
<b>Contractor</b>	60	66.7	66.7	80.0
<b>Designer</b>	18	20.0	20.0	100.0
<b>Total</b>	<b>90</b>	<b>100.0</b>	<b>100.0</b>	

From Table 6.1 it can be seen that the majority of respondents are contractors with clients and designers comprising a relatively lower proportion but as revealed in chapter 5 there is commonality in most of the challenges raised by

all the key participants. What is also relevant in this research is the number of years' experience that the respondents have spent in the construction sector and in particular if that experience was mostly spent undertaking projects delivered through the D&B procurement method. Table 6.2 shows the respondents' years of experience within the construction sector.

**Table 6.2: Respondents' Years of Experience**

	<b>Mean</b>	<b>N</b>
<b>Client</b>	27.33	12
<b>Contractor</b>	23.00	60
<b>Designer</b>	23.56	18
<b>Total</b>	<b>24.63</b>	<b>90</b>

The above Table 6.2 show the average years' experience for the respondents to be over 20 years which is significant as this shows that the respondents are relatively experienced people. Their views are therefore noteworthy and provide significant insight into the research questions under investigation. This coupled with the respondents' job titles as shown in Table 6.3 also indicate that the respondents are a varied mixture of directors, project managers and other senior posts within their organisations which also adds variety to views that they have raised in connection with their experience with D&B procurement. Their level of experience and seniority within their organisations give further validity to the survey results.

**Table 6.3: Respondents' Job Title**

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
<b>Director</b>	12	13.30	13.30	13.30
<b>Project Manager</b>	36	40.00	40.00	53.30
<b>Other</b>	42	46.70	46.70	100.0
<b>Total</b>	<b>90</b>	<b>100.0</b>	<b>100.0</b>	

Table 6.4 shows that the organisations in which the respondents work are actively engaged in construction activity as approximately 57% of the respondents indicated that their organisations' average annual outturn is over £400 million. This indicates that they are actively involved in construction and therefore it can be inferred that they are aware of the challenges that affect construction particularly D&B procurement.

**Table 6.4: Respondents' Organisation's Average Annual spend in property development**

	Frequency	Percent	Valid Percent	Cumulative Percent
<b>Up to £50 million</b>	11	12.2	20.0	20.0
<b>+ £50 - £200million</b>	20	22.2	17.8	37.8
<b>+£200 - £400million</b>	8	8.9	4.4	42.2
<b>+£400million</b>	51	56.7	57.8	100.0
<b>Total</b>	90	100.0	100.0	

Similarly Table 6.5 indicates that 99% of the respondents' organisations have been involved in construction activity for over 10 years. This means that their organisations are fairly established construction players whose views should be noteworthy. Property development in this case was taken to be the carrying out of any construction activity in or over land. As the research was targeted to contractors, designers and clients in the top 100 construction activity league tables the term 'property development' and 'UK construction sector' was deemed common, applicable and relevant to the identified respondent categories.

**Table 6.5: Length of time (in years) Respondents Organisation has been involved in property development/UK construction sector**

				Total
	Client	Contractor	Designer	
<b>+5-10 years</b>	0	0	1	1
<b>over 10 years</b>	12	60	17	89
<b>Total</b>	12	60	18	90

Table 6.6 indicates that the proportion of projects delivered annually using D&B procurement method in most respondents' organisations is over 50%. This is significantly relevant to the research given that the focus of the research is to explore challenges encountered by participants when delivering projects using the D&B procurement method. This also shows that the respondents are not only experienced in construction but also experienced in D&B procurement.

**Table 6.6: Proportion (in value terms) of projects delivered using design and build as a procurement method over the last 5-10 years**

	Participant			Total
	Client	Contractor	Designer	
<b>0-10%</b>	0	4	0	4
<b>10-20%</b>	0	6	4	10
<b>20-30%</b>	4	10	2	16
<b>30-40%</b>	2	0	0	2
<b>40-50%</b>	0	8	0	8
<b>50-60%</b>	0	10	2	12
<b>60-70%</b>	2	20	4	26
<b>70-80%</b>	2	2	2	6
<b>80-90%</b>	2	0	4	6
<b>Total</b>	<b>12</b>	<b>60</b>	<b>18</b>	<b>90</b>

### **6.3.2 D&B PROCUREMENT CHALLENGES AND THEIR SEVERITY AS PERCEIVED BY KEY PARTICIPANTS - CONTRACTORS**

D&B procurement challenges that emerged from both the reviewed literature and interviews were put across to the respondents in order to get an understanding of their perception of the challenges. This is in pursuance with one of the objectives of the research as stated in chapter 1. The respondents were requested to rank the challenges on a scale of 1 – 10, with 1 being low severity and 10 being high severity.

The One sample Wilcoxon Signed rank test (the Wilcoxon test) was deemed appropriate for this kind of data. The data are ordinal and therefore categorical data that has been ranked by respondents. Other statistical tests (Mann Whitney, Kruskal-Wallis, Friedmann) are only used provided certain standard assumptions such as normality and independence are satisfied.



Factor analysis was deemed inappropriate on the basis that the data that it requires should be quantitative at the interval or ratio level. Ranked data that is used in this research is ordinal data that is more suited for testing by the Wilcoxon test. These other statistical tests cannot be used if the normality assumption is not satisfied or that large samples were used. The assumption made for the Wilcoxon test is that the variable being tested is symmetrically distributed about the median. The one sample Wilcoxon Signed rank test uses medians in the analysis and allows the researcher to test whether a sample median differs significantly from a hypothesized value.

Each of the challenges (variables) that have been identified by the contractors in the initial qualitative stage of the research is analysed and presented below. The median of the rankings were assumed to be symmetrically distributed about the median value 5.5. (5.5 is the median of the rankings). Challenges ranked between 1 and 5.5 were classified as low severity challenges subject to the result of the significance test computed using the Asymptotic significance (1 sided test) – see conditions 1 and 2 stated below. Challenges ranked over 5.5 were classified as high severity challenges subject to the result of the significance test computed using the Asymptotic significance (1 sided test) – see condition 3 stated below.

The median value 5.5, and conditions 1 and 2 stated below, has been used as the research proposition. The Asymptotic significance (1 sided test) is used to calculate the statistical significance of the difference between the observed median and the hypothetical median of each of the variables (challenges faced by key participants) and is used as the key decision rule in this analysis. This is because the Asymptotic significance (1 sided test) calculates the significance of the difference between the observed medians and the hypothetical median value 5.50. This provided the researcher with an understanding of the statistical significance of the differences. There may well be a difference between the observed mean and the hypothesised mean but if the difference is not statistically significant then the research proposition is retained. If the following two conditions were satisfied then the decision rule

was to retain the research proposition that the challenge being tested is considered a low severe challenge by respondents:

**Condition 1**

- If the observed median the variable is 5.50 or less and the calculated Asymptotic significance (1 sided test) is greater than 0.05 or

**Condition 2**

- If the observed median of the variable is greater than 5.50 and the calculated Asymptotic significance (1 sided test) is greater than 0.05.

Similarly if the following condition is satisfied then the decision rule was to reject the research proposition and conclude that the challenge being tested is considered a high severe challenge by respondents:

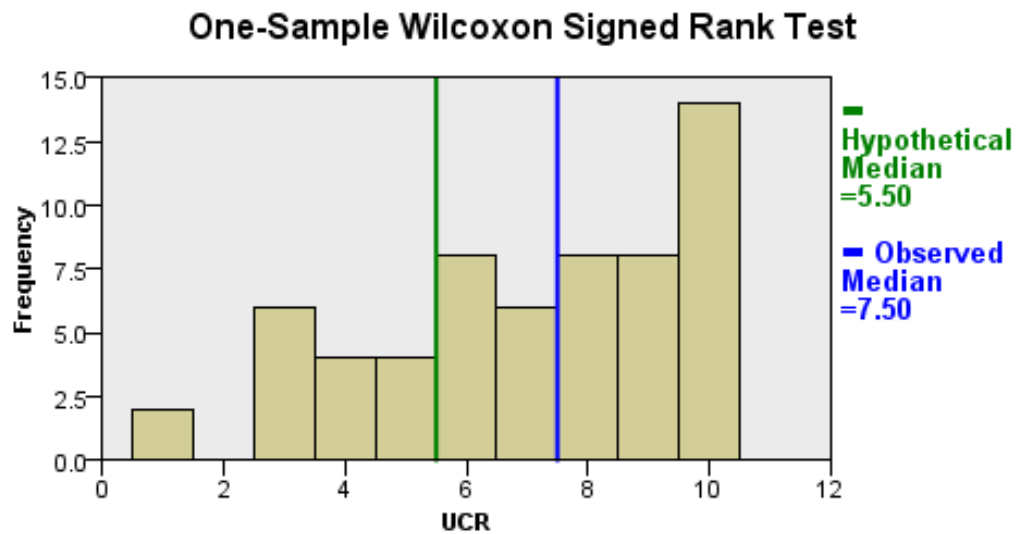
**Condition 3**

- If the observed median of each of the variables is greater than 5.50 and the calculated Asymptotic significance (1 sided test) is less than 0.05

The statistical package for social science (SPSS) is used for the computation of the One sample Wilcoxon Signed rank test and the results for each of the identified challenge are shown in the following Figures 6.1 to 6.30.

**Challenge 1: Unclear/Incomplete Client Requirements (UCR)**

The first attribute to be analysed was 'Unclear or incomplete client requirements' (UCR) and the results of the statistical analysis are presented in Figure 6.1:



<b>Total N</b>	<b>60</b>
<b>Test Statistic</b>	1,452.000
<b>Standard Error</b>	135.069
<b>Standardized Test Statistic</b>	3.976
<b>Asymptotic Sig. (1-sided test)</b>	0.000

**Figure 6.1: Challenge 1 - Contractor: Unclear/Incomplete Client Requirements (UCR)**

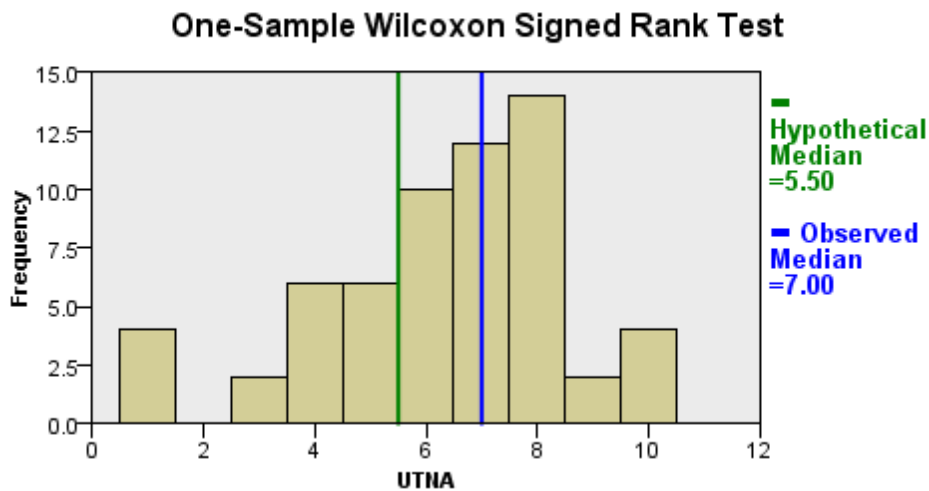
From the above Figure 6.1 the observed median is greater than 5.50 and the calculated Asymptotic Significance (1 sided test) is less than 0.05 at the 5% significance level. This satisfies condition 3 which means that, according to Contractor respondents involved in D&B procurement method, challenge 1 'unclear or incomplete client requirements' is a high severity challenge. The research proposition is therefore rejected. Table 6.7 tabulates the variable analysed, the research proposition, the statistical test used and the decision rule made.

**Table 6.7: Challenge 1 - Contractor: Unclear/Incomplete client requirements (UCR)**

Variable	Proposition	Test	Decision
Unclear/Incomplete client requirements (UCR)	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Reject the research proposition

**Challenge 2:** Underestimated time needed for approvals (UTNA)

Challenge 2 was raised by D&B contractors in the qualitative section of the research in which there was a general perception that some clients underestimate the time that is needed to process all the approvals that are required prior to the D&B contractor undertaking and progressing designs to allow timeous commencement of the physical works. Analysis of the results from the survey is shown in Figure 6.2.



<b>Total N</b>	<b>60</b>
<b>Test Statistic</b>	1,315.000
<b>Standard Error</b>	134.725
<b>Standardized Test Statistic</b>	2.969
<b>Asymptotic Sig. (1-sided test)</b>	0.002

**Figure 6.2: Challenge 2 - Contractor: Underestimated time needed for approvals (UTNA)**

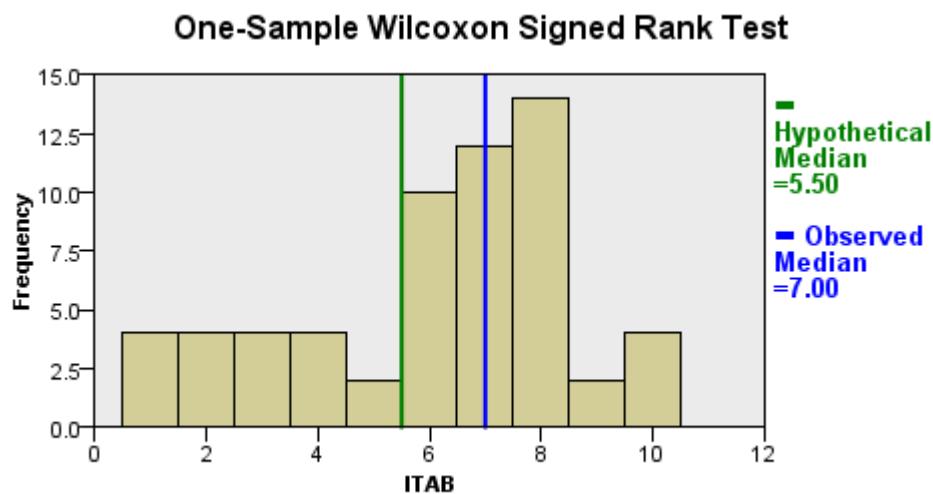
From the above analysis the observed median of the rankings is 7.00 and the calculated Asymptotic significance (1 sided test) is less than 0.05 at the 5% significance level. This meets all the requirements se for condition 3 which means UTNA is a high severity challenge as perceived by contractor respondents. The research proposition is therefore rejected. Table 6.8 tabulates the variable analysed, the research proposition, the statistical test used and the decision rule made.

**Table 6.8: Challenge 2 - Contractor: Underestimated time needed for approvals (UTNA)**

Variable	Proposition	Test	Decision
Underestimated time needed for approvals (UTNA)	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Reject the research proposition

**Challenge 3:** Insufficient time allocated to briefing, tendering and evaluation processes

The results from the statistical analysis undertaken on this challenge are shown in Figure 6.3.



<b>Total N</b>	<b>60</b>
<b>Test Statistic</b>	1,161.000
<b>Standard Error</b>	134.892
<b>Standardized Test Statistic</b>	1.824
<b>Asymptotic Sig. (1-sided test)</b>	0.034

**Figure 6.3: Challenge 3 – Contractor: Insufficient time allocated to briefing, tendering and evaluation processes (ITAB)**

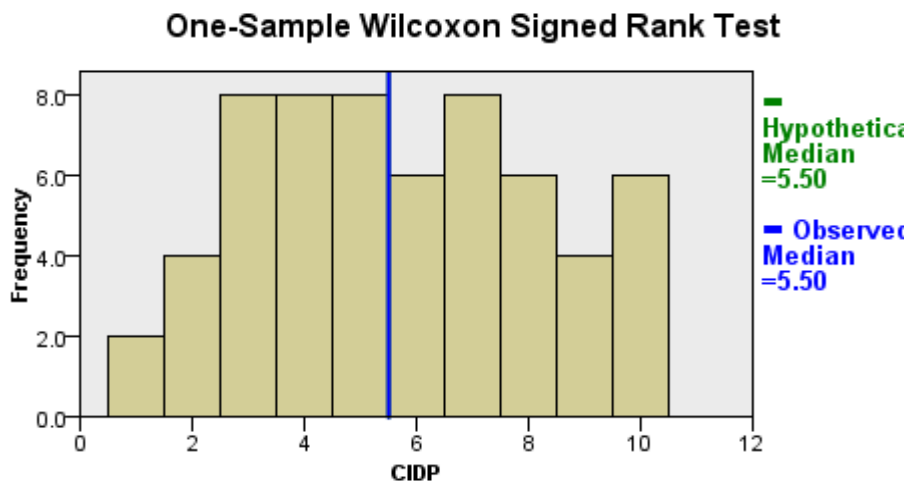
The statistical result on challenge 3 [showing an observed median of 7.00 and an Asymptotic significance (1 sided test) of less than 0.05] indicate that D&B contractor respondents surveyed rank it as a high severity challenge (as it satisfies all the requirements for condition 3) and therefore the research proposition is rejected on this basis. Table 6.9 provides a summary of the statistical analysis undertaken

**Table 6.9: Challenge 3 - Contractor: Insufficient time allocated to briefing, tendering and evaluation processes (ITAB)**

Variable	Proposition	Test	Decision
Insufficient time allocated to briefing, tendering & evaluation processes (ITAB)	Conditions 1 and 2.	One sample Wilcoxon Signed Rank test	Reject the research proposition

**Challenge 4:** Clients interference with the design process (CIDP)

Figure 6.4 shows the results from the statistical analysis undertaken



<b>Total N</b>	<b>60</b>
<b>Test Statistic</b>	983.000
<b>Standard Error</b>	135.029
<b>Standardized Test Statistic</b>	0.504
<b>Asymptotic Sig. (1-sided test)</b>	0.693

**Figure 6.4: Challenge 4 - Contractor: Clients interference with the design process (CIDP)**

The observed median of the rank for this variable/challenge is 5.50 and the Asymptotic significance (1 sided test) is greater than 0.05. This meets the requirements set in condition 1 of the decision rule. The decision rule on this variable is therefore to accept the research proposition and conclude that this variable/challenge is of a low severity according to the contractor respondents surveyed. Table 6.10 provides a summary of the analysis

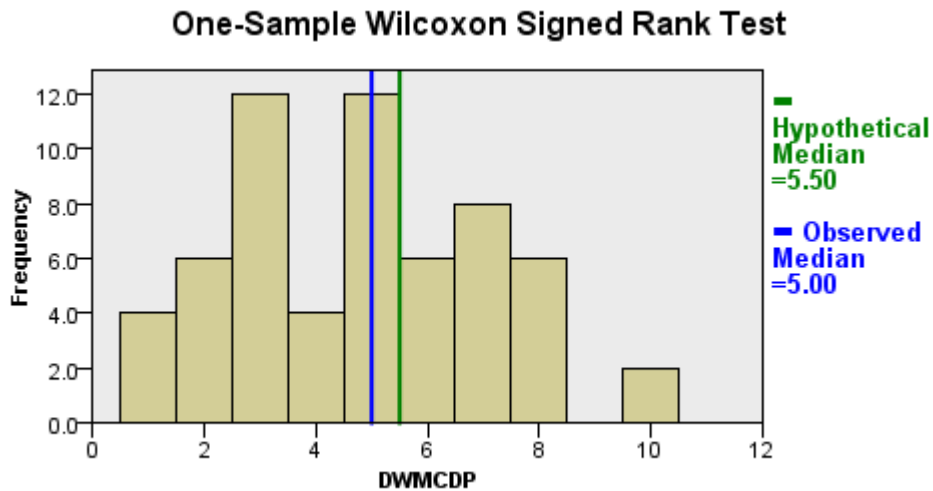


**Table 6.10: Challenge 4 - Contractor: Clients interference with the design process (CIDP)**

Variable	Proposition	Test	Decision
Client's interference with the design process	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 5:** Difficulties working, managing and communicating with design professionals (DWMCDP)

Figure 6.5 shows the results from the statistical analysis undertaken



<b>Total N</b>	<b>60</b>
<b>Test Statistic</b>	605.000
<b>Standard Error</b>	134.780
<b>Standardized Test Statistic</b>	-2.300
<b>Asymptotic Sig. (1-sided test)</b>	0.990

**Figure 6.5: Challenge 5 - Contractor: Difficulties working, managing & communicating with design professionals (DWMCDP)**

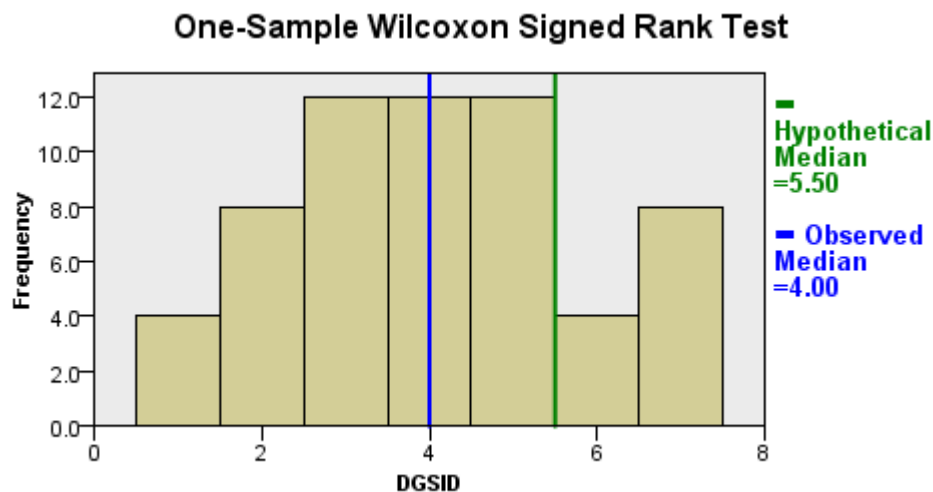
The observed median ranking for this challenge is 5.00 and the Asymptotic significance (1 sided test) is greater than 0.05. This meets the parameters for condition 1 which means challenge 5 is perceived to be of low severity by the surveyed contractor respondents. The decision rule is therefore to retain the research proposition. Table 6.11 provides a summary of the analysis undertaken.

**Table 6.11: Challenge 5 - Contractor: Difficulties working, managing and communicating with design professionals (DWMCDP)**

Variable	Proposition	Test	Decision
Difficulties working, managing & communicating with design professionals	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 6:** Difficulties getting specialist input into the design (DGSID)

Figure 6.6 shows the results from the statistical analysis undertaken



<b>Total N</b>	<b>60</b>
<b>Test Statistic</b>	246.000
<b>Standard Error</b>	134.736
<b>Standardized Test Statistic</b>	-4.965
<b>Asymptotic Sig. (1-sided test)</b>	1.000

**Figure 6.6: Challenge 6 - Contractor: Difficulties getting specialist input into the design (DGSID)**

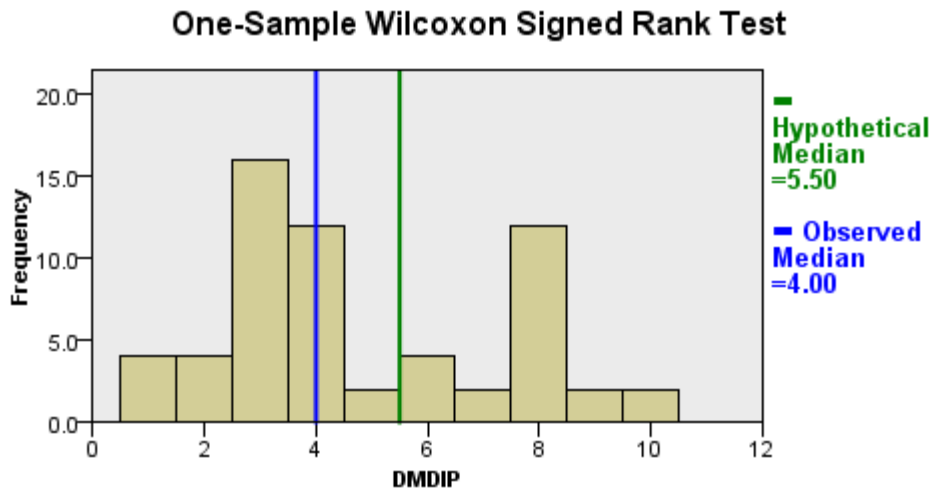
The observed median from the rankings provided by the surveyed contractor respondents is 4.00 which is lower than the research proposition value of 5.50 and the calculated Asymptotic significance (1 sided test) is greater than 0.05. This satisfies the requirements for condition 1 and therefore means that challenge 5 is not considered to be of a high severity by the contractor respondents surveyed. The research proposition is therefore retained. Table 6.12 provides a summary of the analysis undertaken.

**Table 6.12: Challenge 6 - Contractor: Difficulties getting specialist input into the design (DGSID)**

Variable	Proposition	Test	Decision
Difficulties getting specialist input into the design	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

#### **Challenge 7:** Difficulties managing the design iteration process

Figure 6.7 shows the results from the statistical analysis undertaken



<b>Total N</b>	<b>60</b>
<b>Test Statistic</b>	673.000
<b>Standard Error</b>	133.887
<b>Standardized Test Statistic</b>	-1.807
<b>Asymptotic Sig. (1-sided test)</b>	0.965

**Figure 6.7: Challenge 7 - Contractor: Difficulties managing the design iteration process (DMDIP)**

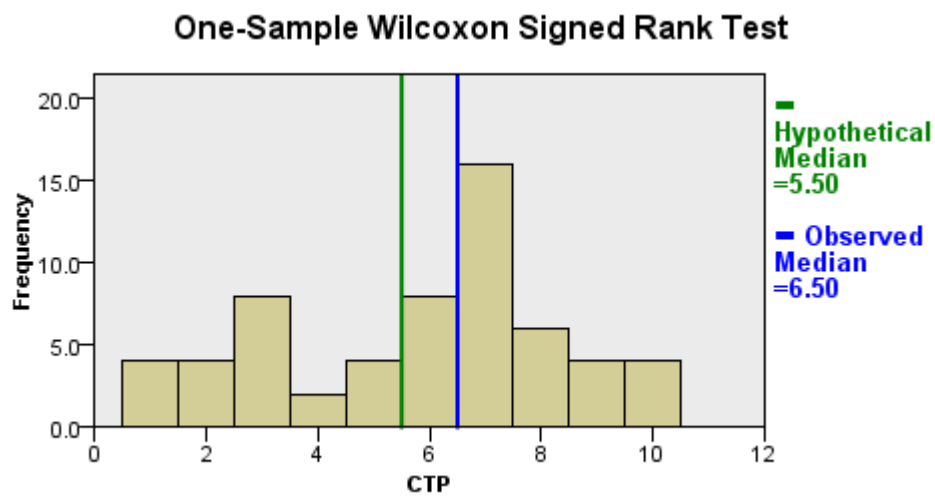
The observed median from the rankings provided by the surveyed contractor respondents is 4.00 and the Asymptotic significance (1 sided test) is greater than 0.05 which fall within the requirements for condition 1. This means that challenge 7 is not considered to be a high severity challenge by the respondents surveyed. The research proposition is therefore retained. Table 6.13 provides a summary of the analysis undertaken.

**Table 6.13: Challenge 7 – Contractor: Difficulties managing the design iteration process (DMDIP)**

Variable	Proposition	Test	Decision
Difficulties managing the design iteration process	The median is 5.5 or less.	One sample Wilcoxon Signed Rank test	Retain the research proposition

### Challenge 8: Costly Tender Process (CTP)

Figure 6.8 shows the results from the statistical analysis undertaken



Total N	60
Test Statistic	1,041.000
Standard Error	134.973
Standardized Test Statistic	0.934
Asymptotic Sig. (1-sided test)	0.176

**Figure 6.8: Challenge 8 - Contractor: Costly tender process (CTP)**

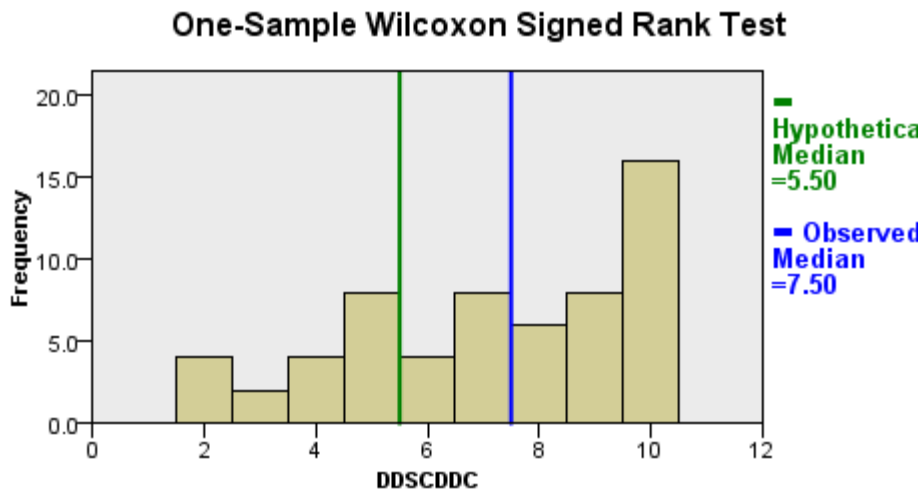
The observed median from the rankings provided by the surveyed contractor respondents is 6.50 but the calculated Asymptotic significance (1 sided test) is greater than 0.05 which meets condition 2 of the research proposition. This means that challenge 8 is not considered to be a high severity challenge by the respondents surveyed at the 5% significance level. The research proposition is therefore retained. Table 6.14 provides a summary of the analysis undertaken.

**Table 6.14: Challenge 8 - Contractor: Costly tender process (CTP)**

Variable	Proposition	Test	Decision
Costly tender process	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 9:** Difficulties differentiating Scope change from design development change (DDSCDDC)

Figure 6.9 shows the results from the statistical analysis undertaken



<b>Total N</b>	<b>60</b>
<b>Test Statistic</b>	1,493.000
<b>Standard Error</b>	135.092
<b>Standardized Test Statistic</b>	4.279
<b>Asymptotic Sig. (1-sided test)</b>	0.000

**Figure 6.9: Challenge 9 - Contractor: Difficulties differentiating Scope change from design development change (DDSCDDC)**

The observed median from the rankings provided by the surveyed respondents is 7.50 which is higher than the research proposition value of 5.50 and the calculated Asymptotic significance (1 sided test) is less than 0.05. This is statistically different from the hypothesised value at the 5% significance level. This means that challenge 9 is considered to be a high severity challenge by the contractor respondents surveyed. The research proposition is therefore rejected. Table 6.15 provides a summary of the analysis undertaken.

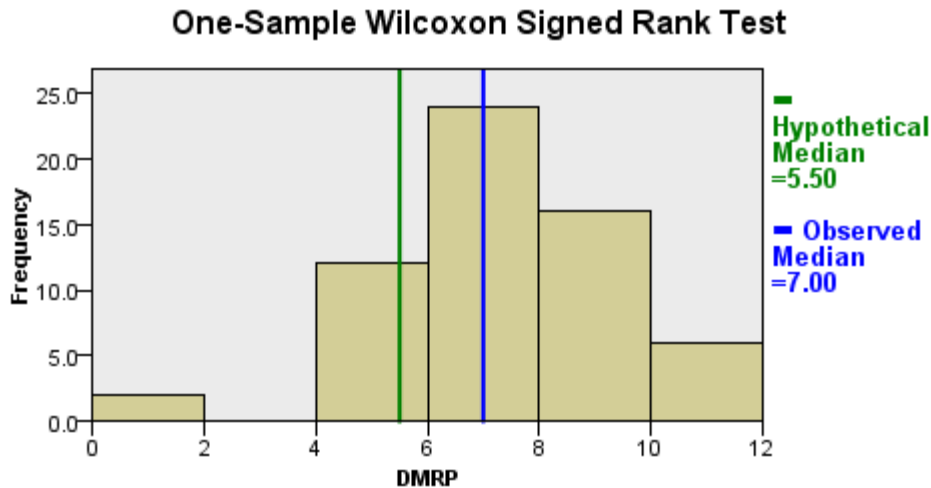


**Table 6.15: Challenge 9 - Contractor: Difficulties differentiating Scope change from design development change (DDSCDDC)**

Variable	Proposition	Test	Decision
Difficulties differentiating scope change from design development change	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Reject the research proposition

**Challenge 10:** Difficulties managing risks passed on by clients which would have been better managed by clients (DMRP)

Figure 6.10 shows the results from the statistical analysis undertaken



<b>Total N</b>	<b>60</b>
<b>Test Statistic</b>	1,615.000
<b>Standard Error</b>	134.662
<b>Standardized Test Statistic</b>	5.198
<b>Asymptotic Sig. (1-sided test)</b>	0.000

**Figure 6.10: Challenge 10 - Contractor: Difficulties managing risks passed on by Clients which would have been better managed by Clients (DMRP)**

The observed median from the rankings provided by the surveyed respondents is 7.00 and the calculated Asymptotic significance (1 sided test) is less than 0.05. This therefore meets all the requirements for condition 3. This is statistically different from the hypothesised value which means that challenge 10 is considered to be a high severity challenge by the contractor respondents surveyed. The research proposition is therefore rejected. Table 6.16 provides a summary of the analysis undertaken.

**Table 6.16: Challenge 10 - Contractors: Difficulties managing risks passed on by clients which would have been better managed by the client (DMRP)**

Variable	Proposition	Test	Decision
Difficulties managing risks passed on by clients which would have been better managed by the client	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Reject the research proposition

Summary of challenge severity as perceived by the contractor respondents surveyed are tabulated in Table 6.17.

**Table 6.17: Summary of the observed rankings and their severity as perceived by the contractor respondents**

Challenges raised by Contractors	Rank test	Asymptotic Test	Severity
1. Unclear/incomplete client requirements	7.50	0.000	High
2. Underestimated time needed for approvals	7.00	0.002	High
3. Insufficient time allocated to briefing/tendering/ evaluation processes	7.00	0.034	High
4. Clients interference with the design process	5.50	0.693	Low
5. Difficulties working/managing/communicating with designers	5.00	0.990	Low
6. Difficulties getting specialist input into the design	4.00	1.000	Low
7. Difficulties managing the design iteration process	4.00	0.965	Low
8. Costly tender process	6.50	0.176	Low
9. Difficulties differentiating scope change from design development	7.50	0.000	High
10. Difficulties managing risk passed on by clients	7.00	0.000	High

From Table 6.17 it can be seen that, according to D&B contractors surveyed in this research the high severity challenges are challenges 1 - 3, 9 and 10 which are 'unclear/incomplete client requirements (UCR)', 'underestimated time needed for approvals (UTNA)', 'insufficient time allocated to briefing, tendering and evaluation processes (ITAB)', 'difficulties differentiating scope change from design development change (DDSCDDC)' and 'difficulties

managing risks passed on by clients which would have been better managed by the client (DMRP)'. All the other challenges 4 - 7 and 8 are perceived to be low severity challenges by D&B contractors surveyed in this research. This highlights the interconnectedness between the main findings of the reviewed literature and the findings from the interviews undertaken. It's noteworthy to see that the challenges that have been highlighted as high severity by D&B contractors in Table 6.17 have been a common feature underpinning the findings from the reviewed literature as well as from the interviews undertaken as summarised in Figures 3.2 and 5.7

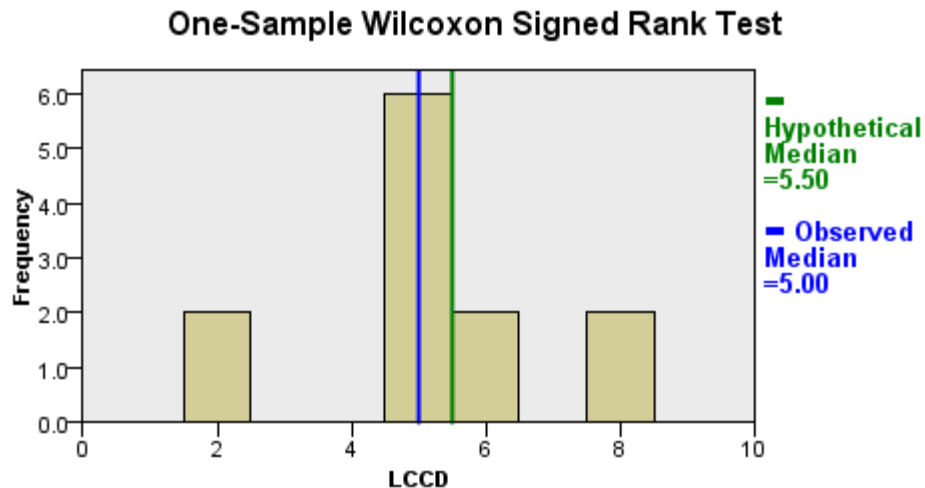
### **6.3.3 D&B PROCUREMENT CHALLENGES AND THEIR SEVERITY AS PERCEIVED BY KEY PARTICIPANTSS - CLIENTS**

The same analytical process that was undertaken for Contractor respondents was adopted for client respondents. The respondents were requested to rank the challenges on a scale of 1 – 10, with 1 being low severity and 10 being high severity.

The One sample Wilcoxon Signed rank test was used as the statistical tool to analyse the ranks in order to inform the researcher of the severity of the challenges/variables identified. The results of the analysis are presented below.

**Challenge 1:** Lack of or insufficient communication with the contractor's designer

Results from the statistical analysis undertaken are depicted in Figure 6.11.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	28.000
<b>Standard Error</b>	12.319
<b>Standardized Test Statistic</b>	-0.893
<b>Asymptotic Sig. (1-sided test)</b>	0.814

**Figure 6.11: Challenge 1 - Clients: Insufficient communication with the contractor's designer (LCCD)**

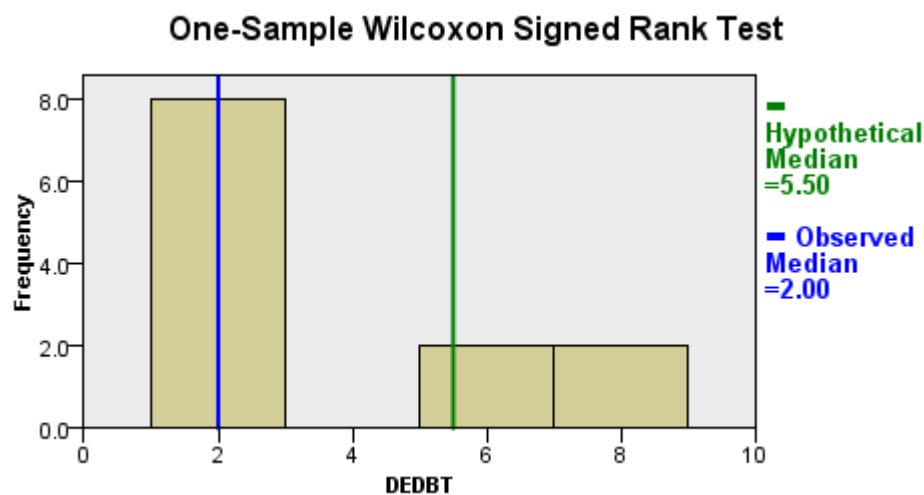
The observed median from the rankings provided by the surveyed respondents is 5.00 which is less than the research proposition value of 5.50 and the calculated Asymptotic significance (1 sided test) is greater than 0.05. This meets all the requirements for condition 1. This means that challenge 1 is not considered to be a high severity challenge by the client respondents surveyed. The research proposition is therefore retained. Table 6.18 provides a summary of the analysis undertaken.

**Table 6.18: Challenge 1 - Clients: Lack of/insufficient communication with the contractor's designer (LCCD)**

Variable	Proposition	Test	Decision
Lack of/insufficient communication with the contractor's designer	Proposition.	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 2: Difficulty in evaluating D&B tenders**

Results from the statistical analysis undertaken are depicted in Figure 6.12.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	10.000
<b>Standard Error</b>	12.319
<b>Standardized Test Statistic</b>	-2.354
<b>Asymptotic Sig. (1-sided test)</b>	0.991

**Figure 6.12: Challenge 2 – Clients: Difficulty in evaluating D&B tenders (DEDBT)**

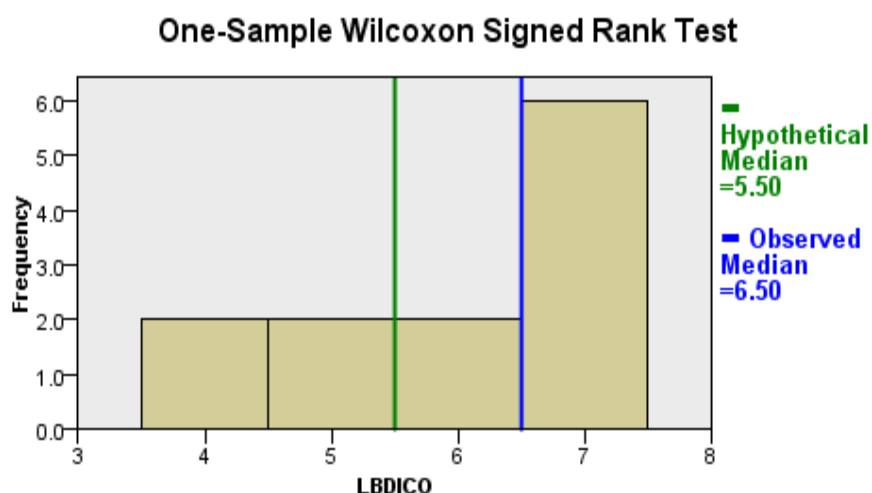
The observed median from the rankings provided by the surveyed respondents is 2.00 which is less than the research proposition median value of 5.50 and the calculated Asymptotic significance (1 sided test) is greater than 0.05. This therefore satisfies the requirements for condition 1. This means challenge 2 is not considered to be a high severity challenge by the client respondents surveyed. The research proposition is therefore retained as the challenge is perceived to be of a very low severity by clients. Table 6.19 provides a summary of the analysis undertaken.

**Table 6.19: Challenge 2 - Clients: Difficulties in evaluating D&B tenders (DEDBT)**

Variable	Proposition	Test	Decision
Difficulty in evaluating D&B tenders	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 3:** Loss of benefit of designer's independent construction oversight and monitoring

Results from the statistical analysis undertaken are depicted in Figure 6.13.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	56.000
<b>Standard Error</b>	12.278
<b>Standardized Test Statistic</b>	1.385
<b>Asymptotic Sig. (1-sided test)</b>	0.083

**Figure 6.13: Challenge 3 - Clients: Loss of benefit of designer's independent construction oversight and monitoring (LBDICO)**

The observed median from the rankings provided by the surveyed respondents is 6.50 which is higher than the research proposition value of 5.50 but the calculated Asymptotic significance (1 sided test) is greater than 0.05 which means the difference is not statistically considered significant. This therefore falls within the parameters of condition 2. Challenge 3 is therefore not considered to be a high severity challenge by the client respondents surveyed. The research proposition is therefore retained as the challenge is perceived to be of low severity by clients. Table 6.20 provides a summary of the analysis undertaken.

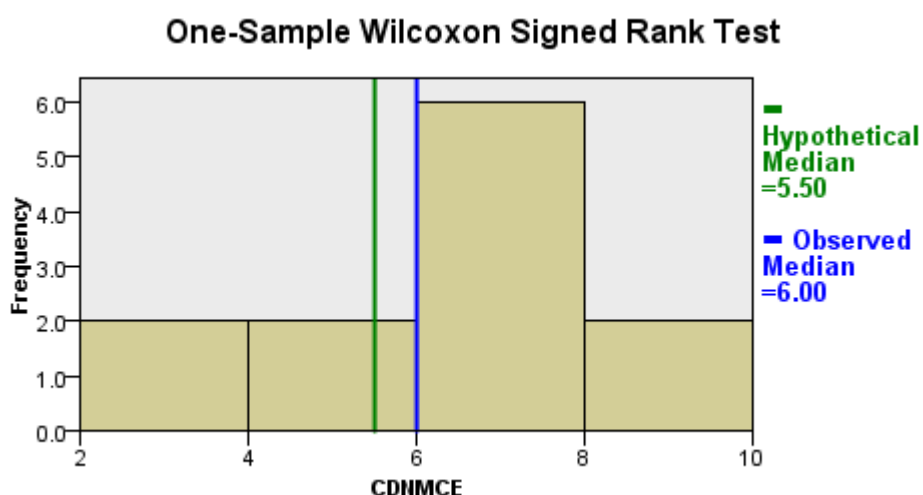


**Table 6.20: Challenge 3 - Clients: Loss of benefit of designer's independent construction oversight and monitoring (LBDICO)**

Variable	Proposition	Test	Decision
Loss of benefit of designer's independent construction oversight & monitoring	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 4:** Contractor's design not meeting/satisfying clients' expectations

Results from the statistical analysis undertaken are depicted in Figure 6.14.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	<b>42.000</b>
<b>Standard Error</b>	<b>12.520</b>
<b>Standardized Test Statistic</b>	<b>0.240</b>
<b>Asymptotic Sig. (1-sided test)</b>	<b>0.406</b>

**Figure 6.14: Challenge 4 - Clients: Contractor's design not meeting/satisfying clients' expectations (CDNMCE)**

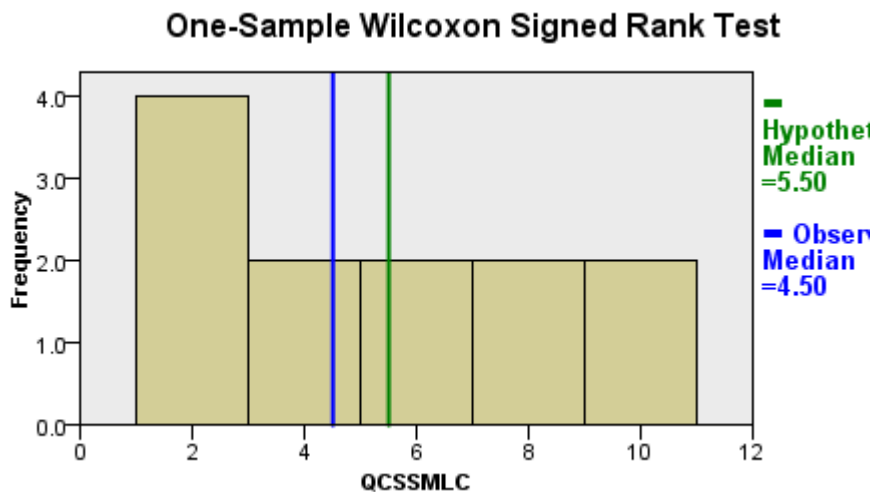
The observed median from the rankings provided by the surveyed respondents is 6.00 which, although higher than the research proposition value of 5.50 is not significantly different based on the calculated Asymptotic significance (1 sided test). This meets the requirements for condition 2. This means challenge 4 is not considered to be a high severity challenge by the client respondents surveyed. The research proposition is therefore retained. Table 6.21 provides a summary of the analysis undertaken.

**Table 6.21: Challenge 4 - Clients: Contractor's designer not meeting/satisfying client's expectation (CDNMCE)**

Variable	Proposition	Test	Decision
Contractor's designer not meeting/satisfying client's expectation	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 5:** Quality criteria/design standards sacrificed to minimum levels by the contractor

Results from the statistical analysis undertaken are depicted in Figure 6.15.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	28.000
<b>Standard Error</b>	12.520
<b>Standardized Test Statistic</b>	-0.879
<b>Asymptotic Sig. (1-sided test)</b>	0.810

**Figure 6.15: Challenge 5 - Clients: Quality/design standards sacrificed to minimum levels by the contractor (QCSSMLC)**

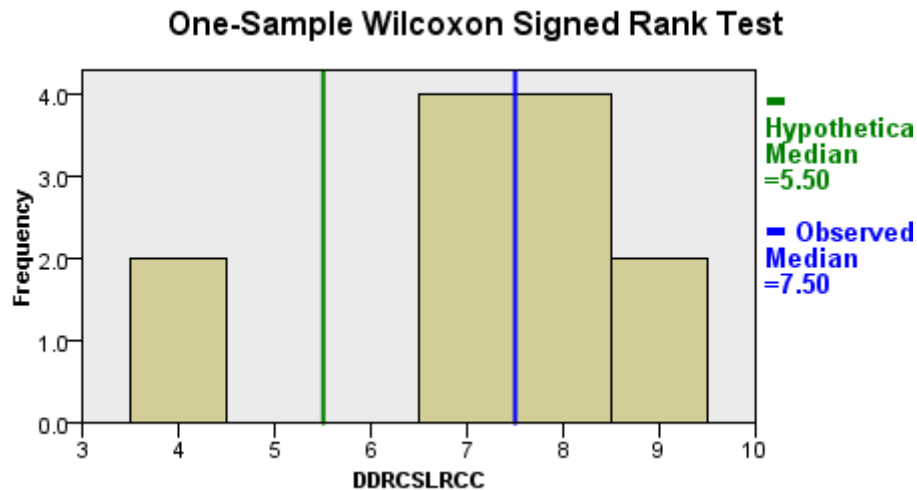
The observed median from the rankings provided by the surveyed respondents is 4.50 which is less than the research proposition value of 5.50. The calculated Asymptotic significance (1 sided test) is greater than 0.05 which means all the requirements for condition 1 have been met. This means that challenge 5 is not considered to be a high severity challenge by the client respondents surveyed. The research proposition is therefore retained. Table 6.22 provides a summary of the analysis undertaken.

**Table 6.22: Challenge 5 - Clients: Quality/design standards sacrificed to minimum levels by the contractor (QCSSMLC)**

Variable	Proposition	Test	Decision
Quality criteria/design standards sacrificed to minimum levels by the contractor	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 6:** Difficulty to define requirements clearly & still leave room for contractor's creativity

Results from the statistical analysis undertaken are depicted in Figure 6.16.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	<b>71.000</b>
<b>Standard Error</b>	<b>12.520</b>
<b>Standardized Test Statistic</b>	<b>2.556</b>
<b>Asymptotic Sig. (1-sided test)</b>	<b>0.006</b>

**Figure 6.16: Challenge 6 - Clients: Difficulty to define requirements & still leave room for Contractor's creativity (DDRCSLRCC)**

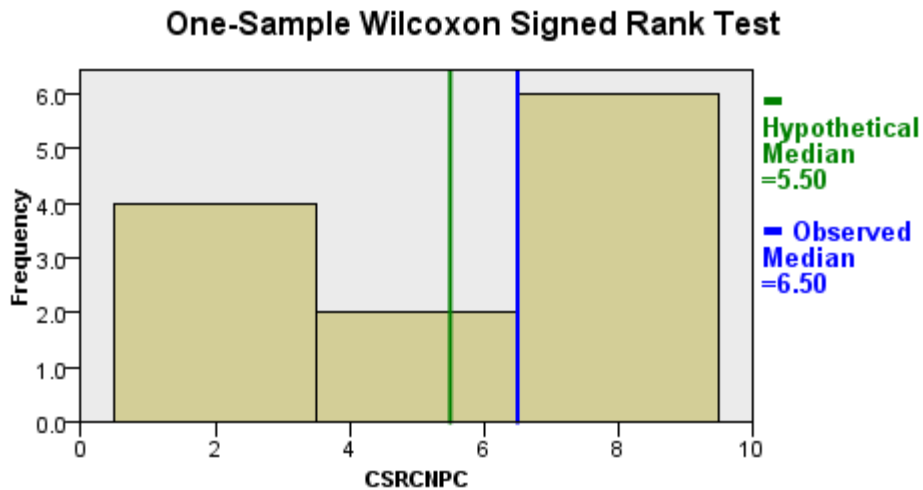
The observed median from the rankings provided by the surveyed respondents is 7.50 which is higher than the research proposition value of 5.50 and the calculated Asymptotic significance (1 sided test) is less than 0.05. Requirements for condition 3 are all met. This means that challenge 6 is considered to be a high severity challenge by client respondents surveyed. The research proposition is therefore rejected. Table 6.23 provides a summary of the analysis undertaken.

**Table 6.23: Challenge 6 - Clients: Difficult to define requirements clearly & still leave room for contractor's creativity (DDRCSLRCC)**

Variable	Proposition	Test	Decision
Difficult to define requirements clearly & still leave room for contractor's creativity	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Reject the research proposition

**Challenge 7:** Cost Savings realised by the Contractor not passed on to the Client

Results from the statistical analysis undertaken are depicted in Figure 6.17.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	33.000
<b>Standard Error</b>	12.520
<b>Standardized Test Statistic</b>	-0.479
<b>Asymptotic Sig. (1-sided test)</b>	0.316

**Figure 6.17: Challenge 7 - Clients: Cost Savings realised by the Contractor not passed on to the Client (CSRCNPC)**

The observed median from the rankings provided by the surveyed respondents is 6.50 which, although higher than the research proposition value of 5.50, is not significantly different based on the calculated Asymptotic significance (1 sided test) which is greater than 0.05. This meets all the requirements stated for condition 2. This means challenge 7 is perceived to be a low severity challenge by the client respondents surveyed. The research proposition is therefore retained. Table 6.24 provides a summary of the analysis undertaken.

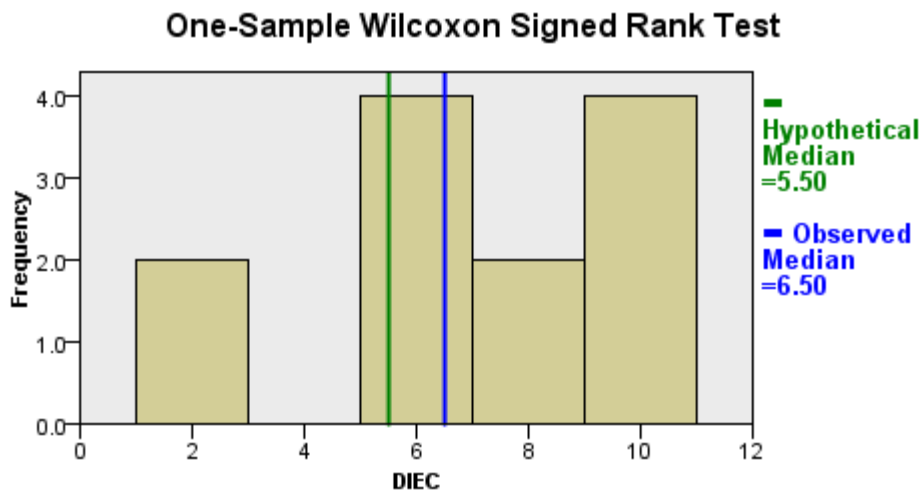


**Table 6.24: Challenge 7 - Clients: Cost Savings realised by the Contractor not passed on to the Clients (CSRCNPC)**

Variable	Proposition	Test	Decision
Cost savings realised by the contractor not passed on to the client	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 8:** Difficulty in introducing and evaluating Change (DIEC)

Results from the statistical analysis undertaken are depicted in Figure 6.18.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	56.000
<b>Standard Error</b>	12.639
<b>Standardized Test Statistic</b>	1.345
<b>Asymptotic Sig. (1-sided test)</b>	0.090

**Figure 6.18: Challenge 8 - Clients: Difficulty in introducing & evaluating Change (DIEC)**

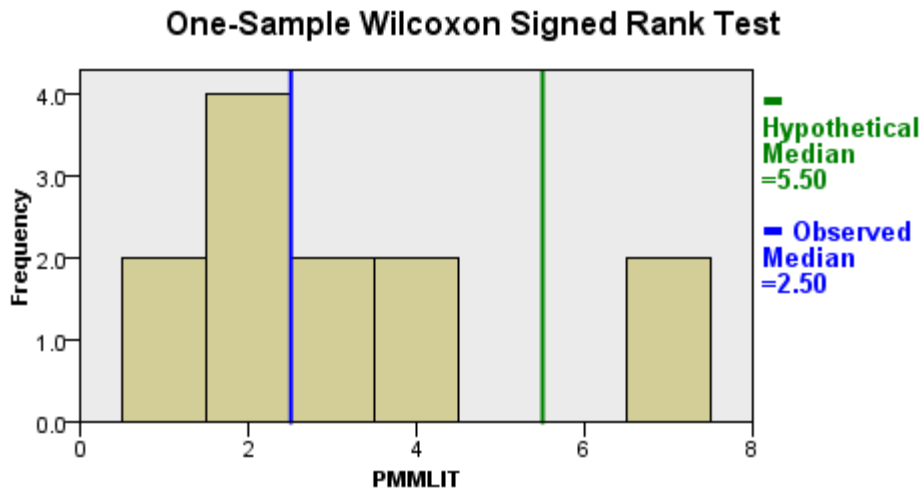
The observed median from the rankings provided by the surveyed respondents is 6.50 which, although higher than the research proposition value of 5.50, is not significantly different as shown by the calculated Asymptotic significance (1 sided test) which is greater than 0.05. This meets the requirements for condition 2 which means that challenge 8 is perceived to be a low severity challenge by client respondents surveyed. The research proposition is therefore retained. Table 6.25 provides a summary of the analysis undertaken.

**Table 6.25: Challenge 8 - Clients: Difficulty in introducing & evaluating Change (DIEC)**

Variable	Proposition	Test	Decision
Difficulty in introducing & evaluating change	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 9:** The D&B procurement method is more labour intensive & technically demanding than the traditional procurement method

Results from the statistical analysis undertaken are depicted in Figure 6.19.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	5.000
<b>Standard Error</b>	12.639
<b>Standardized Test Statistic</b>	-2.690
<b>Asymptotic Sig. (1-sided test)</b>	0.997

**Figure 6.19: Challenge 9 - Clients: The D&B procurement method is more labour intensive & technically demanding than the traditional procurement method (PMMLIT)**

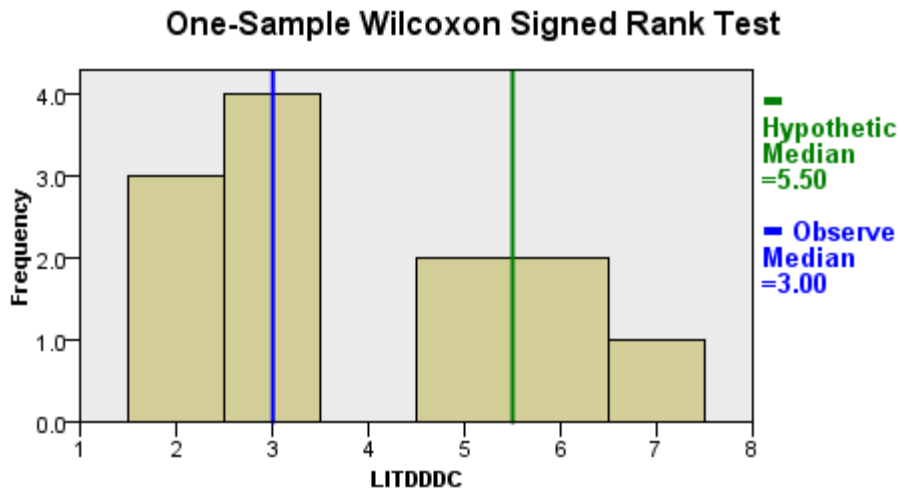
The observed median from the rankings provided by the surveyed respondents is 2.50 which is less than the research proposition value of 5.50. The calculated Asymptotic significance (1 sided test) is greater than 0.05 thereby satisfying all the requirements stated in condition 1. This means challenge 9 is perceived to be a low severity challenge by client respondents surveyed. The research proposition is therefore retained. Table 6.26 provides a summary of the analysis undertaken.

**Table 6.26: Challenge 9 - Clients: The D&B procurement method is more labour intensive & technically demanding than the traditional procurement method (PMMLIT)**

Variable	Proposition	Test	Decision
The D&B procurement method is more labour intensive & technically demanding than the traditional procurement method	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 10:** Lack of involvement in technical discussions as the design is developed by the contractor (LITDDDC)

Results from the statistical analysis undertaken are depicted in Figure 6.20.



<b>Total N</b>	<b>12</b>
<b>Test Statistic</b>	10.000
<b>Standard Error</b>	12.629
<b>Standardized Test Statistic</b>	-2.296
<b>Asymptotic Sig. (1-sided test)</b>	0.989

**Figure 6.20: Challenge 10 - Clients: Lack of involvement in technical discussions as the design is developed by the contractor (LITDDDC)**

The observed median from the rankings provided by the surveyed respondents is 3.00 which is less than the research proposition value of 5.50 and the calculated Asymptotic significance (1 sided test) is greater than 0.05 thereby satisfying all the requirements in condition 1. This means that challenge 10 is perceived to be a low severity challenge by the client respondents surveyed. The research proposition is therefore retained. Table 6.27 provides a summary of the analysis undertaken.

**Table 6.27: Challenge 10 - Clients: Lack of involvement in technical discussions as the design is developed by the contractor (LITDDDC)**

Variable	Proposition	Test	Decision
Lack of involvement in technical discussions as the design is developed by the contractor	The median is 5.5 or less.	One sample Wilcoxon Signed Rank test	Retain the research proposition

Summary of challenge severity as perceived by the client respondents surveyed are tabulated in Table 6.28.

**Table 6.28: Summary of the observed rankings and their severity as perceived by the client respondents**

Challenges raised by Clients	Rank test	Asymptotic Test	Severity
1. Lack of/insufficient communication with the contractor's designer	5.00	0.814	Low
2. Difficulties in evaluating D&B tenders	2.00	0.991	Low
3. Loss of benefit of designer's independent construction oversight	6.50	0.083	Low
4. Contractor's designer not meeting/satisfying clients' expectation	6.00	0.406	Low
5. Quality/design standards sacrificed to minimum levels	4.50	0.810	Low
6. Difficulty to define requirements & still leave room for creativity	7.50	0.006	High
7. Cost savings realised by contractor not passed on to clients	6.50	0.316	Low
8. Difficulty in introducing & evaluating change	6.50	0.090	Low
9. D&B method is labour intensive & technically demanding	2.50	0.997	Low
10. Lack of involvement in tech. Discussions as the design is developed	3.00	0.989	Low

From Table 6.28 it can be seen that, according to clients surveyed in this research the only high severity challenge is 'difficult to define requirements clearly and still leave room for contractor's creativity' (DDRCSLRCC) – challenge 6. All the other challenges 1 - 5, 7 - 10 are perceived to be of low severity. These findings appear to show that the issue of defining requirements is a high severity challenge to clients using D&B as a procurement method. It should be recalled from findings of both the reviewed literature and the interview phases of this research that most of the challenges

raised (as summarised in Figures 3.2 and 5.7) appear to manifest from the lack of clarity of employers' requirements. This is an important finding that should be encompassed within the research framework to facilitate better integration of design and construction processes.

#### **6.3.4 D&B PROCUREMENT CHALLENGES AND THEIR SEVERITY AS PERCEIVED BY KEY PARTICIPANTS - DESIGNERS**

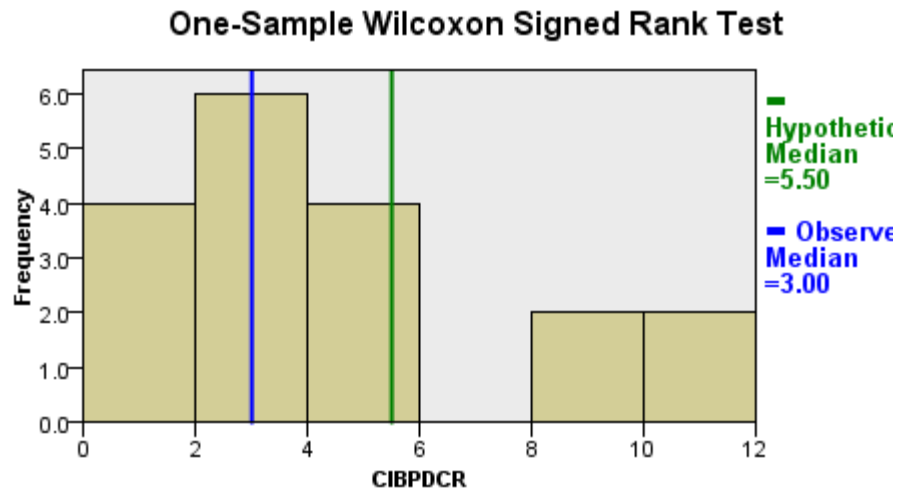
The same analytical process that was undertaken for Contractor and Client respondents was used for designer respondents as well. The respondents were requested to rank the challenges on a scale of 1 – 10, with 1 being low severity and 10 being high severity.

The One sample Wilcoxon Signed rank test was used as the statistical tool to analyse the ranks in order to inform the researcher of the severity of the challenges/variables identified. The results of the analysis are presented below.

**Challenge 1:** Conflict of interest between professional duty & Contractor's requirements

Results from the statistical analysis undertaken are depicted in Figure 6.21.





<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	52.000
<b>Standard Error</b>	22.806
<b>Standardized Test Statistic</b>	-1.469
<b>Asymptotic Sig. (1-sided test)</b>	0.929

**Figure 6.21: Challenge 1 - Designers: Conflict of interest between professional duty & Contractor's requirements (CIBPDCR)**

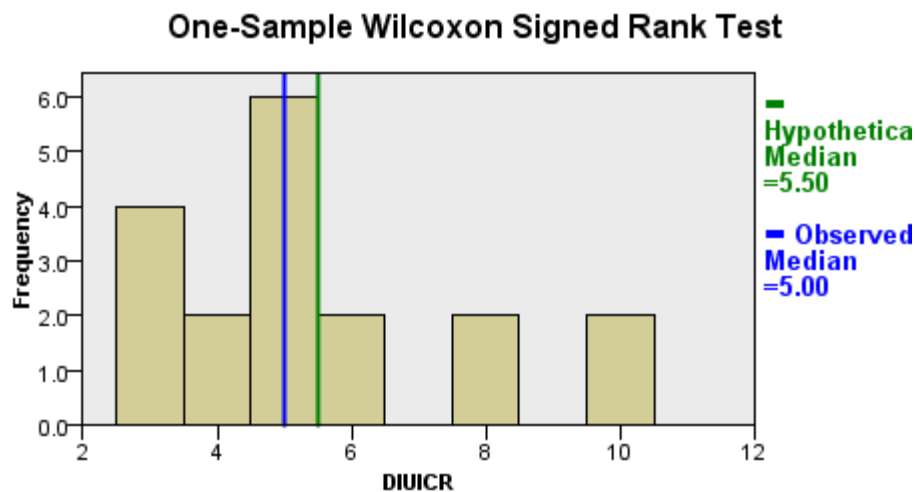
The observed median from the rankings provided by the surveyed respondents is 3.00 which is less than the research proposition value of 5.50. The calculated value of the Asymptotic significance (1 sided test) is greater than 0.05 thereby satisfying the requirements for condition 1. This means that challenge 1 is perceived to be a low severity challenge by design respondents surveyed. The research proposition is therefore retained. Table 6.29 provides a summary of the analysis undertaken.

**Table 6.29: Challenge 1 - Designers: Conflict of interest between professional duty & Contractor's requirements (CIBPDCR)**

Variable	Proposition	Test	Decision
Conflict of interest between professional duty & Contractor's requirements	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 2:** Difficulties interpreting unclear/incomplete client requirements

Results from the statistical analysis undertaken are depicted in Figure 6.22.



<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	71.000
<b>Standard Error</b>	22.630
<b>Standardized Test Statistic</b>	-0.641
<b>Asymptotic Sig. (1-sided test)</b>	0.739

**Figure 6.22: Challenge 2 - Designers: Difficulties interpreting unclear/incomplete client requirements (DIUICR)**

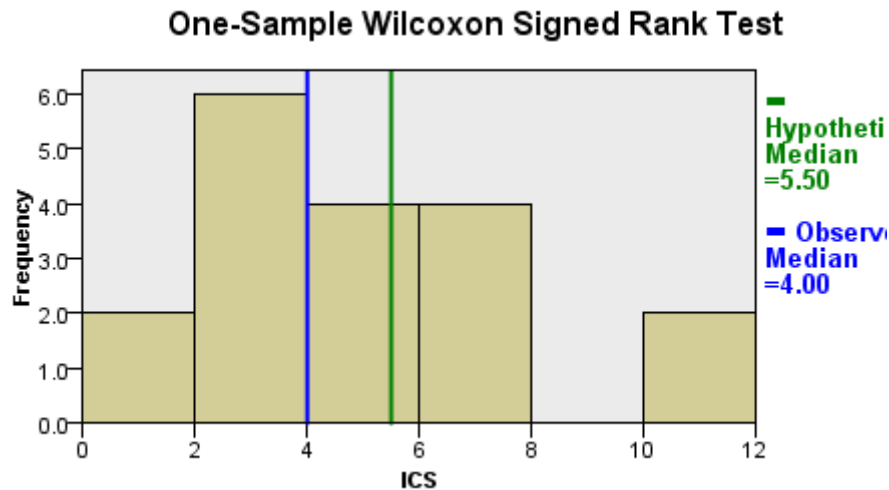
The observed median from the rankings provided by the surveyed respondents is 5.00 which is less than the research proposition value of 5.50. The calculated Asymptotic significance (1 sided test) is greater than 0.05 thereby satisfying all the requirements for condition 1. This means that challenge 2 is perceived to be a low severity challenge by design respondents surveyed. The research proposition is therefore retained. Table 6.30 provides a summary of the analysis undertaken.

**Table 6.30: Challenge 2 - Designers: Difficulties interpreting unclear/incomplete client requirements (DIUICR)**

Variable	Proposition	Test	Decision
Difficulties interpreting unclear/incomplete client requirements	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 3:** Inadequate/lack of communication with end users & other stakeholders

Results from the statistical analysis undertaken are depicted in Figure 6.23.



<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	47.000
<b>Standard Error</b>	22.806
<b>Standardized Test Statistic</b>	-1.688
<b>Asymptotic Sig. (1-sided test)</b>	0.955

**Figure 6.23: Challenge 3 - Designers: Inadequate/lack of communication with end users & other stakeholders (ICS)**

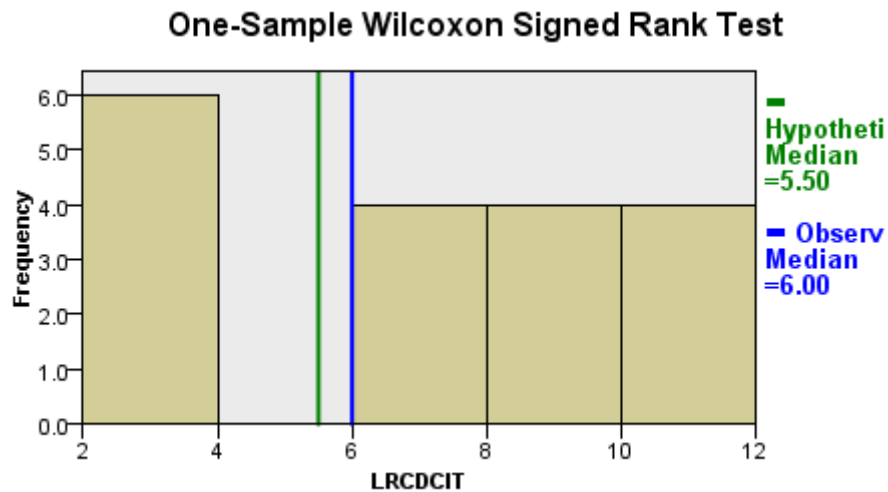
The observed median from the rankings provided by the surveyed respondents is 4.00 which is less than the research proposition value of 5.50. The calculated Asymptotic significance (1 sided test) is greater than 0.05 which means all the requirements for condition 1 have been satisfied. Challenge 3 is therefore perceived to be a low severity challenge by design respondents surveyed. The research proposition is therefore retained. Table 6.31 provides a summary of the analysis undertaken.

**Table 6.31: Challenge 3 - Designers: Inadequate/lack of communication with end users & other stakeholders (ICS)**

Variable	Proposition	Test	Decision
Inadequate/lack of communication with end users & other stakeholders	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 4:** Limited recovery of design costs incurred during tender when the tender is not won by the D&B contractor (LRCDCIT)

Results from the statistical analysis undertaken are depicted in Figure 6.24.



<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	114.000
<b>Standard Error</b>	22.453
<b>Standardized Test Statistic</b>	1.269
<b>Asymptotic Sig. (1-sided test)</b>	0.102

**Figure 6.24: Challenge 4 - Designers: Limited recovery of design costs incurred during tender when the tender is not won by the D&B contractor (LRCDCIT)**

The observed median from the rankings provided by the surveyed respondents is 6.00 which, although higher than the research proposition value of 5.50, is not statistically different from the research proposition according to the calculated Asymptotic significance (1 sided test). This satisfies the requirements for condition 2. This means challenge 4 is perceived to be a low severity challenge by design respondents surveyed. The research proposition is therefore retained. Table 6.32 provides a summary of the analysis undertaken.

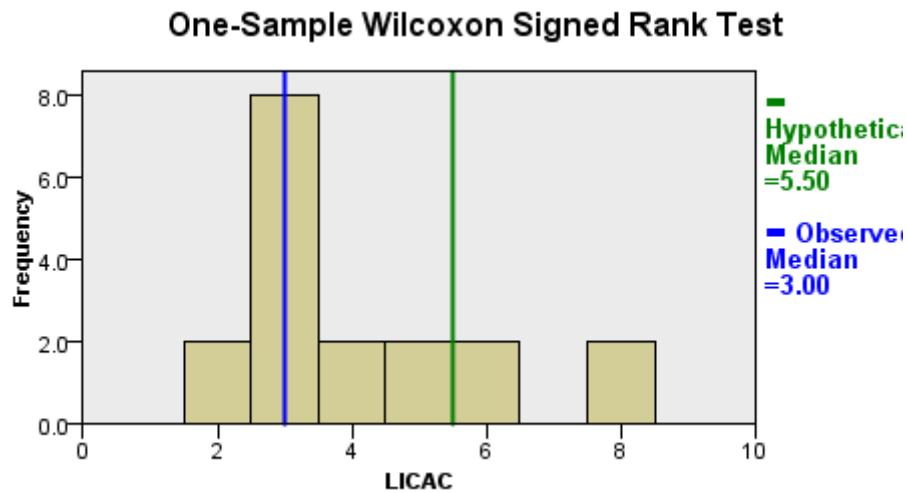
**Table 6.32: Challenge 4 - Designers: Limited recovery of design costs incurred during tender when the tender is not won by the D&B contractor (LRCDCIT)**

Variable	Proposition	Test	Decision
Limited recovery of design costs incurred during tender when the tender is not won by the D&B contractor	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 5:** Late input of constructability advice from the contractor resulting in delays to design deliverables

Results from the statistical analysis undertaken are depicted in Figure 6.25.





<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	28.000
<b>Standard Error</b>	22.475
<b>Standardized Test Statistic</b>	-2.558
<b>Asymptotic Sig. (1-sided test)</b>	0.995

**Figure 6.25: Challenge 5 - Designers: Late input of constructability advice from the contractor resulting in delays to design deliverables (LICAC)**

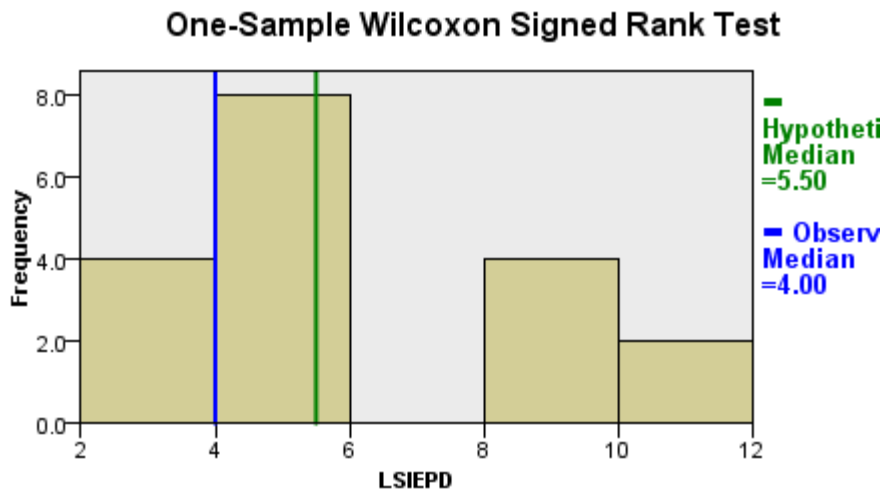
The observed median from the rankings provided by the surveyed respondents is 3.00 which is less than the research proposition value of 5.50. The calculated Asymptotic significance (1 sided test) is greater than 0.05 which satisfies all the requirements for condition 1. This means that challenge 5 is perceived to be a low severity challenge by design respondents surveyed. The research proposition is therefore retained. Table 6.33 provides a summary of the analysis undertaken.

**Table 6.33: Challenge 5 - Designers: Late input of constructability advice from the contractor resulting in delays to design deliverables (LICAC)**

Variable	Proposition	Test	Decision
Late input of constructability advice from the contractor resulting in delays to design deliverables	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 6:** Lack of specialist involvement in the early parts of the design resulting in late changes & delays to construction

Results from the statistical analysis undertaken are depicted in Figure 6.26.



<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	85.000
<b>Standard Error</b>	22.630
<b>Standardized Test Statistic</b>	-0.022
<b>Asymptotic Sig. (1-sided test)</b>	0.509

**Figure 6.26: Challenge 6 - Designers: Lack of specialist involvement in the early parts of the design resulting in late changes & delays to construction (LSIEPD)**

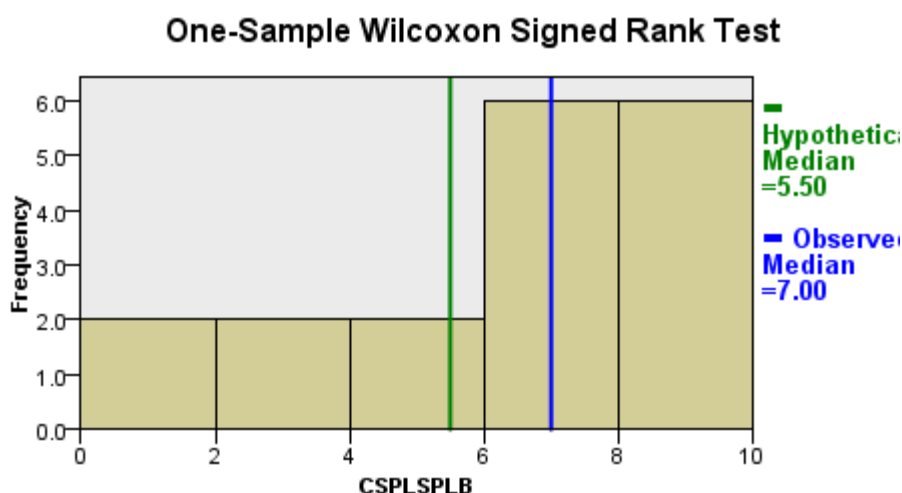
The observed median from the rankings provided by the surveyed respondents is 4.00 which is less than the research proposition value of 5.50. The calculated Asymptotic significance (1 sided test) is greater than 0.05 thereby satisfying the requirements for condition 1. This means that challenge 6 is perceived to be a low severity challenge by design respondents surveyed. The research proposition is therefore retained. Table 6.34 provides a summary of the analysis undertaken.

**Table 6.34: Challenge 6 - Designers: Lack of specialist involvement in the early parts of the design resulting in late changes & delays to construction (LSIEPD)**

Variable	Proposition	Test	Decision
Lack of specialist involvement in the early parts of the design resulting in late changes & delays to construction	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 7:** Cost saving pressures leading to services procured on lump sum basis which may be inequitable to the designer (CSPLSPLB)

Results from the statistical analysis undertaken are depicted in Figure 6.27.



<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	108.000
<b>Standard Error</b>	22.806
<b>Standardized Test Statistic</b>	0.987
<b>Asymptotic Sig. (1-sided test)</b>	0.162

**Figure 6.27: Challenge 7 - Designers: Cost saving pressures leading to services procured on lump sum basis which may be inequitable to the designer (CSPLSPLB)**

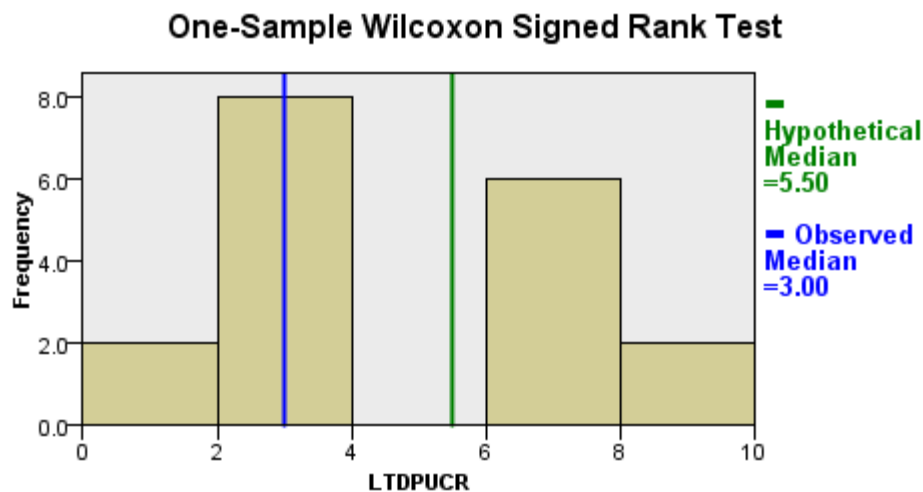
The observed median from the rankings provided by the surveyed respondents is 7.00 which, although higher than the research proposition value of 5.50 is not statistically different from the research proposition since the Asymptotic significance (1 sided test) is greater than 0.05. This satisfies all the requirements for condition 2. This means challenge 7 is perceived to be a low severity challenge by design respondents surveyed. The research proposition is therefore retained. Table 6.35 provides a summary of the analysis undertaken.

**Table 6.35: Challenge 7 - Designers: Cost saving pressures leading to services procured on lump sum basis which may be inequitable to the designer (CSPLSPLB)**

Variable	Proposition	Test	Decision
Cost saving pressures leading to services procured on lump sum basis which may be inequitable to the designer	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 8:** Lack of transparency in decision processes which underpinned client requirements leading to requirement misunderstandings (LTDPUCR)

Results from the statistical analysis undertaken are depicted in Figure 6.28.



<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	44.000
<b>Standard Error</b>	22.475
<b>Standardized Test Statistic</b>	-1.846
<b>Asymptotic Sig. (1-sided test)</b>	0.675

**Figure 6.28: Challenge 8 - Designers: Lack of transparency in decision processes which underpinned client requirements leading to requirement misunderstandings (LTDPUCR)**

The observed median from the rankings provided by the surveyed respondents is 3.00 which is less than the research proposition value of 5.50. The calculated Asymptotic significance (1 sided test) is greater than 0.05 therefore satisfying the requirements for condition 1. This means that challenge 8 is perceived to be a low severity challenge by design respondents surveyed. The research proposition is therefore retained. Table 6.36 provides a summary of the analysis undertaken.

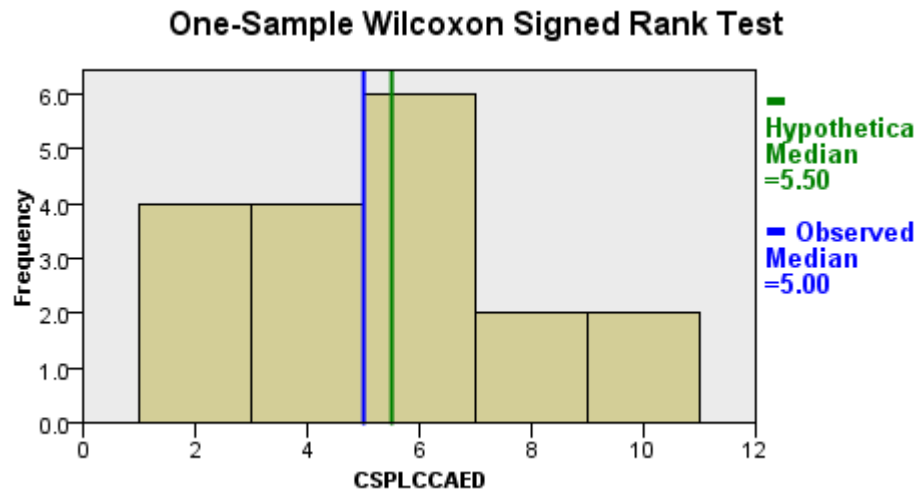
**Table 6.36: Challenge 8 - Designers: Lack of transparency in decision processes which underpinned client requirements leading to requirement misunderstandings (LTDPUCR)**

Variable	Proposition	Test	Decision
Lack of transparency in decision processes which underpinned client requirements leading to requirement misunderstandings	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 9:** Cost saving pressures leading to claims from the contractor alleging 'errors' in design for genuine design development matters (CSPLCCAED)

Results from the statistical analysis undertaken are depicted in Figure 6.29.





<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	59.000
<b>Standard Error</b>	22.806
<b>Standardized Test Statistic</b>	-1.162
<b>Asymptotic Sig. (1-sided test)</b>	0.878

**Figure 6.29: Challenge 9 - Designers: Cost saving pressures leading to claims from the contractor alleging 'errors' in design for genuine design development matters (CSPLCCAED)**

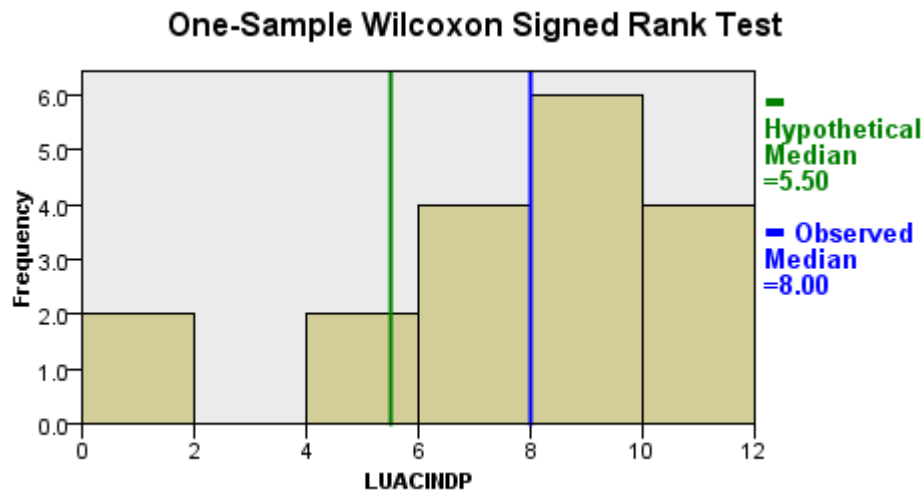
The observed median from the rankings provided by the surveyed respondents is 5.00 which is less than the research proposal value of 5.50. The calculated Asymptotic significance (1 sided test) is greater than 0.05 which means all the requirements for condition 1 have been satisfied. This means that challenge 9 is perceived to be a low severity challenge by design respondents surveyed. The research proposition is therefore retained. Table 6.37 provides a summary of the analysis undertaken.

**Table 6.37: Challenge 9 - Designers: Cost saving pressures leading to claims from the contractor alleging 'errors' in design for genuine design development matters (CSPLCCAED)**

Variable	Proposition	Test	Decision
Cost saving pressures leading to claims from the contractor alleging 'errors' in design for genuine design development matters	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Retain the research proposition

**Challenge 10:** Lack of understanding & appreciation from the contractor on the iterative nature of the design process resulting in insufficient time allowances in the programme (LUACINDP)

Results from the statistical analysis undertaken are depicted in Figure 6.30.



<b>Total N</b>	<b>18</b>
<b>Test Statistic</b>	133.000
<b>Standard Error</b>	22.740
<b>Standardized Test Statistic</b>	2.089
<b>Asymptotic Sig. (1-sided test)</b>	0.019

**Figure 6.30: Challenge 10 - Designers: Lack of understanding & appreciation from the contractor on the iterative nature of the design process resulting in insufficient time allowances in the programme (LUACINDP)**

The observed median from the rankings provided by the surveyed respondents is 8.00 which is greater than the research proposition value of 5.50. The calculated Asymptotic significance (1 sided test) is less than 0.05. The requirements for condition 3 are satisfied. This means that challenge 10 is perceived to be a high severity challenge by design respondents surveyed. The research proposition is therefore rejected. Table 6.38 provides a summary of the analysis undertaken.

**Table 6.38: Challenge 10 - Designers: Lack of understanding & appreciation from the contractor on the iterative nature of the design process resulting in insufficient time allowances in the programme (LUACINDP)**

Variable	Proposition	Test	Decision
Lack of understanding & appreciation from the contractor on the iterative nature of the design process resulting in insufficient time allowances in the programme	Conditions 1 and 2	One sample Wilcoxon Signed Rank test	Reject the research proposition

Summary of challenge severity as perceived by the designer respondents surveyed are tabulated in Table 6.39.

**Table 6.39: Summary of the observed rankings and their severity as perceived by the design respondents**

Challenges raised by designers	Rank test	Asymptotic Test	Severity
1. Conflict of interest between professional duty & contractor's requirements	3.00	0.929	Low
2. Difficulties interpreting unclear/incomplete client requirements	5.00	0.739	Low
3. Inadequate/lack of communication with end users & other stakeholders	4.00	0.955	Low
4. Limited recovery of design costs for unsuccessful tenders	6.00	0.102	Low
5. Late input of constructability advice from the contractor	3.00	0.995	Low
6. Lack of specialist involvement in the early parts of the design	4.00	0.509	Low
7. Cost saving pressure leading to services procured on a lump sum basis	7.00	0.162	Low
8. Lack of transparency in decision processes which underpinned client Req'ts**	3.00	0.675	Low
9. Cost saving pressures leading to misunderstanding of design development	5.00	0.878	Low
10.Lack of understanding by the contractor of the design iterative process	8.00	0.019	High

Item 8 in Table 6.39 the word 'Req'ts\*\*' - means 'Requirements'

From Table 6.39 above it can be seen that, according to designers surveyed in this research, the only high severity challenge is 'lack of understanding and appreciation from the D&B contractor on the iterative nature of the design process resulting in insufficient time allowances in the programme' (LUACINDP) – challenge 10. All the other challenges 1 - 9 are perceived to be of low severity.

## **6.4 Discussion on survey findings**

The following section presents discussions on the findings from the survey undertaken to explore how all the three respondent categories perceive the severity of the challenges they face when delivering projects through the D&B procurement method.

### **6.4.1 Discussion on Findings from the contractor respondent category**

From the evidence of the findings obtained in the survey it appears that contractors perceive the following challenges to be of high severity:

- Unclear/incomplete client requirements
- Underestimated time needed for approvals
- Insufficient time allocated to briefings/tendering/evaluation processes
- Difficulties differentiating scope change from design development
- Difficulties managing risks passed on by clients

Unclear/incomplete client requirements have been a common theme that has been noted in both the reviewed literature and the interview stages of the research. It would appear that, without a clearly formulated employers' requirements the D&B contractor will not be able to understand what is required of him to deliver and the resultant contractors' proposal may not be able to match the employers' requirements. It is easy to see why D&B contractors perceive this to be a high severity challenge since there is a whole host of challenges in connection with employers' requirements that have been identified in the qualitative phase of the research. These were variously noted as poor drafting, discrepancies, conflicting information, insufficient information and other related issues.

The employers' requirements is a key document that underpins the whole D&B procurement method and without a well formulated and robust document expressing what the employer actually need from the built environment then it

is understandable that D&B contractors perceive this to be a high severity challenge.

Without a clear understanding of the scope (employers' requirements) gaps between the contractors' proposals and employers' requirements will surface leading to a manifestation of other noted challenges including, but not limited to, perceived poor end product, strained relationships and 'risk dumping' from one party to the other down the supply chain.

Underestimated time needed for approvals has been perceived as a high severity challenge probably due to the fact that, in some D&B procured projects, the D&B contractor is tasked with obtaining all the approvals required for the built environment asset to be developed such as planning, development control, environmental and other related approvals that may be required. On some complex projects this takes significant time and effort to be accomplished. Sufficient time has to be allowed for in the whole project development cycle for these approvals to be obtained.

Should time durations for undertaking such crucial activities be insufficient D&B contractors would find themselves in significant risk since without such approvals no construction on site would be allowed to commence. Follow on activities on the D&B programme would therefore be impacted upon leading to project delays and cost escalation which not all may be recoverable from the client.

Insufficient time allocated to briefings/tendering/evaluation processes is another challenge that D&B contractors have perceived to be of high severity. The issue of insufficient time for briefings, tendering and the evaluation process has been echoed in the qualitative phase as one of the key challenges. It would appear from the evidence gained in the reviewed literature and interviews that D&B contractors bemoan the amount of time they are given to understand the employers' requirements (the brief) to enable them to provide a robust tender. D&B contractors appear to suggest that if they are given sufficient time to review the brief they would be able to come

up with a robust contractors' proposal that meets the clients' requirements. The less time there is, it would appear, would cause them problems and may result in the end product not meeting the client's aspirations.

Similarly it appears from the survey results that D&B contractors perceive that there is insufficient time allocated to the evaluation of their submitted D&B tenders. This appears to suggest that clients are not spending relatively long periods of time analysing and reviewing D&B tenders. In addition the usual parameters of cost and time clients have to review other factors included within the contractors' proposal such as quality, health and safety, sustainability, designs and others. This demands significant amounts of time and resource on the client's side. From this finding in the survey it would appear that D&B contractors are of the opinion that clients are not spending sufficient time analysing the submitted D&B tenders. This should be frustrating for the D&B contractors considering the time, resources and effort they would have put into the production of contractors' proposals.

Difficulties differentiating scope change from design development is another highlighted high severity challenge encountered by D&B contractors. From the evidence provided in the qualitative phase of the research it would appear that D&B contractors find themselves in a situation where the demarcation between scope change and design development may appear to be 'blurred'. This would be particularly so in situations where there are lots of changes to design (especially when such changes are instigated by clients as part of the clarification of scope) as the project progresses. If the design phase of the project has not got a definitive end phase where the design is 'frozen' then it is easy to see why this is a high severity issue to D&B contractors.

D&B contractors commonly price for development of the design (depending on the D&B variant used) and make an allowance for design development within their D&B tenders. The issue arise when such an allowance is not sufficient to accommodate the various design iterations that the design sometimes goes through. D&B contractors cannot just add any sum for this design development allowance as they will be in competition with other

contractors on the market. This then acts as a constraint to the sum that D&B contractors can include within D&B tenders. As noted in chapter 5 this issue causes problems between designers and D&B contractors as some D&B contractors interpret some design development changes as 'designer correcting mistakes in the earlier designs'. On the basis of this issue it is no wonder why D&B contractors perceive this challenge as a high severity challenge.

From the evidence derived from the reviewed literature and interview data analysis it has been noted that D&B procured projects carry significant risks to the D&B contractor. The risks are mainly centred on delivering the projects not only in accordance with the time frames set but within the D&B tender sum regardless of any changes to the design development. Additional sums are only payable to the D&B contractor when and if there are any changes to the scope. This coupled with the perception that the scope is not well defined imposes significant risks to the D&B contractor.

From the evidence provided in the qualitative section it would appear that D&B contractors are then perceived to pass on some of the risks to designers and the supply chain. This then is said to lead on to other challenges such as conflict of interest, strained relationships and unfavourable contractual arrangements.

Client interference with the design process, difficulties working with/managing/communicating with designers; difficulties getting specialist input into the design; difficulties managing the design iteration process and costly tender process were all categorised as low severity challenges. This appears to show that although these variables are still noted as challenges they are not as severe and possibly D&B contractors could manage them more than the other noted high severity challenges.



#### **6.4.2 Discussion on Findings from the client respondent category**

It would appear from the client respondents that the only challenge that they perceive to be of high severity is the difficulty to define requirements and still leave room for creativity. This is in tandem with the findings in the qualitative phase of the research in particular research findings by Leite (2005) who observed that clients seldom perceive the project as a whole. This lack of holistic view is perceived to lead to an underestimation of those critical requirements that appear to be negligible at first glance but of great effect in the future he went on to observe. This is said to make the process inherently open to future changes leading to prolongation in costs and time of delivery.

Another contrasting view from evidence obtained in the qualitative phase is that some clients find themselves in a quandary since the more flexibility they allow in the wording of requirements the more the requirements are perceived to be inadequate by D&B contractors. Similarly the less flexibility they allow in the wording of requirements the less the opportunity for the D&B contractor to innovate and come up with alternative cost effective designs.

It would appear that lack of insufficient communication with the contractors' designer; difficulties in evaluating D&B tenders; loss of benefit of designers' independent construction oversight; contractors' designer not meeting/satisfying clients' expectation; quality/design standards sacrificed to minimum levels; difficulty in introducing and evaluating change; D&B method is labour intensive and technically demanding and lack of involvement in technical discussions as the design is developed are perceived to be low severe challenges by the surveyed client respondents. This is probably because the clients surveyed in this phase of the research are well established clients who have set up robust communication and review processes for administering the D&B contract. From the reviewed literature it appears that if key participant roles are understood, and all three category participants participate in setting realistic time scales and accurate documentation are produced and strong management from both the client and

D&B team are used then some of the noted severity of challenges are neutralised.

#### **6.4.3 Discussion on Findings from the design team respondent category**

From the evidence obtained in the survey it appears that the challenge in connection with the lack of understanding by the D&B contractor of the design iterative process is perceived to be high by designers.

This is perhaps not a surprising finding on the basis of the evidence from the qualitative phase of the research. According to Mitchell et al (2011) the design development process is considered to be the most extensive and complex stage of the construction process. Planning based on the critical method has been found to be significantly less successful in planning the design process (Austin et al, 1999). It has been observed from these previous research efforts (Mitchell, 2011 and Austin et al, 1999) that D&B contractors have found the design process to be ill defined, generally iterative and usually containing design cycles which cannot be modelled using sequential planning techniques.

Evidence from the interview phase, in particular comments by TCN3, when he stated that *'the designer will produce a tender design which is very high level and therefore open to further exploration, investigation, checking and verification in the later stages of the process and D&B contractors would inevitably take this as a basis for computing their tender and construction programme'* According to TCN3 design development risk is not known until the design is further developed by this iterative process.

From the designer's perspective it is easier to see why this is a high severity risk item due to many factors such as perceived lack of understanding of the design iterative process by the D&B contractor leading to inadequate programme allowances for design resulting in mismatch between the planned design duration and the actual duration taken to complete the designs. This has the potential 'knock on effects' on the project cost and time which may

result in conflicts and strained relationships between the designer and the D&B contractor.

Conflict of interest between professional duty and contractors' requirements; difficulties interpreting unclear/incomplete client requirements; inadequate/lack of communication with end users and other stakeholders; limited recovery of design costs for unsuccessful tenders; late input of constructability advice from the contractor; lack of specialist involvement in the early parts of the design; cost saving pressure leading to services procured on a lump sum basis; lack of transparency in decision processes which underpinned client requirements and cost saving pressures leading to misunderstanding of design development challenges have all been perceived to be of low severity by the surveyed design respondents.

This appears to indicate that designers surveyed in this phase of the research have found ways (practice based enablers) to deal with and manage the many challenges that have been raised in the qualitative phase. This perhaps has led to the neutralisation of the noted challenges into low severity challenges.

#### **6.4.4 Comparison between findings from the three respondent categories**

From the findings of the survey it is noteworthy that the employers' requirements in terms of lack of clarity, insufficiency, poor drafting, discrepancies and other related issues has been ranked a high severity challenge by both clients and contractors. This appears to show that employers' requirements are a key ingredient for the D&B procurement method to work in practice.

Although employers' requirements are noted as a high severe challenge by both clients and contractors the impact of the challenge on both respondents is different. For clients, it appears that they find it difficult to formulate employers' requirements as precisely as they could and still leave room for the D&B contractor to innovate. The challenge appears to be hinged upon the

'fine line' on which they have to 'draw the line' in specifying requirements without necessarily being prescriptive and therefore 'closing the door' for any opportunities for the contractor to come up with innovative designs.

On the other hand contractors face the challenge of not understanding the employers' requirements leading to conflicting information with the contractors' proposals. This then is perceived to lead to other related issues such as clarifications of employers' requirements later on in the process which then is perceived to be misinterpreted by the contractor as scope changes.

This mismatch between employers' requirements and contractors' proposals is also perceived to result in clients not satisfied with the end product. Strained relationships will inadvertently ensue as a consequence of this mismatch between employers' requirements and contractors' proposals. This is probably why one of the practice based enablers noted in chapter 5 advocates for involvement of all key parties early in the process which includes the formulation of employers' requirements.

Designers, on the other hand, surprisingly did not raise this as a high severity challenge opting instead to rank the challenge pertaining to 'lack of understanding by the contractor of the design iterative process' as a high severity challenge. This implies that, although designers consider other issues as challenges, it is the D&B contractor's lack of understanding of the design iterative process which is a high severe challenge.

On the basis of the evidence obtained in the qualitative phase of the research this confirms that the design development process is the most complex and extensive stage of the design and construction process. It is in this phase that the designer is heavily involved in terms of the degree of detail produced as well as the volume of information produced. In addition this phase of the design and construction process is the phase in which the project delivery team interfaces with the designer opening up further lines of communication with the expanded project team. Perhaps because of this designers felt that the earlier challenges faced in the interpretation of employers' requirements

are low severity challenges compared to this phase in the design and construction process.

Underestimated time needed for approvals has been denoted by the surveyed D&B contractors as a high severity challenge. This is due to the fact the challenge is more encountered by D&B contractors as they are the ones who find themselves managing the approval processes. In cases where this is included as a D&B contractor's risk then it is perceived as high severity challenge by D&B contractors. Not surprising as this is probably not one of the D&B contractors' traditional skill sets.

Insufficient time for briefing/tendering/evaluation processes has been raised as a high severity challenge by D&B contractors. This is possibly due to how this impacts on them as they put together the D&B tender. The more time they have to undertake all the required processes the more they will be able to understand the requirements, question them and formulate contractors' proposals that aligns with the employers' requirements.

It is interesting to note that D&B contractors have ranked 'difficulties differentiating scope change from design development' as a high severity change. This compares, interestingly, with the designers' ranking on 'lack of understanding by the contractor of the design iterative process'. From the evidence presented in the qualitative phase of the research it would appear that D&B contractor's lack of understanding of the iterative process of the design possibly results in the D&B contractor misinterpreting design development as change ins cope. This then is said to result in other challenges resulting in conflicts, poor relationships as well as strained relationships among the parties involved.

Difficulties managing risks passed on by clients have been considered as a high severity challenge by contractors leading them to pass on the risks to others down the supply chain. This is possibly why designers end up feeling the challenge relating to design development by contractors not understanding the iterative nature of design.

It would appear from the survey findings that, although the challenges noted in the qualitative phase of the research are all encountered by key participants of the D&B procurement method, a relatively few number of the challenges have been found in the survey to be of high severity. This is possibly due to the way the challenges are felt further down the contractual chain noting that the principal contract is between the client and the D&B contractor who in turn sub-contracts some or all of the design services to the designer.

The results from the survey also show that unclear employers' requirements has been categorised as a high severity challenge encountered by both the clients and D&B contractors. This finding is in tandem with the results from the qualitative phase of the research which shows that most of the factors underlying challenges faced by key participants can be traced back to issues in connection with employers' requirements.

As shown in Figure 5.8 the key challenges noted are inter-connected. The severity of the challenges may differ between the three respondent categories but factors underlying all challenges are intricately related. It is the understanding of this intricacy that will lead to the formulation of a framework that can facilitate the integration of design and construction processes under the D&B procurement method.

## **6.5 CHAPTER SUMMARY AND KEY FINDINGS**

The chapter has provided an analysis of the findings from the questionnaire survey undertaken as a second and final stage of the research as outlined in the methodology section in chapter 4. The chapter presents the findings in two forms. Firstly the earlier sections of the chapter presented the descriptive statistics of the data gathered in the research. This was followed by further statistical analysis of the data principally aimed at ascertaining the severity of the challenges experienced by key participants of the D&B procurement process. This was undertaken in order to fulfil research objectives 1 and 2 identified in chapter 1.

The descriptive statistics of the research indicated that the respondents were not only experienced people (all of them had over 20 years' experience in the construction industry) but were also influential people within their organisations as 53% of them were either Project Managers or Directors. In addition 99% of the respondents' organisations have been in the construction industry for over 10 years which means they are fairly established players within the construction industry with more than 57% of the respondents' organisations turning over on average £400 million per year. The descriptive statistics also show that the proportion of projects, on average, delivered through D&B procurement on an annual basis by the respondents' organisations is over 50% which is significantly relevant given the focus of the research on D&B challenges experienced by key participants.

The statistical analysis of the challenges perceived by the respondents show that, according to the contractors surveyed high severity challenges that they have experienced are the following:

- Unclear/incomplete client requirements
- Underestimated time needed for approvals
- Insufficient time allocated briefing, tendering and evaluation processes
- Difficulties differentiating scope change from design development changes
- Difficulties managing risks passed on by clients which would have been better managed by clients

All the other challenges identified were ranked as low severity challenges. Similarly client respondents ranked only one challenge as of high severity which is

- Difficulty to define requirements clearly and still leave room for the contractor's creativity

The rest of the challenges identified in the interview phase of the research were ranked as low severity

On the other hand designer respondents ranked the following challenges as a high severity challenge

- Lack of understanding and appreciation from the D&B contractor on the iterative nature of the design process resulting in insufficient time allowances in the programme

All the other challenges were ranked as low severity by the designer respondents in this research.

It is noticed from the results of this analysis that there is some interconnectedness in the severity ranking of contractors and clients particularly the challenge of client requirements. Whilst contractors have ranked this challenge as a high severity challenge in terms of lack of clarity or lack of completeness in client requirements correspondingly clients have identified it as a high severity challenge portraying it as a difficulty they encounter in defining requirements clearly and still leaving room for the contractor's creativity.

It would appear that designers are of the opinion that D&B contractors' lack of understanding of the design iterative process is a challenge of high severity as it impacts on the time that they are allocated to deliver professional design services. This may possibly then result in other knock on effects on the D&B project such as conflicts as well as time and cost overruns which were highlighted in the interview phase of the research.

The results of the descriptive statistics undertaken in earlier section of this chapter including the calibre of the respondents in terms of their work experience in the UK construction sector and the strategic positions they occupy in their respective organisations provide validity and credence to the views that they have expressed in this research.

The next chapter amalgamates the key findings from the reviewed literature, the face to face interviews and the questionnaire survey resulting in the



formulation of the framework to facilitate better integration of design and construction processes within a D&B procurement method.

## **CHAPTER 7**

### **DISCUSSIONS AND SYNTHESIS**

#### **7.1 INTRODUCTION**

The main aim of the research, as stated in chapter 1, was to develop a framework to facilitate better integration of design and construction processes resulting in effective and efficient implementation of D&B procurement. In order to achieve this several research objectives were set and an approach designed that would be used to deliver the stated objectives. In addition a series of key research questions that have been formulated as a formal expression of the research in order to migrate from the broad research interest to the specific research focus.

This chapter discusses the findings from the research process adopted and demonstrate how this research has fulfilled the aim, accomplished the research objectives and addressed the research questions as set out in chapter 1. This chapter also presents discussions on practical challenges and practice based enablers that key participants face when delivering construction projects through the D&B procurement method. On the basis of the results from the research findings this chapter also presents the framework that may be of use in facilitating better integration of design and construction processes resulting in effective and efficient implementation of the D&B procurement method. Recommendations and contributions of the research to the body of knowledge are also proposed and research limitations are also highlighted in this chapter.

#### **7.2 DISCUSSIONS**

The importance of integrating the design and construction processes has been highlighted and stressed in the reviewed literature as shown in chapters 2 and 3 of this research. However, despite the importance and advantages

brought about by integration, it would appear from the reviewed literature that there are still problems associated with integrating these key construction processes which if not addressed may well lead to the perpetuation of some of the problems encountered in traditional procurement methods where design and construction processes were separated.

This section however discusses findings from UK construction industry practitioners' experiences by focusing on challenges/problems they encounter in practice when they undertake construction projects using D&B procurement method as well as focusing on the severity of the challenges encountered. In addition to discussions on these challenges the section also covers practice based enablers that key participants have used or suggest to be used in order to address the challenges they have encountered with the D&B procurement method. This discussion section helps the research to sufficiently justify all the stated research objectives as they are covered in the following sub-sections.

#### **7.2.1 EXPLORATION OF CHALLENGES AFFECTING KEY PARTICIPANTS OF THE D&B PROCUREMENT METHOD**

Developing an understanding of the challenges affecting key participants of the D&B procurement method is one of the objectives of this research as set out in chapter 1. Key questions underpinning this objective as set out in chapter 1 are 'what are the underlying challenges experienced by key participants of D&B procurement method?' and 'what are the factors underpinning such challenges?'. In theory D&B procurement is seen as the answer to some, if not all, the problems that had been experienced by the construction sector as a result of the separation of design and construction processes.

Studies by researchers such as Opfer et al (2002), CIRC (2001), Chan et al (2010) and David and Dorman (2008) further support this. However it would also appear from the reviewed literature that the potential advantages and benefits of integrating design and build processes (through D&B procurement methods) are somewhat impaired by the existence of a host of challenges that

have been identified in both the reviewed literature and the interviews undertaken with key participants experienced with the D&B procurement method. This sub-section discusses the findings from the reviewed literature and the interviews undertaken with key participants of the D&B procurement method.

The reviewed literature, in chapters 2 and 3, has shown that there are several challenges that have been encountered by key participants when delivering projects through the D&B procurement method. Some of these challenges were traced back to the generic processes, the organisational make up, the managerial and legal aspects emanating from the D&B procurement method itself. It would appear from the reviewed literature that the D&B procurement method, far from resolving the so called 'root causes' of construction industry problems by integrating design and construction processes, the method has generated its own set of unique challenges that require resolution in one way or the other if the full potential benefits of this procurement method are to be realised.

The qualitative section of the research (reviewed literature and interviews with key participants) showed that there are several challenges that are faced by all key participants throughout the project delivery process. Early on in the process the very challenge of producing and defining requirements imposes problems to clients as it is more labour intensive and technically demanding compared to the design led traditional fragmented procurement process as opined by Fahmy and Jeargeas (2004), a problem that had been previously raised by Ndekugri and Church (1996).

This challenge affects not only clients but designers and contractors as well. Contractors opine that as a result of the difficulty that clients face with producing and defining their requirements they are faced, in some cases, with incomplete and/or unclear employers' requirements resulting in a mismatch between their proposals and the employers' requirements.

Similarly designers, faced with unclear/incomplete employers' requirements, opine that this will lead to a mismatch between the final construction product and the clients' expectation leading to dissatisfaction and strained relationships. In addition the qualitative section of the research also showed that the design stages of the process are also fraught with challenges particularly relating to team working (Moore and Dainty, 2001; Ling and Poh, 2008; Linowes, 2000), communication (Fahmy and Jergeas; 2004), planning the design process (Austin et al; 1999) and managing the design and construction integration (Moore and Dainty, 2001).

Similar type challenges to those encountered in the design phase of the project development cycle have been reported in the construction phase of the D&B procurement method. The main challenge raised in the reviewed literature as impacting the construction phase of the D&B procurement method is the perception that an integrated project culture had failed to develop within the D&B procurement delivery method and that roles and responsibilities had continued as if under the traditional design led procurement method. Although Moore and Dainty (1999; 2000) mainly raises this as a challenge this was further corroborated by further revelations from the interviews undertaken as part of the qualitative process of the research.

Main findings from the interview section of the research, in addition to corroborating most of the challenges highlighted in the reviewed literature, revealed some significant new findings as noted in chapter 5. Some of these new findings were pivotal to the research as they shed some light to some of the underlying root cause of the challenges that had been raised in the reviewed literature. One of these new findings is about design development which appears to resonate as a challenge in findings from all 3 key participants in one way or the other.

Designers view design development as an iterative process that evolves over time as more information is fed back to the designers during the design review processes when comments are made and transmitted to the designers. Contractors on the other hand are perceived to sometimes misunderstand this

process by not allowing sufficient time in their D&B construction programmes which invariably leads to breakdown of relationships as soon as time scales are missed and on site construction programme requirements are not met.

Clients on the other hand perceive some D&B contractors as failing to involve them in design development reviews and in some cases when they are involved their suggestions/ideas are sometimes misinterpreted as design changes attracting additional claims for additional payment and requests for extensions of the design and construction period. The challenge of other stakeholders within some client organisation has been shown to bring with it a source of strained relationships between the D&B contractor and the client team particularly in situations where such other stakeholders' requirements are not properly coordinated and clearly articulated during the early stages of the brief development.

The design management function provided by D&B contractors has been raised as one of the new findings from the interview stages. The new dimension raised in the interview section of this challenge is that some D&B contractor design managers tend to focus more on churning out design information (drawings, schedules and such other design outputs) to the construction teams at the expense of undertaking crucial coordinating functions that are needed for the design management process to work effectively. In such cases designers find themselves fulfilling this function which may lead to unrecoverable costs and/or redirection of design from the crucial design function to the coordinating function with knock on effects on design programmes and cost/time slippages.

Findings from the reviewed literature as well as interviews held with key participants of the D&B procurement method appear to show an apparent chasm between the theory and practice of D&B procurement as a method of delivering construction projects. The very pillars upon which the D&B procurement method has been based upon such as single point responsibility, team integration, improved communication between the parties and integration of processes appear to be fraught with several challenges which,

unless addressed and dealt with at inception of the process, may continue to impair the performance of this integrated procurement method leading paradoxically to the perpetuation of construction problems that the method had been brought about to address.

D&B procurement challenges highlighted in the reviewed literature were corroborated by findings from the interviews held with key participants of the D&B procurement method. In addition, as indicated in chapter 5, the fluidity and flexibility of the semi structured interviews undertaken helped to identify several new challenges that were not highlighted in the reviewed literature and indeed provided further insight into some of the intricacies of the challenges as well as some underlying causes of the challenges. Both the reviewed literature and the interviews undertaken provided interesting interconnectedness of the challenges that the 3 key participants encountered in delivering projects using D&B as a procurement method. The challenges appear to be all interconnected in one way or the other and what appear to be different is the extent to which the challenge(s) affected other related challenge(s) experienced by key participants of the D&B procurement method.

### **7.2.2 FACTORS UNDERPINNING CHALLENGES EXPERIENCED BY KEY PARTICIPANTS OF D&B PROCUREMENT METHOD**

From the reviewed literature and the interviews undertaken it appears that the main factors underpinning the challenges experienced by key participants of D&B procurement method are the following:

- Apportionment of risk between the key parties
- The parties' involvement or lack of involvement in the whole process
- Understanding or lack of understanding of the whole D&B procurement process by the parties

Risk apportionment in any procurement method is an essential element around which most of the key processes of project delivery revolve. In the

much established traditional procurement method all parties understood the risks that they were taking. The contractor took the risk for the construction element and the client took the risk for the design element which was designed on his behalf by the designer. The contractor based his/her price and programme on the basis of a well detailed design and the risks for the whole project delivery were generally perceived to be equally shared/apportioned between the parties. However D&B procurement method brought about a significant shift to this as the risk profile shifted to the contractor as he/she was now not only responsible for the construction of the project but the design element as well.

Results from the interviews undertaken in this research have shown that a majority of challenges that have been raised by key participants can be traced back to each of the parties trying to pass on risks to the other. For instance D&B contractors perceive that some clients tend to pass on most project risks to the D&B contractor as manifested in the following underlying factors:

- Interface challenges with other client stakeholders particularly in connection with clarification of employers' requirements post contract which is perceived to be better managed by the client pre-contract
- Design development risks which is perceived to be emanating from incomplete/unclear employers' requirements
- Delayed approvals from key stakeholders and other parties which is perceived to be better managed by clients
- Lack of key information to inform the D&B contractor at tender stage leading to incorrect assumptions being made
- Difficulty in interpreting and pricing employers' requirements
- Costly tenders due to risks passed on to the contractor

Similarly designers feel the same as they also perceive that contractors tend to pass on some of their risks to designers particularly the following:

- Pricing professional services on a fixed lump sum basis on the back of unclear/incomplete employers' requirements



- Design creep risk passed on to the designer by use of onerous sub-contract terms and conditions
- Unrealistic time scales for design development process provided for within the overall project delivery programme mainly triggered by contractors taking on and accepting unrealistic project delivery time scales from clients

Clients on the other hand perceive that some D&B contractors are 'short changing them' especially at the end of the delivery process when the final product is perceived to be of an inferior quality. Such a perception can be traced back to the allocation of risk within a D&B procurement setting and the challenges that it brings to those parties burdened with managing the risks imposed.

Involvement of the parties in the whole D&B procurement process is one of the underlying factors that underpin some of the challenges raised in both the reviewed literature and the interviews undertaken. It is clear from this research that the key parties involved with the D&B procurement process are involved at various stages of the process and rarely are they all involved in the whole process in a truly integrated fashion. This poses a problem in practice resulting in:

- Delayed 'buy-in' from key stakeholders within the client's organisation leading to delays in the later stages of the process
- Non – involvement of D&B contractors in the formulation of employers' requirements leading to misinterpretation of requirements and poor end product
- Late comments from stakeholders leading to time and cost delays and potential further straining of relationships between the parties
- Conflicting objectives/priorities from different stakeholders within the client's organisation resulting in time/cost impacts which may further strain relationships between the parties

- Late involvement of the designer in the whole process leading to potential lack of understanding of the requirements and further strain in relationships between the parties

The other main underlying factor emanating from the reviewed literature and interviews undertaken is the challenge of lack of understanding of the process by some of the key participants leading to the occurrence of the challenges that have been noted in chapters 2 and 3. The challenge of imposition of risks to other parties, lack of understanding of the design iterative process, late harnessing of buildability into the design process, lack of experience in managing the design process, lack of involvement of designers in the formulation of design development risks, lack of authority of some clients' Project Managers, lack of appreciation of the 'big picture' when pricing D&B tenders by contractors all point to a lack of understanding and perhaps lack of experience in managing the D&B procurement process by both parties. This then leads to a manifestation of some of the challenges that have been highlighted by key participants in chapters 5 and 6 of this research.

### **7.2.3 SEVERITY OF THE CHALLENGES ENCOUNTERED BY KEY PARTICIPANTS OF D&B PROCUREMENT METHOD**

It may be recalled that the focus of chapters 2 and 3 was to review related literature in order to identify and explore D&B procurement method challenges encountered by key participants of this procurement method. The identified challenges were further explored and tested using semi-structured interviews with contractors, designers and clients which were presented in chapter 5. A survey was then undertaken in order to get an understanding of the severity of the challenges affecting key participants to the D&B procurement method.

Analysis of the survey results as presented in chapter 6 indicate that out of all the challenges raised by key participants the high severity challenges identified by respondents are the following:

- Unclear/incomplete client requirements

- Underestimated time needed for approvals
- Insufficient time allocated briefing, tendering and evaluation processes
- Difficulties differentiating scope change from design development changes
- Difficulties managing risks passed on by clients which would have been better managed by clients
- Difficulty to define requirements clearly and still leave room for the contractor's creativity
- Lack of understanding and appreciation from the D&B contractor on the iterative nature of the design process resulting in insufficient time allowances in the programme

These results indicate that time scales for undertaking the D&B procurement process, the briefing process including articulation of employers' requirements, integration of design and construction processes as well as management of design processes are perceived as the main challenges that affect participants when delivering projects using the D&B procurement method.

#### **7.2.4 PRACTICE BASED ENABLERS THAT ADDRESS D&B PROCUREMENT METHOD CHALLENGES**

It has been revealed in the interview section of the research that despite the existence of challenges that have been experienced by key participants to the D&B procurement method participants have also come up with practical suggestions that help to resolve some of the effects of the challenges encountered with this integrated procurement method. This research has looked into answering the key question of 'how have the underlying challenges of D&B procurement method been addressed in practice by key participants of D&B procurement method?'

As part of the interview process key participants came up with several practice based enablers that have been used in order to address the challenges encountered with D&B procurement method of project delivery. These findings

were summarised in chapter 5 and the patterns from the responses that emerged were grouped into 8 themes as follows:

- Quality control and assurance processes embedded in all stages of the process
- Client involvement throughout the process
- Commercial arrangements that support collaboration
- Culture change
- Early involvement by key parties to the process
- Integrated design and contractor organisations
- Investing time and effort in developing employers' requirements
- Training and development

From the reviewed literature D&B procurement method is said to be dependent on the effective integration of the design and construction processes. Such integration requires the parties to be working together from start to finish of the project. It demands that requirements are clearly set out at the outset and that key parties are involved and consulted throughout the process. In this process project risks are jointly identified and allocated to parties who are based able to manage the risks.

### **7.3 RESEARCH FINDINGS SYNTHESIS**

As elucidated in chapter 1, integration of design and construction processes in the construction industry is commonly considered to result in a seamless procurement process, along with improved team relationships and a product delivered more efficiently. Despite the perceived benefits of such integration it is argued in this research there is still disparities between the theory and practice of design and build procurement as a method of delivering construction projects and significant challenges remain which both impair the performance of the procurement method and paradoxically undermine the achievement of team integration – the very key facet that D&B procurement is perceived to promote.

The central tenet of this research was that a better understanding of the structure of underlying challenges and barriers affecting key participants of the D&B procurement method will enable an in-depth understanding of the persistent and deep-rooted problems that have hampered the full integration of design and build processes in a D&B procurement method construction set up. This in turn may well be a potential major contributor of the continued poor performance of the construction industry despite the increase in adoption of the D&B procurement method as indicated in chapter 1.

Literature review has revealed a plethora of challenges and problems that key participants have faced when delivering construction projects through the D&B procurement method. Some of these challenges appear to revolve mainly around employers' requirements. All three key participant categories appear to have challenges with employers' requirements as shown in chapters 2 and 3. Clients appear to have difficulties in defining requirements and at the same time leaving enough room for innovation by the D&B contractor.

This then, as revealed in the reviewed literature, may lead on to the formulation of unclear/incomplete employers' requirements that D&B contractors bemoan as this problem invariably is said to lead to a mismatch between the contractors' proposals and the employers' requirements. In the same vein the reviewed literature revealed that designers have difficulties in interpreting unclear/incomplete employers' requirements which then results in a mismatch between the ultimate delivered product and the client's expectations.

Apart from the challenge emanating from employers' requirements the reviewed literature revealed other challenges that have been reported to be faced by key participants when delivering projects through the D&B procurement method:

#### **(a) From clients' perspective**

- ❖ Owner's loss of benefit of the designer's independent construction oversight
- ❖ Contractor's design not meeting/satisfying the owners' expectations
- ❖ Quality criteria/design standards sacrificed to minimum levels in order to maximise profits
- ❖ Difficulty to define employers' requirements clearly and still leave room for contractor's creativity
- ❖ Lack of/insufficient communication with the contractor's designer and his specialists
- ❖ The delivery method (D&B procurement method) is more labour intensive and technically demanding than the traditional approach
- ❖ Cost savings realised by the contractor are not passed to the client

#### **(b) From contractors' perspective**

- ❖ Unclear/incomplete client requirements leading to mismatch between contractors' proposals and employers' requirements
- ❖ Insufficient time allocated briefing, tender documentation and evaluation processes
- ❖ Difficulties working, managing and communicating with design professionals
- ❖ Difficulties in getting specialist input into the design
- ❖ Imposition of additional risks peculiar to D&B procurement method

#### **(c) From the designers' perspectives**

- ❖ Conflict of interest between professional duty and contractor's requirements
- ❖ Difficulties in interpreting unclear/incomplete client requirements
- ❖ Inadequate/lack of communication with end users and other stakeholders

From the above it shows that, based on the reviewed literature, key participants of the D&B procurement method have encountered challenges with this procurement method. It would also appear that these challenges can be traced back to how the D&B procurement method is set up. The challenges appear to originate from D&B procurement method specifics such as single point responsibility, communication between and among the key participants, the formulation of employers' requirements and their interpretation by the other parties, cost involved in the whole procurement process, management of design and construction risks as well as the way in which specialist supply chain partners are engaged.

The intricacy and connection of these challenges appear to be a combination of inter-related elements emanating from the organisational and contractual characteristics of the D&B procurement method. It will be recalled from the reviewed literature that the D&B procurement method is about the client engaging a single organisational entity (the D&B contractor) to undertake both the design and construction processes associated with a construction project. This entails the D&B contractor undertaking all the key processes that were traditionally separated.

From the challenges gleaned from the reviewed literature it would appear that this 'single point responsibility' brings with it associated challenges particularly to construction clients. Because the contractor is in charge of the entire design and construction processes clients appear to feel 'out of control' of the whole process. In addition, the reviewed literature appears to show that there is a feeling of 'loss of benefit of the designer's independent construction oversight leading to a feeling of more 'loss of control'.

The challenges identified in the reviewed literature as shown in chapters 2 and 3 were further tested by carrying out in-depth interviews with 33 key participants of D&B procurement method. The aim of the in-depth interviews with key participants of D&B procurement method was twofold:

- In-depth interviews were undertaken to seek an understanding of the practical challenges that are faced by key practitioners of D&B procurement method and
- To seek an understanding of practice based enablers that practitioners have used or propose to deal with the identified practical challenges they have experienced in practice

The result and analysis of these in-depth interviews was the focus of chapter 5. Through the use of content analysis several challenges were discovered. These are listed as follows:

- Unfavourable contractual arrangements
  - subcontracting arrangements between designers and D&B contractors
  - contracting arrangements
- Conflict of interest between the parties
- Strained relationships between the parties
- Cost of the whole process – tendering costs
- Imposition of risks to the D&B contractor and designer
- Lack of control by clients
- Lack of experience & understanding of the D&B processes:
  - harnessing buildability
  - management of design & difficulties differentiating scope change from design development
  - design iterative process
- Lack of involvement of key stakeholders
- Poor administration of change
- Poor quality of the end product
- Time allowed in the whole process including approvals
- Unclear employers' requirements

Figure 7.1 shows a synthesis of the findings from both the reviewed literature and the interviews undertaken with key participants.



## Challenges faced by key participants of D&B procurement method

### Challenges from the reviewed literature

#### Clients:

- Loss of benefit of designer's independent advice
- Contractor's design not meeting/satisfying owner's expectation
- Quality criteria/Design standards sacrificed to minimum levels in order to maximise profits
- Difficult to define requirements clearly & still leave room for contractor creativity
- Lack of/insufficient communication with contractor's designer
- The delivery method is more labour intensive & technically demanding than the traditional approach
- Cost savings realised by the contractor not passed to the client

#### Designers:

- Conflict of interest between professional duty & contractor's requirements
- Difficulties in interpreting unclear/incomplete client requirements
- Inadequate/lack of communication with end users & other stakeholders

#### Contractors:

- Unclear/incomplete client requirements leading to mismatch between proposals & requirements
- Insufficient time allocated briefing, tender documentation & evaluation processes
- Difficulties working, managing & communicating with design professionals
- Difficulties in managing the design iteration process
- Difficulties in getting specialist input into the design
- Imposition of additional risks peculiar to D&B procurement method

### Additional challenges from the interviews undertaken

#### Clients:

- Lack of control by clients
- Poor administration of change

#### Designers:

- Cost of the whole process - Limited recovery of design costs for unsuccessful tenders & cost saving pressures leading to
- Lack of understanding of design development
- Lack of involvement of key stakeholders including key specialist suppliers
- Lack of understanding of the D&B processes – harnessing buildability
- Unfavourable sub-contracting arrangements between designers & contractors leading to services being procured on a lump sum basis
- Lack of understanding of the D&B processes – design iterative process

#### Contractors:

- Time allowed in the whole process including approvals
- Lack of understanding of the D&B processes & difficulties differentiating scope change from design development – management of design
- Lack of understanding of the D&B processes – client interference with the design process
- Cost of the whole process – tender costs

**Figure 7.1: Synthesis of research findings from reviewed literature and Interviews**

Figure 7.1 shows that the challenges that have been explored and noted in the reviewed literature are still being encountered by key participant of D&B procurement method. Findings from the interviews undertaken show the existence of additional challenges that key participants encounter and they all appear to be linked with the key findings from the reviewed literature. For instance, the reviewed literature showed that clients were bemoaning the loss of benefit of the designer's independent construction oversight. This is mirrored with a related additional challenge that has been highlighted in the interview phase in which clients were under the perception of lack of control in some parts of the process.

Similarly designers, in the interview phase, raised several challenges they have encountered which they perceive to be emanating from a combination of lack of understanding and experience of the processes that are associated with the D&B procurement method. In the same vein, contractors raised a few additional challenges that had not been raised in the reviewed literature which they perceived to be emanating from lack of understanding and experience with the D&B procurement processes by clients. In particular they perceived this to be prevalent in what they opined to be interference by clients with the design process. Surprisingly the interview phase also revealed some contractors admitting that they at times encounter challenges with the design management process. The reviewed literature had revealed that contractors have difficulties working, managing and communicating with design professionals.

From the findings of both the reviewed literature and interviews undertaken it is evident that the challenges are interconnected and are linked in so many ways. The challenges that the qualitative phase 'unearthed' all appear to be emanating from contractual arrangements, processes, communication, people's responsibilities and duties under the D&B procurement method.

In pursuance to the accomplishing of objective 2 of this research, which is to understand the severity of the identified challenges from a wider audience, a survey was undertaken in the form of self-completed questionnaires targeting

a wider audience of key participants of the D&B procurement method. The audience targeted were different from the respondents used in the interview stage of the research. Chapter 4 describes the process used in the survey stage of the research and chapter 6 presents the results of the data analysis from the survey. This three stage methodological process combining literature review, qualitative interviews and questionnaire survey then forms the methodological process model that has been described in chapter 4.

The results of the survey analysis, as reported in chapter 6, resulted in the classification of the noted challenges presented in Figure 7.1 into either low or high severity risks. This is figuratively presented in Figure 7.2

Figure 7.2 shows that, although there are several challenges that are encountered by key participants of the D&B procurement method, they are perceived differently in terms of severity of their impact to the whole process. The following challenges are perceived to be of high severity:

- Risk management and sharing mechanisms between the parties
- Unclear/incomplete client requirements
- Underestimated time needed for approvals
- Difficulties differentiating scope change from design development
- Lack of understanding by the contractor of the design iterative processes and
- Difficulty to define requirements and still leave room for creativity

The rest of the other noted challenges are perceived as low severity. This is portrayed in Figure 7.2 below.

## Challenges faced by key participants of D&B procurement method

### Low severity challenges – shown in normal font

#### Clients:

- Loss of benefit of designer's independent advice
- Contractor's design not meeting/satisfying owner's expectation
- Quality criteria/Design standards sacrificed to minimum levels in order to maximise profits
- Difficult to define requirements clearly & still leave room for contractor creativity
- Lack of/insufficient communication with contractor's designer
- The delivery method is more labour intensive & technically demanding than the traditional approach
- Cost savings realised by the contractor not passed to the client

#### Designers:

- Conflict of interest between professional duty & contractor's requirements
- Difficulties in interpreting unclear/incomplete client requirements
- Inadequate/lack of communication with end users & other stakeholders

#### Contractors:

- Unclear/incomplete client requirements leading to mismatch between proposals & requirements
- Insufficient time allocated briefing, tender documentation & evaluation processes
- Difficulties working, managing & communicating with design professionals
- Difficulties in managing the design iteration process
- Difficulties in getting specialist input into the design
- Imposition of additional risks peculiar to D&B procurement method

### High severity challenges – shown in bold underlined font

#### Clients:

- Lack of control by clients
- Poor administration of change

#### Designers:

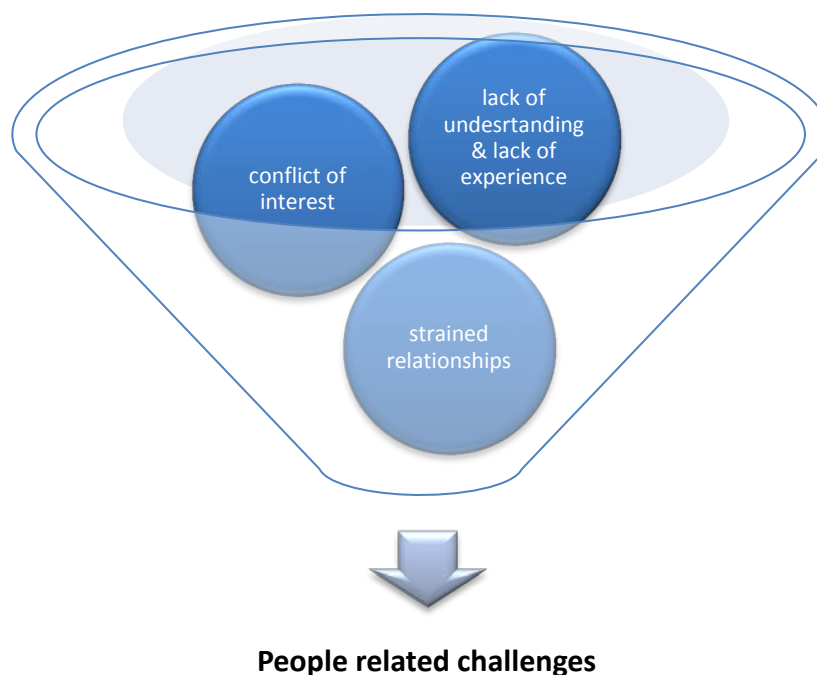
- Cost of the whole process - Limited recovery of design costs for unsuccessful tenders & cost saving pressures leading to
- Lack of understanding of design development
- Lack of involvement of key stakeholders including key specialist suppliers
- Lack of understanding of the D&B processes – harnessing buildability
- Unfavourable sub-contracting arrangements between designers & contractors leading to services being procured on a lump sum basis
- **Lack of understanding of the D&B processes – design iterative process**

#### Contractors:

- **Time allowed in the whole process including approvals**
- **Lack of understanding of the D&B processes & difficulties differentiating scope change from design development – management of design**
- Lack of understanding of the D&B processes – client interference with the design process
- Cost of the whole process – tender costs

Figure 7.2: Synthesis of research findings from reviewed literature, Interviews and survey phases

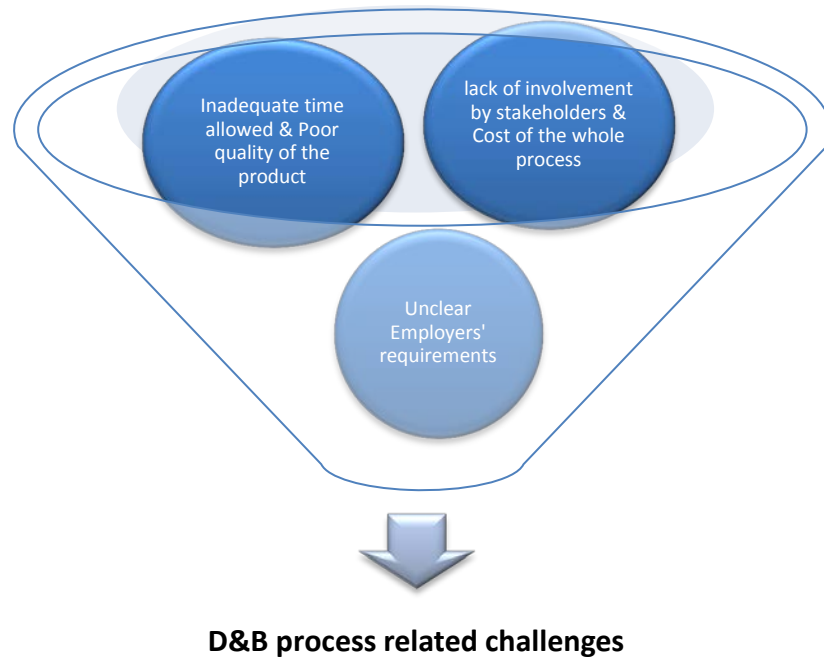
From the evidence provided by key participants in the qualitative phase of the research the challenges encountered were categorised in accordance with characteristics of the noted challenges to allow ease analysis and use in the research. Challenges that were largely influenced by contractual arrangements were synthesised into ‘contractual related challenges’. Challenges that were largely connected and impacted with the way the D&B processes operated were synthesised as ‘process related challenges’. Similarly challenges largely associated with D&B risk transfer and share mechanism were synthesised under ‘D&B project related risk challenges’. Challenges largely in connection with people, their knowledge and experience of the D&B procurement method were similarly synthesised as ‘people related challenges’. Figures 7.3, 7.4, 7.5 and 7.6 below show this challenge synthesis.



**Figure 7.3: People related challenge synthesis**

Conflict of interest, lack of understanding/lack of experience and strained relationships are all people related challenges that key participants have raised in the interview phase of the research. It is the action/inaction of the

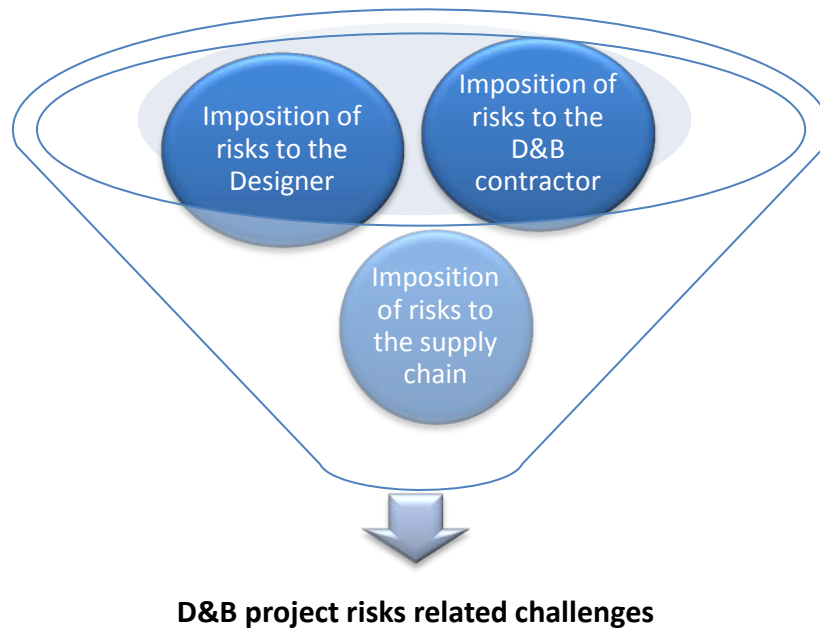
participants themselves that have a bearing on these challenges, hence their categorisation under 'People'.



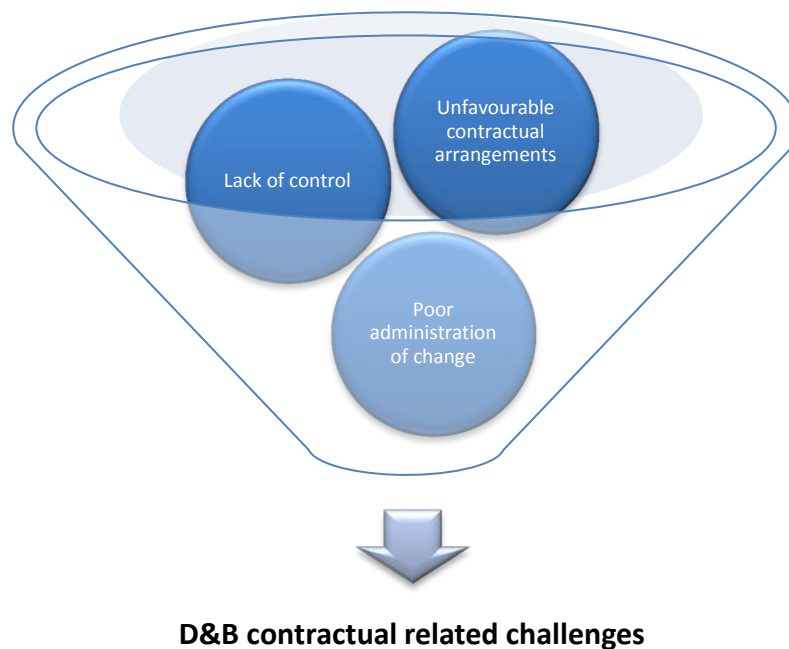
**Figure 7.4: D&B process related challenge synthesis**

Inadequate time allowed undertaking the required processes, poor quality of the end product, lack of involvement in the processes by stakeholders, cost of the whole process and unclear/incomplete employers' requirements all point to process related challenges. From the evidence presented in the qualitative phase of the research these challenges are traceable to the way or manner in which D&B procurement processes are undertaken. Hence the reason why such challenges have been synthesised into 'D&B process related challenges' as shown in Figure 7.4.

The way risk is managed in a D&B procurement method environment has been perceived by a majority of key participants, particularly contractors and designers. They opined that clients imposed significant risks to contractors, who in turn pass it on the supply chain including to designers as well. This process has been labelled as 'risk dumping' and is generally viewed as one of the key challenges around which other challenges evolve. Figure 7.5 depicts this.



**Figure 7.5: D&B project risk related challenge synthesis**



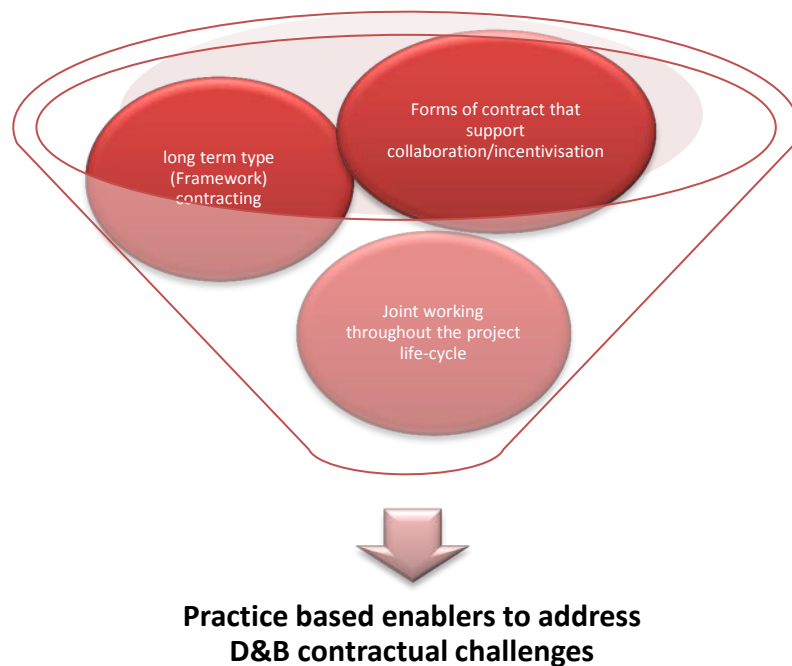
**Figure 7.6: D&B contractual related challenge synthesis**

The typical organisational set up for a D&B procured project, as shown in Figure 2.2 is governed by the contractual arrangements arising from a D&B procured project. In particular this invariably results in the D&B contractor having single point responsibility for design and construction processes. This is perceived by some clients as taking away most of the control they had before in conventional procurement methods. In addition, designers in particular, opined that due to cost pressures exerted on the contractor they end up being procured to undertake professional design services on the basis of what they view as unfavourable contractual arrangements.

Similarly all three category respondents perceive that poor administration of change is a common occurrence in D&B procured projects. This, they opined, appear to be mainly due to a combination of a lack of a robust basis to evaluate change in a D&B procured project, lack of flexibility for clients to introduce change and difficulty to assess change as there is no transparency and granularity to the D&B tender make up. These challenges were therefore grouped as 'contractual related challenges' as depicted in Figure 7.6.

With all the key challenges encountered by key participants identified from the reviewed literature and further corroborated with findings from the interviews practice based enablers were then analysed and aligned against the key challenges that they were intended to address. The practice based enablers were also synthesised into categories that have been identified in Figures 7.3, 7.4, 7.5 and 7.6. The following Figures portrays the identified practice based enablers and assigns them to the relevant categories for ease analysis in readiness for the research framework.

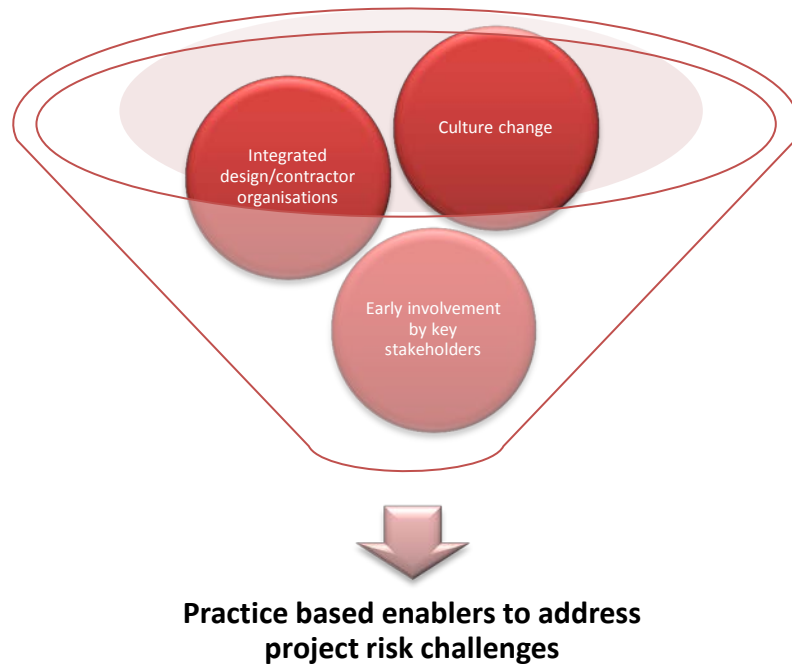




**Figure 7.7: D&B practice based enablers – to address contractual challenges**

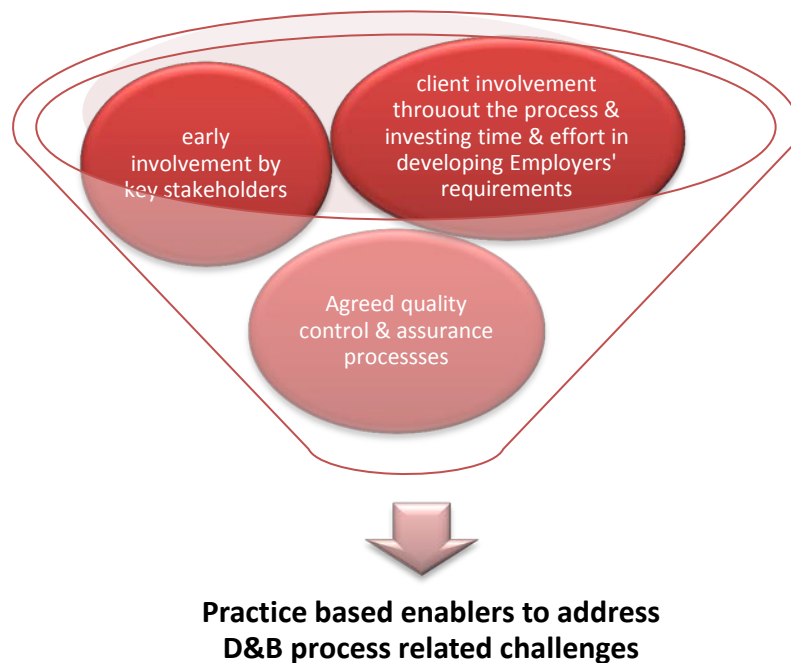
From the interview data obtained in the qualitative phase of the research key participants came up with practice based enablers that could address the contractual related challenges depicted in Figure 7.6. The main theme coming across from this suggested enabler is the importance of early engagement by the key parties, the formulation of contracts that support and encourage joint working and the establishment of long term type agreements governing how the parties should engage in future contracts.

In order to address the D&B project related risk challenges several practice based enablers have been suggested and these have been synthesised in Figure 7.8 below. Early involvement of key parties and stakeholders, culture change, formation of integrated designer/contractor organisations have been suggested to be enablers that should be able to address the D&B project related challenges.



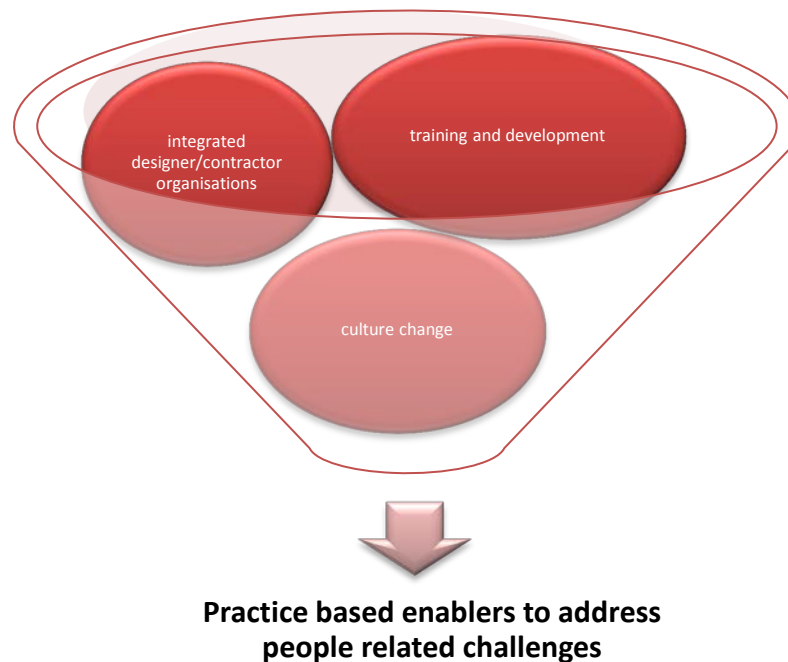
**Figure 7.8: D&B practice based enablers – to address project related risk challenges**

Practice based enablers perceived to address D&B procurement method process related challenges can also be synthesised as depicted in Figure 7.9 below.



**Figure 7.9: D&B practice based enablers – to address process related challenges**

In a similar vein practice based enablers to address people related challenges noted in Figure 7.3 have been synthesised and depicted as shown in Figure 7.10 below. As can be seen from Figure 7.10 there are several practice based enablers that are shared with other categories such as integrated design/contractor organisations and culture change. This shows the inter-relationship between both the challenges and the practice based enablers.



**Figure 7.10: D&B practice based enablers – to address people related challenges**

Culture change, integrated designer/contractor organisations and training and development have been perceived to be the enabler for people related challenges. This is perceived to bring with it improved communication and coordination between the parties, early and continuous engagement of the parties from the early project conception phase through the whole life-cycle of the project.

A holistic synthesis of the challenges and practice based enablers derived from both the qualitative and quantitative phases of the research as illustrated

above resulted in the development of the framework for the facilitation of the design and construction integration under the D&B procurement method. This is presented in the following sub-section.

#### **7.4 PROPOSED FRAMEWORK**

As part of the research objective and in partial fulfilment of the research aim, this sub-section proposes a framework to facilitate better integration of design and construction processes. It is anticipated that this framework will also serve as guidance for participants to use and refer to when undertaking project development using D&B procurement method.

The framework is derived from both the reviewed literature chapters 2 and 3 as well as the analysis and synthesis of data carried out in chapters 5, 6 and 7. It may be recalled that the central argument advanced in this research is that there appears to be a gap between the theory and practice of D&B procurement. This gap could only be understood by a holistic analysis of the challenges that have been experienced by key participants of D&B procurement method and practice based enablers to address the challenges encountered.

It is suggested in this research that the realisation of the potential benefits of D&B procurement can only be realised by applying the practice based enablers as noted in previous sections. It should be noted that such practise based enablers proposed emanated from a comprehensive understanding of the challenges affecting key participants of D&B procurement method through a methodological sequence involving a detailed literature review, semi-structured interviews and questionnaire surveys. It is against the backdrop of this triangulated approach that the framework facilitating better integration of design and construction processes resulting in effective and efficient implementation of D&B procurement has been formulated.

Although each of the key participants appears to have faced different aspects of the challenges they appear to stem from the same themes as shown in

chapters 5 and 7. There is an inter-relationship among and between the challenges which leads to some form of interconnectedness. It will be recalled that chapters 5 and 7 of the research concluded by summarising the findings in terms of 4 broad categories which are people, process, contract and project risks. Challenges encountered and how they were dealt with in practice were then classified into each of the identified broad category and the results were portrayed in Figure 5.7.

On the basis of these findings the framework facilitating better integration of design and construction processes within D&B procurement method should therefore consist of the following fundamental aspects:

- A. People related aspects that support design/construction integration
- B. Robust processes to ensure integration of design and construction
- C. Robust risk identification, allocation and management of project risks
- D. Contractual arrangements that support and promote integration

A brief synopsis of these fundamental aspects which are of central importance to design and construction integration is provided below:

#### **A. People related aspects**

Integration of design and construction processes principally mainly involves the merging of different disciplines from mainly the contractor's organisation and the designer's organisation. Invariably as observed in this research these organisations have different goals, needs and cultures. The challenge then is how to merge them into a cohesive and mutually supportive D&B procurement delivery unit.

Several practice based enablers revolving around ensuring that project participants are knowledgeable and experienced in D&B procurement, creating a team work ethos between the parties, continuous training and developing participants to ensure that they are equipped with the skills and knowledge of D&B procurement and actively foster to remove the traditional

barriers between the parties in a way that improves the effective and efficient delivery of the project. It would appear from the findings that design and build procurement is heavily dependent on team integration and people related aspects as discussed are key to this team integration. Both organisations (the client, the contractor and the designer) would need to actively facilitate and foster this. Support from the top at the executive level is required for this to happen. A high degree of commitment by all involved is necessary for team integration to be realised.

## **B. Robust processes to ensure integration of design and construction**

Closely linked to development of integrated teams is the development of integrative project processes and working practices specifically targeted at promotion of design and construction integration. Such robust processes should encompass all the stages of D&B procurement commencing with formulation of requirements, tender document preparation, pre-qualification of potential D&B contractors, evaluation of D&B tenders, engagement, design, construction and hand over to the end users. This approach would assist the team to focus on front-end activities that in turn should assist the whole team in the identification, definition and evaluation of client requirements in order to identify suitable solutions. Such processes should be clearly articulated and continuously reviewed to ensure good practice is captured & bad practice is rinsed out.

D&B contractors should also ensure that such processes are in place with their supply chain including designers to ensure that there is end to end robust systems that promote the integration of design and construction in all stages of the process. From the client's perspective such processes should incorporate the active involvement of stakeholders, contractors and designers throughout the process thus forming multi-functional teams which would potentially reduce the likelihood of costly changes and production difficulties later on in the process. The formation of this multi-functional team early on in the process would enable design and construction decisions to be made early

thus obviating challenges later on that have been hitherto experienced by the parties of the D&B procurement. Project success relies upon the right people having the right information at the right time. Active involvement of key parties, commencing during the early stages of the project may help foster a team environment and encourage appropriate and timely communication and decision making.

Effective systems to manage the design iteration processes should be identified early in the project development cycle. This is to ensure that the right resources with the right capacity and capability to manage design are identified and continuously reviewed through the project development cycle. The design iteration process involves lots of drafting, rework and examination of possibilities some of which may not necessarily be pursued. This process needs to be understood and managed well. The most fundamental aspects of managing design iteration is to enable positive design iteration on value delivery and to ensure that crucial parameters are not fixed too early to prejudice positive improvements in later stages of the design process.

In addition to setting up such robust processes coordination of the processes should be in place to ensure that each of the project development phase activity is coordinated for a seamless progression from one phase to the other. Progressive design fixity encompassing a consistent planning and review procedure which takes into account reviews of work undertaken in the phase being reviewed, approval of progression to the next phase, joint planning the resourcing and execution of the next phase and more importantly fixing and/or approval of information throughout the process.

### **C. Robust risk identification, allocation and management of project risks**

Project risks and how they are identified and shared between the parties is one of the challenges that came out of the research findings as impacting negatively on integration of design and construction teams. The main challenge appears to be centred on the perception that key parties are

engaged in what could be described as 'risk dumping' without consideration of the ability of the other party's to manage the 'dumped' risks.

A process that promotes all key parties engaging not only at the early stages of the process but through the whole project development cycle would invariably encourage team to work together as a joint team with shared project goals and objectives. Regular joint workshops to identify, analyse and manage project risks should be adopted throughout the whole D&B procurement stages to ensure that project risks are continuously reviewed and seamlessly managed by key project participants. This encourages a no surprise culture and promotes a shared approach to risk management. Such regular joint risk management workshops will encourage participants to deal with project risks proactively prior to them becoming real challenges impacting on project time and cost.

#### **D. Contractual/Organisational arrangements that support and promote integration**

In order for the above stated design and construction integration aspects to be fully embedded by key participants of D&B procurement it is important that contractual arrangements that actively support integration underpinned by the following: clear roles and responsibilities of the parties, clear duties and rights of the parties, transparent and robust change management controls and processes, clear communication lines, balanced risk sharing mechanism, promotion of innovation and 'outside the box' thinking ethos supported by rewarding success through incentivisation mechanisms and key performance measurements that are specific, measurable, achievable, realistic and time specific.

Although collaboration is a very wide theme involving a large amount of interrelated matters findings from this research suggest that integrating design and construction will necessarily require a collaborative design approach with not only the D&B contractor and designer but with the client and the supply chain as well. This demands a change in culture, a change in the usual ways

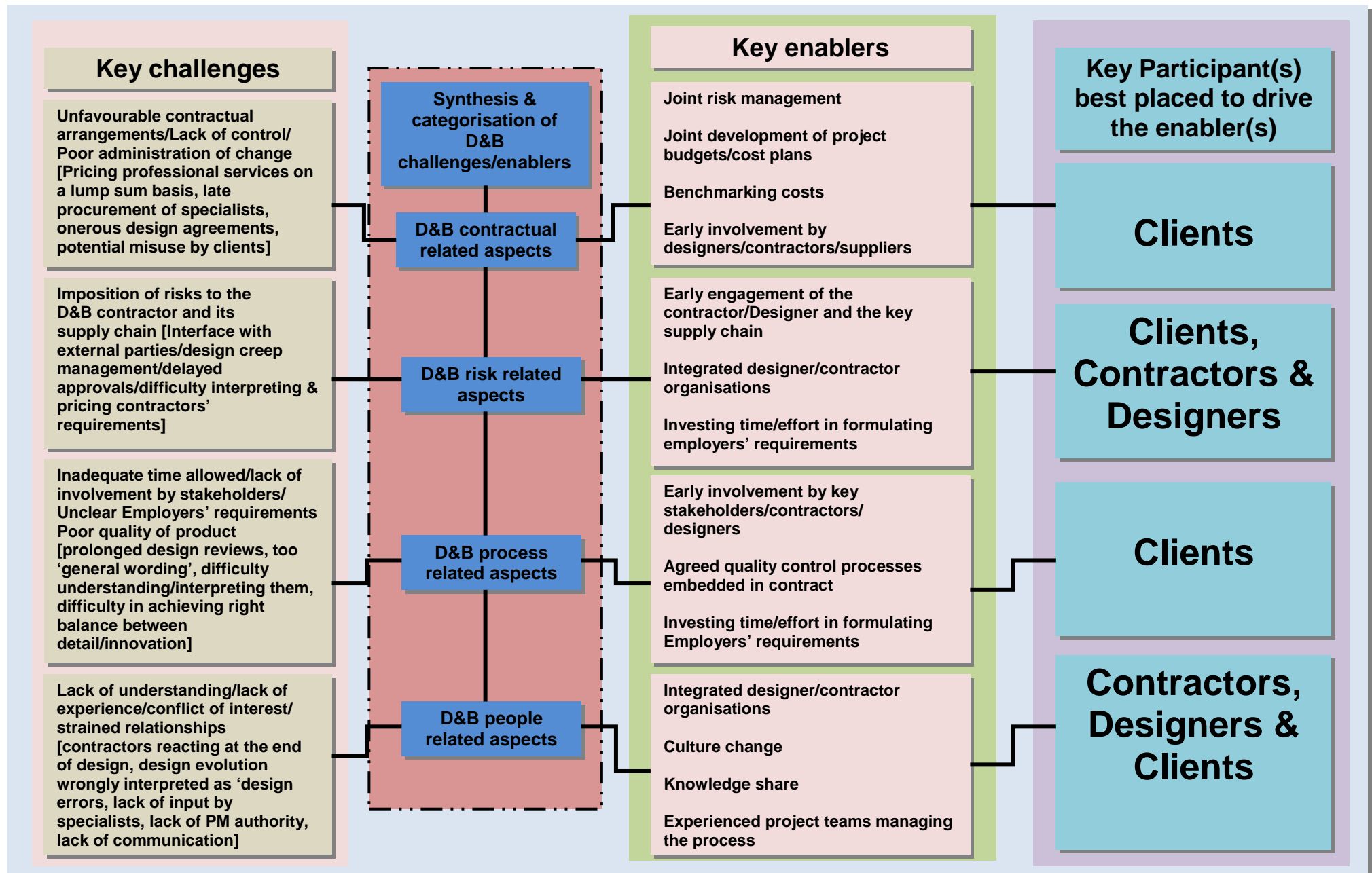


of working in order to enable effective interaction with others in the project team.

It is noteworthy from the research findings that the above stated fundamental aspects underpinning design and construction integration are interrelated and interconnected in some way, shape or form. The findings show that effective integration of design and build processes is an intricate system that involve people who are tasked to manage it, who in turn implement the integration process that drives the D&B procurement system through the whole development cycle governed by contractual arrangements that promotes integration, coordination and collaboration between and among the parties.

In this interplay of people and process, project risks are jointly identified, reviewed and managed by key parties (including client, designer, users, key supply chain and other stakeholders) early on in the process thereby facilitating an equitable sharing of project risks that ensures that the best party able to manage the identified risks is allocated the risks instead of the 'risk dumping' process that has been highlighted in the research findings. Once this is established then the system/procurement method should be able to do away with most if not all deep rooted challenges that appear to have hampered its effective and efficient implementation in the construction industry.

These findings from this research suggest that D&B procurement is an intricate process that involves interplay of complex processes; social, technical and economical. From the findings it can therefore be said that the mere adoption of D&B as a procurement method doesn't necessarily lead to the integration of design and construction in practice. Understanding the challenges that affect integration and how they can be addressed through the use of appropriate practice based enablers is a precursor to creating an enabling framework to facilitate better integration of design and construction processes in practice. Figure 7.11 is a graphical presentation of the proposed framework that embodies the aforestated key aspects of D&B procurement.



**Figure 7.11: Proposed Framework for facilitating better integration of design & construction processes within D&B procurement method**

Sections of the proposed framework and its use and benefits to practitioners:

### **1. Key challenges faced by key participants involved with the D&B procurement method.**

Initial findings from the reviewed literature identified key challenges that have been presented in Figure 3.2. Findings from the interview phase of the research corroborated the initial findings from the reviewed literature as presented in chapter 5. In addition to the challenges that were noted from the reviewed literature the interview phase generated new challenges that were not identified from the reviewed literature. More importantly the interview phase provided further information on sub-categories of challenges faced by key participants.

### **2. Synthesis and categorisation of D&B challenges and enablers.**

For ease of analysis and presentation the challenges and the sub-categories of the challenges as well as enablers were synthesised and grouped into 4 main categories (Contractual, risk allocation and management, process and people). The categorisation was based on the main characteristic aspects of the challenges and enablers. Chapter 7 presents a detailed discussion and synthesis of the D&B challenges and enablers. The proposed framework portrays this categorisation and synthesis of the key challenges and key enablers emanating from the research findings.

### **3. Key enablers to the D&B challenges.**

As set out in chapter 1 this research undertook to carry out a holistic exploration of, not only the challenges that are encountered by key participants of D&B procurement method but, the identification of practice based enablers that are proposed to address the encountered challenges. Chapter 5 presented these enablers and chapter 7 presented discussions and synthesis of enablers suggested by practitioners. The proposed

framework presents, not only the challenges that have been encountered but, the enablers to address each of the noted challenges

#### **4. Key participant(s) best placed to drive the enabler(s)**

It will be recalled from the aim of the research presented in chapter 1 that the main purpose of the proposed framework is to facilitate better integration of design and construction processes. This, it is hoped, may help in unlocking the potential benefits associated with such an integrated procurement method. In order for these potential benefits to flow it is suggested in this research that key participants should help in driving the enablers. On the basis of the interview findings the proposed framework incorporates suggested key participants who should be able to help drive the implementation of the enablers.

In summary the proposed framework incorporates and captures all the key findings from the research making it an integrated framework capable of facilitating better integration of design and construction processes. The proposed framework introduces the concept of practice based enablers on the basis that the enablers presented are suggested by practitioners, some of whom have used them before and they have been found to work. This relevance to practice is a fundamental strength of the proposed integrated framework presented in Figure 7.11.

#### **5. Suggestions for use by practitioners and associated benefits**

The presented integrated framework can be used by practitioners involved in D&B procurement method in all phases of the project. During the pre-construction phases practitioners, in particular clients and their advisers, can use the framework as part of their assessment and evaluation of project delivery options. The proposed framework has sufficient information to enable clients and their advisors to make appropriate choices when considering delivering their proposed projects using the D&B procurement method.

In the follow on phases of project procurement the proposed framework will enable clients and their advisors to set up strategies and processes in connection with requirements processing and management. The proposed framework provides them with key information that would inform their decision making processes in terms of requirements processing and engagement of key parties early and continuously throughout the project life cycle.

Due to its clarity and presentation of associated challenges encountered in the follow on phases of the procurement process such as D&B tender preparation, appraisal and appointment of the D&B contractor, the proposed integrated procurement method will help clients and their advisors to address the challenges early on before the right contractor with the requisite skill sets to deliver the project is appointed.

Similarly the proposed integrated model provides designers and contractors with key information and visibility of both the challenges and the corresponding enablers that will put them in good stead after appointment to deliver D&B procured projects. The proposed integrated framework will also help contractors and designers to consider each other's drivers when delivering projects through the D&B procurement method. This may help them to work much more closely and implement the suggested integrative enablers that will assist in the facilitation of design and construction.

Due to its all-encompassing design (encapsulating both the challenges and enablers encountered by key participants involved in D&B procurement) the proposed integrated framework is a relevant practical tool that can be used in the whole project lifecycle from inception to project completion. As a result of this the proposed framework can be used as a toolkit and/or guidance by practitioners when delivering D&B projects.

It may be recalled that chapter 3 of this research presented the research conceptual framework on the basis of information from the reviewed

literature. This was portrayed in Figure 3.3. As highlighted in chapters 5, 6 and 7 findings from the reviewed literature have been corroborated by findings from the interviews. The conceptual framework highlighted the key participants targeted by the research. Findings from the interviews shows that key participants identified in the reviewed literature are involved in key aspects of the D&B procurement method. In particular the challenges identified in the interview stages support the notion that D&B contractors engage designers as sub-consultants/sub-contractors rather than employing them in-house. The conceptual framework had shown these organisational entities as two separate organisations within the D&B contractor organisation envelope.

The discussion and synthesis chapter (chapter 7) shows that the categorisation of the challenges and enablers was not entirely as shown by the research conceptual framework. The research conceptual framework had categorised challenges and enablers as organisational, contractual, processes, financial/technical and people/managerial. This is contrasted with the categorisation emanating from the synthesis undertaken in chapter 7 which shows these as risk management, contractual, processes and people. This is possibly due to the fact that the interview phase unearthed in-depth contextual data that was not evident from the reviewed literature.

## **7.5 MAIN FINDINGS**

Having explored key participants' experiences with the D&B procurement method this research presents the following as its main findings:

- ❖ There are significant gaps between the theory and practice of D&B procurement
- ❖ Such gaps between theory and practice of D&B procurement can be traced back to the historical problems associated with traditional design led procurement methods

- ❖ D&B typical development processes are fraught with challenges particularly in terms of the parties involvement in the process, the level of design (if any) undertaken by clients prior to appointment of D&B contractors
- ❖ Design management and design/construction coordination skills of some D&B contractors have been observed to be inadequate and lacking
- ❖ There has been observations of lack of team synergy and process integration within D&B contracting organisations
- ❖ Significant challenges have also been reported with not only the quality and content of employers' requirements but the whole briefing process has been shown to be fraught with problems leading to misinterpretation and misunderstandings and therefore a mismatch between employers' requirements and contractors' proposals
- ❖ Perceived misunderstandings of the D&B procurement method by participants is perceived to result in 'risk dumping' from clients to contractors who in turn are perceived to 'pass on such risks' to their supply chain including designers causing problems down the supply chain
- ❖ This 'risk dumping' process results in budgetary and time pressures in the process of design and construction which in turn results in adversarial relationships among project team members
- ❖ There are 4 main practice based enablers that have been identified to address the challenges encountered with D&B procurement method.

The practice based enablers identified are people, processes, project risks and contractual arrangements. These have been highlighted in subsection 7.2.4 which culminated in the formulation of a framework that is proposed to facilitate better integration of design and construction processes resulting in effective and efficient implementation of D&B procurement as shown in Figure 7.11. The contribution to the body of knowledge that this research has generated is now presented in the sub-section below.

## **7.6 CONTRIBUTION TO THE BODY OF KNOWLEDGE**

The review of related literature enabled the researcher to find the gap in knowledge associated with construction projects delivered through the D&B procurement method. The research gap identified was a general lack of a holistic exploration of challenges faced by clients, designers and contractors when undertaking construction projects delivered through the D&B procurement method. The gap is significant since without such a holistic exploration of not only the challenges but practice based enablers adopted to deal with the challenges the realisation of potential benefits emanating from the integration of design and construction processes could remain untapped to the detriment of the construction sector.

In order to fill the gap the researcher used a robust research methodology. This involved both a comprehensive and critical review of related literature, face to face semi-structured interviews and a questionnaire survey. This then generated comprehensive and appropriate qualitative and quantitative data which was analysed by appropriate data analytic tools to generate the building blocks of a framework to be used for facilitating the integration of design and construction processes when utilising the D&B construction procurement delivery method.

Although there were several significant further findings from the primary data generated by this research in general some of the findings of this research are in agreement with the findings from the reviewed literature. However the novelty of this research stems from taking a holistic approach to the understanding of challenges encountered by key participants of D&B procurement method since effective integration of design and construction processes still remains a major problem in construction. To understand holistically these challenges that emanate from such a complex phenomenon like D&B construction procurement it required an in-depth exploration of key participants' experiences as undertaken in this research thereby bridging the research gap that had hitherto existed.



In order to address the research gap research objectives, as identified in chapter 1, are rigorously explored and all research questions resolved. This research, among other contributions, has also broadened the understanding of the challenges affecting key participants of D&B procurement in terms of identification of the challenges, their possible underlying root causes, their severity and more importantly practice based enablers that have been used to address the challenges. This was highlighted in chapters 2, 3, 5, 6 and 7. As a result of this comprehensive analysis of challenges and practice based enablers associated with D&B procurement method a framework to facilitate better integration of design and construction processes and thus creating the bedrock for effective and efficient implementation of this procurement method was produced and presented in sub-section 7.3 and graphically presented in Figure 7.11.

This is in line with the research aim, stated in chapter 1, of proposing a framework which will assist in the facilitation of better integration of design and construction processes within the D&B procurement method. In addition it is also envisaged that the framework will serve as a guide/toolkit for project developers and key participants of D&B procurement method. Such a framework is even more significant to the broader construction industry given that it is estimated that approximately 95% of the industry's clients are occasional and infrequent with little or no experience of working with the industry or the processes by which designers, contractors and suppliers are procured.

The research has therefore added new insights into the challenges encountered by key participants when design and build processes are integrated through the D&B procurement method. It can therefore be said that this research will serve as a basis for future studies on D&B procurement integration challenges because it has greatly enhanced our understanding of not only the challenges that are experienced by key participants but also suggested how the identified challenges can be addressed in practice

This research therefore enabled the researcher to explain a set of challenges or processes which are perhaps central to a developing body of theory in connection with D&B procurement method which are both definable and relevant to a wider body of theory. The analysis and explanation of the results throws light on processes or challenges which are pivotal or central to some wider body of explanation or knowledge on challenges, their possible dimensions, their severity and practice based enablers adopted to address the challenges.

## **7.7 CHAPTER SUMMARY**

The chapter presented discussions and synthesis of the findings from the reviewed literature, interviews and questionnaire surveys. This involved detailed discussions on findings relating to challenges, their severity and the accompanying practice based enablers that have been suggested in order to address the challenges brought about by the D&B procurement method.

Through the process of finding synthesis the chapter categorised both challenges and enablers into categories to allow ease of analysis. This assisted in the formulation of the framework. The processes that were taken to develop the framework were provided together with the potential use that the framework can be put to by the key participants. Benefits emanating from the use of the framework were also presented.

The following chapter presents the conclusions and recommendations of this research. Research limitations are also presented.

## **CHAPTER 8**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **8.1 INTRODUCTION**

From the evidence provided in this research adopting the D&B procurement method as a construction project delivery method is not a panacea for getting the much needed integration of design and construction processes. An exploration of the challenges currently faced by key participants of the D&B procurement method is needed together with getting an understanding of practice based enablers that practitioners have used/advocate for addressing the challenges encountered. Such a holistic exploration of both challenges and enablers associated with the practice of D&B procurement should be the bed rock against which a framework for facilitating the integration of design and construction processes can be developed as advanced by this research.

The following sections present the main conclusions and recommendations of the research. The research has examined the D&B method of construction procurement, identified challenges faced by key participants and unearthed practice based enablers that have been used and suggested by key participants to address the encountered challenges. The research has also made the case for adoption of robust processes and systems, transparent risk management processes, appropriate contractual arrangements that support design and construction integration and early involvement of key parties as the bedrock for facilitating better integration of design and construction processes. The aim of this research is to develop a framework to facilitate better integration of design and construction processes. Such a framework should be able to serve as guidance to key participants of the D&B procurement method.

This chapter reviews how well this has been achieved in consideration of the objectives and questions set out in chapter 1 of this research. The key

features of the new framework which address many of the key challenges identified are also described.

## **8.2 RESEARCH FINDINGS**

Conclusions on research findings are now presented in the following sub-sections. The conclusions are presented in accordance with the set objectives outlined in chapter 1.

### **8.2.1 Objective 1: To develop an in-depth understanding of the challenges affecting key participants in D&B procurement method**

Upon completion of the literature review as noted in chapters 2 and 3 an understanding of the challenges associated with D&B procurement method was developed in order to achieve and fulfil the requirements of objective 1 of the research. Findings from the reviewed literature were further tested and contextualised by undertaking semi-structured interviews with key participants of D&B procurement method.

The qualitative phase of the research ‘unearthed’ several challenges identified in reviewed literature. The exploration of such secondary data revealed the existence of several challenges that can be traced back to generic processes, organisational structures, team communication and collaboration, contractual, managerial and legal aspects emanating from the D&B procurement method.

It would appear from the reviewed literature and interviews undertaken that the D&B procurement method, far from resolving the so called ‘root causes’ of the construction industry problems by integrating design and construction, it has brought its own challenges, concerns and problems that require resolution if some of the many construction industry problems are to be resolved.

The review of related literature and the interview phase of the research enabled the researcher to gain a more extensive understanding of the challenges faced by key participants of the D&B procurement method. This

phase of the literature revealed the following regarding the challenges faced by key participants of the D&B procurement method:

#### Challenges faced by designers

- ❖ Conflict of interest between professional duty and contractors' requirements
- ❖ Difficulties interpreting unclear/incomplete client requirements
- ❖ Inadequate/lack of communication with end users and other stakeholders
- ❖ Limited recovery of design costs for unsuccessful tenders
- ❖ Late input of constructability advice from the contractor
- ❖ Lack of transparency in decision processes which underpinned client requirements
- ❖ Lack of specialist involvement in the early parts of the design
- ❖ Cost saving pressure leading to:
  - services procured on a lump sum basis
  - misunderstanding of design development

#### Challenges faced by contractors

- ❖ Unclear/incomplete client requirements
- ❖ Insufficient time allocated to briefing, tender documentation and evaluation processes
- ❖ Difficulties in
  - working, managing and communicating with design professionals
  - managing the design iterative process
- ❖ Difficulties in getting specialist input into the design
- ❖ Imposition of additional risks to the contractor
- ❖ Clients interference with the design process
- ❖ Costly tender process
- ❖ Difficulties differentiating scope change from design development

## Challenges faced by clients

- ❖ Client's loss of benefit of the designer's independent construction oversight
- ❖ Contractor's design not meeting the client's expectation
- ❖ Quality criteria/design standards sacrificed to minimum levels in order to maximise profits
- ❖ Difficulties to define requirements clearly and still leave room for contractor's creativity
- ❖ Lack of/insufficient communication with contractor's designer and his specialists
- ❖ Cost savings realised by the contractor not passed on to the client
- ❖ The delivery method is more labour intensive and technically demanding than traditional approach

In addition to the interview results corroborating findings from the reviewed literature the interviews also generated several new findings as noted in chapter 5 of the research. The fluidity and flexibility of semi-structured interviewing adopted enhanced validity of the findings. The interviews also satisfactorily answered the research questions with the exception of the question relating to the severity of the challenges which was addressed in chapter 6 of the research.

### **8.2.2 Objective 2: To explore the severity of challenges encountered by key participants**

Chapter 6 focused on the statistical analysis of the findings from the survey undertaken by the researcher in order to fulfil objective 2 of the research as well as answering the research questions relating to exploration of the severity of the challenges noted in both the reviewed literature and the interviews. Findings from this sequential methodology were brought together and presented in chapter 7 and on this basis the following conclusions can be drawn from the exploration of the severity of the challenges as perceived by the surveyed key participants:

### Severity of challenges as perceived by contractors – high severity challenges

- ✓ Unclear/incomplete client requirements
- ✓ Underestimated time needed for approvals
- ✓ Insufficient time allocated to briefing/tendering/evaluation processes
- ✓ Difficulties differentiating scope change from design development
- ✓ Difficulties managing risk passed on by clients

### Severity of challenges as perceived by contractors – low severity challenges

- ✓ Clients' interference with the design process
- ✓ Difficulties in
  - working/managing/communicating with designers
  - getting specialist input into the design
  - managing the design iteration process
- ✓ Costly tender process

Similarly client respondents ranked the challenges the following challenge as a high severity challenge:

- ✓ Difficulty to define requirements and still leave room for creativity

The following challenges were ranked as low severity challenges by client respondents:

- ✓ Lack of/insufficient communication with the contractor's designer
- ✓ Difficulties in evaluating D&B tenders
- ✓ Loss of benefit of the designer's independent construction oversight
- ✓ Contractor's design not meeting/satisfying client's expectation
- ✓ Quality/design standards sacrificed to minimum levels
- ✓ Cost savings realised by contractor not passed on to clients
- ✓ Difficulty in introducing and evaluating change
- ✓ D&B method is labour intensive and technically demanding

- ✓ Lack of involvement in technical discussions as the design is developed.

Designers surveyed in this research, on the other hand, have ranked the following challenges as low severity:

- ✓ Conflict of interest between professional duty and contractor's requirements
- ✓ Difficulties interpreting unclear/incomplete client requirements
- ✓ Inadequate/lack of communication with end users and other stakeholders
- ✓ Limited recovery of design costs for unsuccessful tenders
- ✓ Late input of constructability advice from the contractor
- ✓ Lack of specialist involvement in the early parts of the design
- ✓ Cost saving pressure leading to services procured on a lump sum basis
- ✓ Lack of transparency in decision processes which underpinned client requirements
- ✓ Cost saving pressures leading to misunderstanding of design development

Designers surveyed, however, ranked the following challenge as a high severity challenge:

- ✓ Lack of understanding by the contractor of the design iterative process

Although the ranking of the severity of the challenges by all three respondent categories appear to be different there is a connection between them. For instance employers' requirements has been ranked as a high severity challenge by the contractor respondent on the basis that they perceive the requirements to be poorly drafted, unclear, incomplete and laden with discrepancies. Similarly client respondents have ranked as high severity the challenge relating to difficulties to define requirements and still leave room for



creativity. The challenges highlighted appear to be centred on contractual, communication, risk share, people and processes as highlighted in chapter 5.

### **8.2.3 Objective 3: To identify practice based enablers that key participants have used/propose to address the key challenges identified**

From the evidence provided in the qualitative phase of the research, in particular the interview phase; the following practice based enablers were highlighted:

- Quality control and assurance processes embedded in all stages of the process
- Client involvement throughout the process
- Commercial arrangements that support collaboration
- Culture change
- Early involvement by key parties to the process
- Integrated design and contractor organisations
- Investing time and effort in developing employers' requirements
- Training and development

It would appear from the research findings that, for the challenges noted to be addressed, practice based enablers that address the contractual, communication, people, processes and risk management must be addressed and adopted early in the procurement process. According to key participants interviewed these practice based enablers would involve engagement of key stakeholders at an early stage, experienced personnel within the client organisation or external consultants experienced with D&B procurement to advise and manage the D&B procurement process as well as setting up a robust D&B tender evaluation process. This selection process would enable the appointment of a D&B contractor with the requisite experience, track record and personnel experienced with D&B procurement.

Key participants interviewed in the qualitative phase pointed out that, in order for the perception of poor quality of the end product to be addressed, the D&B

tender process should embed quality control and assurance processes that will also be embedded in the D&B contract to ensure that there is clarity in the qualitative aspects of the project to be delivered.

In order to ensure the active involvement of the client throughout the process communication lines, duties and responsibilities for key aspects of the D&B procurement method must be expressly embedded in the D&B contract. From the evidence provided in the qualitative phase of the research it would appear that key participants are of the opinion that the D&B contract should embed arrangements that support and promote collaboration. This, they opine, would encourage project team to work together and address problems jointly and therefore avoid the passing on of risks from one party to the other through the supply chain.

Culture change has been identified as one of the practice based enablers that involves setting up of co-located project team offices, sharing resources among and between the key participants organisations, sharing lessons learnt, joint resolution of problems on projects and the setting up of joint project team forums to openly discuss project challenges. This, the key participants opined, will help to endanger a joined up team mentality and demands a culture change from all three respondent categories.

Early involvement of the key parties involved in the whole D&B process is another practice based enabler that the interviewed key participants pointed out in the qualitative phase of the research. This, they opined, will entail engagement and involvement of the designer, the contractor, the client and other key stakeholders from the outset to the end of the project delivery process. Early involvement of key supply chain partners has also been highlighted from the interviews as an enabler that will help decision makers in the D&B process to understand availability of resources, lead in periods, whole life costs and a host of other technical characteristics of products that may well be the subject of consideration at that early stage. In addition, the interviewed key participants opined, this may well assist in managing project risks at an early stage and greatly assist in the formulation of employers'

requirements that key participants would be able to understand and interpret when submitting contractors' proposals. Time and effort spent in compiling the employers' requirements is viewed by key participants interviewed as a key enabler that addressing some of the challenges they have encountered. Outputs from such early involvement would benefit the production of realistic programmes that are reflective of all three category respondents' planned methodology.

Training and development of personnel involved in the D&B procurement process has been highlighted as another key enabler that helps to address some of the challenges encountered. Key participants interviewed see this key enabler as involving regular workshops with project teams briefing project teams on key aspects of D&B procurement; dissemination and application of lessons learnt on D&B procurement challenges and enablers from previously completed D&B projects; regular staff exchange programmes targeting specific roles within a D&B project delivery set up; on the job training and mentoring for key D&B management staff and other targeted training programmes aimed at specific aspects of D&B procurement method.

Another practice based enablers raised by key participants involved in the qualitative phase of the research is for the facilitation of setting up of integrated designer/contractor type organisations. This is said to entail the setting up of project delivery consortiums in which there is formal integration between the contractor and the designer. Key participants interviewed were of the opinion that such setting up of framework agreements between the contractors and designers would also facilitate integration of these two participants of the D&B procurement method.

This shows that, although key participants of the D&B procurement have encountered challenges with the procurement method, they have come up with practical suggestions (referred to in this research as practice based enablers) that they opine would work to address the challenges. This, they further opine, would help to facilitate the integration of design and construction

processes which would then hopefully result in unlocking potential benefits associated with this integrated procurement method.

#### **8.2.4 Objective 4: To propose a framework that will help to facilitate better integration of design and construction processes**

It will be recalled from chapter 1 that the aim of the research is to develop a framework to facilitate better integration of design and construction processes. Using the evidence from the reviewed literature (in chapters 2 and 3) and the findings from the interview data (in chapter 5) the research framework was formulated and presented in chapter 7. Using the challenges and the practice based enablers that have been identified in the qualitative phase of the research a framework was developed that will hopefully help practitioners of the D&B procurement method to realise the potential benefits of this integrated procurement method.

The proposed framework is formulated around the key broad categories of the challenges and the practice based enablers which have been highlighted as contractual matters, people related matters, risk management aspects and process related matters. Each broad category captures both the challenge and the corresponding practice based enabler that has been used to address the challenge. Such a diagrammatic presentation of the framework has been adopted in order to assist practitioners and other users of D&B procurement method to understand, not only, the challenges associated with the procurement method but the practice based enablers that can be used to address the key challenges noted.

From the research findings on key challenges and practice based enablers associated with the D&B procurement method it would appear that the three respondent categories face challenges that are inter-related. This is not surprising as the processes involved in this procurement method are linked in an intricate pattern that appear to centre on people, processes, contractual duties, responsibilities, obligations and the way risk is managed and

transferred. The proposed framework has therefore been formulated to mirror this categorisation and intricacy.

On the basis of the findings from this research and the accomplishment of the research objectives as stated in chapter 1 the following conclusions can be drawn from this holistic exploration of the experiences encountered by key participants when delivering construction projects using the D&B procurement method.

- ✓ Adopting D&B procurement method as a project delivery method doesn't automatically lead to the integration of design and construction in practice. A significant amount of time and effort needs to be spent in creating and facilitating integrative processes and systems to ensure that the gap between the theory and practice of D&B procurement is covered.
- ✓ Unique characteristics of D&B procurement method must be understood by the key participants to the process particularly articulation of requirements and briefing process, managing the design iteration process, involvement of key parties in the whole process, culture change in the ways participant work and relate to each other, risk/opportunity sharing and setting up contractual mechanisms that promotes collaboration, team synergy and trust.
- ✓ D&B procurement method challenges as experienced by key participants to the process are interrelated and interconnected which demands a holistic approach to their exploration and understanding. This boils down to addressing people, processes, contractual arrangements and risks associated with the whole development cycle from inception to completion.
- ✓ A practitioner centred approach is key to harnessing practice based enablers that can be used to address the challenges highlighted as

impacting on the realisation of the potential benefits from this integrated procurement method.

- ✓ Project requirements and project characteristics as well as business drivers for the proposed project should be methodically reviewed and used as one of the key basis for adopting the D&B procurement method. D&B procurement method is not a 'one size fit all' procurement method and not all projects can be suited for delivery through this procurement method

This research has successfully developed a new framework to facilitate better integration of design and construction processes. The framework represents a significant advancement to addressing challenges that are currently experienced by key participants of the D&B procurement method.

The research makes the case that such a framework, if adopted and used, should result in better integration of design and construction processes that the D&B procurement method is intended to provide to the parties involved as well as to the wider construction industry. Adoption of this framework will considerably contribute to the effective use and realisation of the numerous significant potential benefits brought about by integrating design and construction processes as embodied within the D&B procurement method. Not only will this assist other practitioners in the construction industry but academia and other fellow researchers in this field as well.

### **8.3 RECOMMENDATIONS**

On the basis of the reviewed literature, semi-structured interviews with key participants of D&B procurement method and analysis from the questionnaire survey undertaken recommendations are made to assist practitioners of D&B procurement to effectively and efficiently implement the process. This will enable the achievement of benefits that could potentially emanate from the integration of design and construction processes and hopefully address some

of the deep rooted problems that have hampered the performance of the construction industry. The following recommendations are made:

- D&B procurement method is not a 'one size fit all' procurement method and clients should methodically match project circumstances and requirements (which are different from one project to the other) before selecting the procurement method. It's certainly not a panacea of the problems encountered in the construction industry.
- Key parties to the process (designers, contractors and client organisation including key stakeholders) must be involved early in the process to ensure that client requirements are clearly articulated and communicated. Adequate time and effort must be invested in order to get this key process accomplished.
- Through this early involvement of the key parties project risks are identified jointly and apportioned in a well clearly documented risk register thereby avoiding the 'risk dumping' perception that has been said to be common with some of the engagement practices currently experienced in the industry.
- D&B procurement is a unique procurement method that has distinct characteristics and processes which demands knowledge and experience that may not be readily available to project participants who were used to other traditional forms of procurement. In such cases training and development of people is key to the implementation of the integration processes associated with the procurement method. Continual learning and development of personnel is pivotal if this integrated procurement method is going to generate the desired results.
- The contractual mechanism that sets out rights and obligations of the parties should be based on principles of joint collaboration and sharing of project risks and opportunities thereby avoiding some of the strained relationships that have been highlighted in this research.

- Addressing challenges experienced by D&B procurement method key participants is a multi-faceted interrelated process that covers not only the integration processes associated with the procurement method but the people themselves, project risks and joint analysis and management thereof as well as the contractual mechanism that legally binds the parties.
- Practice based enablers, as articulated in chapter 5, provide the building blocks enabling the efficient and efficient implementation of the D&B procurement method
- The industry should do more to enable the collation and propagation of feedback from D&B projects. The professional bodies and client and contractor association bodies in the industry should come up with ways in which participant experiences can be shared with others in the construction industry. Both success and failure can offer important lessons for the future.

#### **8.4 LIMITATIONS OF THE RESEARCH**

Although the main aim and objectives of this research were met and all the research questions were adequately answered this sub-section acknowledges and highlights the limitations of this research. These are listed below:

- ❖ The inability to test the framework by the author of this research. The main reason for this is that usually construction projects take long to undertake from inception to completion and such time frames are outside the scope of the allocated duration of the research.
- ❖ Although the main focus of this research is about qualities of entities and on processes and meanings that are not experimentally examined in terms of quantity there were unequal representation in the samples used for the three category respondents during both the interviews and the questionnaire survey phases of the research.



- ❖ The study only looked at experiences from key participants (designers, contractors and designers) and other participants of the D&B procurement method such as suppliers, sub-contractors and end-users have not been involved. Although such an all-encompassing study would require significantly more time to undertake and additional resources outside the capacity and capability of the current research further research can be undertaken in future to cover these participants.
- ❖ As the research is based on key participants' experiences, accounts, actions and other related variables these challenges tend to change over time and can be impacted significantly with dimensions such as the social, economic and technological factors. The results of this research may not necessarily be reflective of the challenges experienced by key participants of D&B procurement method in the UK construction sector in future given the dynamic nature of the variables noted. Further research should be undertaken to review how the constant interplay of this dynamic interplay of challenges, their underlying factors and practice based enablers to address them.
- ❖ The research focus has been the experiences of D&B procurement key participants in the UK construction sector and other geographical environments have not been covered. Given that the world is generally viewed as one global village it will be interesting to undertake this type of research in other geographical areas and identify trends and patterns of the challenges experienced by participants of D&B procurement method.
- ❖ Research respondents (clients) used in the survey phase of the research were mainly property developers based on the top 100 list of top clients listed in the league tables for 2012 published by the Construction News.

## REFERENCES

- Abi-Karam, T., (2005). 'Design/Build Selection Process – Art or Science?' *Cost Engineering*, Vol. 47 No 5, pages 14-19.
- Adami, M., and Kiger, A., (2005). 'The use of triangulation for completeness purposes'. *Nurse Researcher*, Vol. 12 No 4, pages 19-28.
- Akintoye, A., (1994). Design and Build: A survey of construction contractors' views. *Construction Management and Economics*, Vol. 12 pages 155 – 163.
- Akintoye, A., and Skitmore, M., (1994). 'Models of UK private sector quarterly construction demand'. *Construction Management and Economics*, Vol. 12, pages 3-13.
- Akintoye, A., and Fitzgerald, E., (2000). 'A survey of current cost estimating practices in the UK'. *Construction Management and Economics*, Vol. 18, pages 161-172.
- Albanese, B., (1993). Team Building: Implications for the Design Construction Process; Construction Industry Institute, Austin, TX.
- Anumba, C.J., (1989). 'An integrated two dimensional and three dimensional data structure for a structural engineering CAD system', PhD thesis, University of Leeds, Leeds.
- Anumba, C.J., and Watson, A.S., (1991). 'An integrated CAD data structure for structural engineering', *Computing Systems in Engineering*, Vol. 2, No 1, pages 115-123.
- Anumba, C.J., and Watson, A.S., (1992). 'An innovative approach towards designer-oriented CAD systems', *The Structural Engineer*, Vol. 70, No 9, pages 165-169.
- Anumba, C.J., and Evbuomwan, N.F.O., (1997). 'Concurrent engineering in design-build projects'. *Construction Management and Economics*, Vol. 15, pages 271-281.
- Arayici, Y., Ahmed, V., and Aouad, G., (2006). 'A requirements engineering framework for integrated systems development for the construction industry'. *IT in Construction (ITcon)*, Vol. 11 pages 35-55.
- Atkinson, P., Coffey, A., Delamont, S., Lofland, J., and Lofland, L., (2001) *Handbook of Ethnography*, London: Sage.

- Aulakh, P., and Gencturk, E., (2000). 'International principal-agent relationships: control, governance and performance'. *Industrial Marketing Management*, Vol.29, pages 521-538.
- Austin, S., Baldwin, A., Li, B., and Waskett, P., (1999). 'Analytical design-planning techniques. (ADePT) an IDEF0v model of the detailed building design process'. *Design Studies*, Vol. 20, No 3, pages 279-296.
- Austin, S.A., Baldwin, A.N., Hammond, J., Murray, M., Root, D., Thomson, D., and Thorpe, A., (2001). *Design Chains: A Handbook for Integrated Collaborative Design*, London: Thomas Telford.
- Bahill, A.T., and Dean, F., (1999). *Discovering system requirements* in Sage, A. P., (Ed), *Handbook of System Engineering and Management*, New York: Wiley – Interscience, pages 175-219.
- Ball, M., (1988). *Rebuilding Construction: Economic Change and the British Construction Industry*. London: Routledge.
- Barlow, J., et al., (1997). *Towards Positive Partnering*. Bristol: The Policy Press.
- Barrett, P.S., and Stanley, C., (1999). *Better construction Briefing*, Oxford: Blackwell Science.
- Barter, S.L., (1988). *Introduction in Barter, S.L. (ed.), Real Estate Finance*. London: Butterworths.
- Beard, J., Loulakis, M., and Wundram, E., (2001). *Design Build: Planning through development*, McGraw-Hill, New York.
- Bennett, J., Potheary, E., and Robinson, G., (1996). *Designing and Building a World Class Industry*, Centre for Strategic Studies, Reading University.
- Blaikie, N., (2000). *Designing Social Research*, Cambridge: Polity.
- Bo, X., and Chan, A., (2012). 'Investigation of barriers to entry into the design-build market in the People's Republic of China'. *Journal of Construction Engineering and Management*, Vol. 138 Issue 1, pages 120-127
- Bowen, P.A., Pearl, R.G., and Edwards, P.J., (1999). 'Client briefing processes and procurement method selection: a South African study'. *Engineering Construction and Architectural Management*, Vol. 6 No 2, pages 91-104.
- Brace, I., (2008). *Questionnaire Design, How to plan, structure and write survey material for effective market research*, second edition, Kogan Page Limited, London

- Brandon, P., and Betts, M., (1995). Integrated construction Information. E&F Spon, London.
- British Property Federation (BPF), (1983). Manual of the BPF system for building design and construction. British Property Federation Federation, UK.
- Brockbank, A., McGill, I., & Beech, N., (2002). *Reflective Learning in Practice*, Gower.
- Brookfield, S. D., (1987). *Developing Critical Thinkers: Challenging Adults to Explore Alternative Ways of Thinking and Acting*, Open University Press.
- Bryman, A., et al.,(2009). *Handbook of Data Analysis*, SAGE.
- Bryman, A., (2008). Social Research methods. New York: Oxford University Press Incorporation.
- Bryman, A., (2008). Triangulation Info paper on the Encyclopaedia of Social Science Research Methods. Available at: [www.referenceworld.com/sage/socialscience/samples.html](http://www.referenceworld.com/sage/socialscience/samples.html) - (accessed on 10th August 2012).
- Brink, Y.v.d., and Amagboso, M., (2010). 'Understanding the divergence between output and employment in the UK construction industry'. *Economic & Labour Market Review*, Vol. 4 No 3, pages 42-51.
- Cabinet Office & Efficiency & Reform Group (2014). *New Models of Construction Procurement*, London: Government Publications.
- Cargan, L., (2007). *Doing social research*, London: Rowman & Littlefield Publishers.
- Cecil, R., (1983). 'Design and build'. *Architectural Journal*, Vol. 177, No 13, pages 61-62.
- Chan, D.W.M., and Kumaraswamy, M.M., (1997). A Comparative study of causes of time overruns in Hong Kong construction projects'. *International Journal of Project Management*, Vol. 15, No 1, pages 55-63.
- Chan, A.P.C., (2000). 'Evaluation of enhanced design and build system – a case study of a hospital project'. *Construction Management and Economics*, Vol. 18, pages 863-871.
- Chan, E.H., and Chan, A.P.C., (2000). Design-Build Contracts in Hong Kong – some legal concerns. In: Serpell A, (ed.) Information and Communication in construction procurement. Chile: Pontificia Universidad Catolica de Chile; pages 183-200.

- Chan, E.H., and Chan, A.P.C., (2001). 'Managing Conflict in design information of international construction projects'. *Journal of Architectural Management*, ASC,E Vol. 6 No 1, pages 32-57.
- Chan, A.P.C., Ho, D.C.K., and Tam. C.M., (2001). 'Design and Build Project Success Factors: multivariate Analysis'. *Journal of Construction Engineering and Management*, Vol. 127 No 2, pages 93-100.
- Chan, E.H.W., and Yu, A.T.W., (2005). 'Contract strategy for design management in the design and build system'. *International Journal of Project Management*, Vol. 23, pages 630-639.
- Chan, D.W.M., Chan, A.P.C., Lam, P.T.I., and Wong, J.M.W., (2010). 'Identifying the critical success factors for target cost contracts in the construction industry'. *Journal of Facilities Management*, Vol. 8 No 3, pages 179-201.
- Chang, A.S., Shen, F.Y., and Ibbs, W., (2010). 'Design and construction coordination problems and planning for design-build project new users'. *Canadian Journal of Civil Engineering*, Vol. 37 No 12, pages 1525-1534
- Cherns, A.B., and Bryant, D.T., (1984). 'Studying the client's role in construction management'. *Construction Management and Economics*, Vol. 2, pages 177-184.
- Chileshe, N., and Watson, P., (2005) Application of methodological triangulation in construction management research: some key empirical findings, in Hampt, T.C., and Smallwood, J.J. (eds.) "Rethinking & revitalising construction safety, health, environment and quality; CIB WW99 Working Committee 4<sup>th</sup> Triennial International Conference, Port Elizabeth, 17-20 May pages 699-712.
- Chinyio, A.C., Olomolaiye, P.O., and Corbett, P., (1998). 'An evaluation of the Project Needs of the UK Building clients', *International Journal of Project Management*, Vol. 16, pages 385-391.
- Cohenca-Zall, D., (1994). 'Process of planning during construction', *Journal of Construction Engineering Management*, ASCE, Vol. 120 No 3, pages 561-578.
- Construct I.T. (CIT), (1996). Benchmarking Best Practice Report: briefing and Design, *Construct IT Centre of Excellence*, Salford.
- Construction Industry Review Committee (CIRC), (2001). Construct for Excellence: *Report of the CIRC*, CIRC, Hong Kong.
- Construction News (2012). Available at: <http://www.cnplus.co.uk/> - (accessed on 3rd July 2012)

Contracts in use by the RICS: a survey of building contracts in use during 2010. Available at:  
[http://www.rics.org/Global/CONTRACTS%20IN%20USE\\_FINAL\\_%20Nov2012\\_%20lteage\\_081112.pdf](http://www.rics.org/Global/CONTRACTS%20IN%20USE_FINAL_%20Nov2012_%20lteage_081112.pdf) - (accessed on 16th February 2015)

Cooper, H., (1984). *The integrative research review: A Systematic approach*, Beverley Hills, CA: Sage

Cox, A., and Thompson, I., (1997). 'Fit for purpose contractual relations: determining a theoretical framework for construction projects', *European Journal of Purchasing and Supply Management*, Vol. 3 No 3, pages 127-135.

Creswell, J. W., (2003). *Research Design: Qualitative, Quantitative, and Mixed Methods Approach* (2nd Edition). London: Sage.

Creswell, J. W., and Plano Clark, V.L., (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.

Creswell, J. W., (2009) 3<sup>rd</sup> ed. *Research design, Qualitative, Quantitative and Mixed Methods Approaches*, London: Sage.

Cuffe, T., (ed.), (2003). *UK Standard Industrial Classification of Economic Activities*. Office for National Statistics, London.

David, C., and Dorman, P., (2008). 'The rise and rise of two-stage tendering', *International Construction Law Report*, Vol. 25 No 4, pages 511-517.

Denscombe, M., (2007). *The Good Research Guide for small-scale social research projects*: 3rd edition. Maidenhead: McGraw- Hill Education Open University Press.

Denzin, K., N., and Lincoln, Y., S., (editors) (2000); *Handbook of Qualitative Reserach*, 2<sup>nd</sup> Edition, Sage Publications, Inc. London.

Denzin, K., N., and Lincoln, Y., S., (editors) (2005); *Handbook of Qualitative Reserach*, 3rd Edition, Sage Publications, Inc. London.

Department of the Environment (DoE), (1982). *The United Kingdom Construction Industry – A guide to methods of obtaining a new industrial building in the UK*, Invest in Britain Bureau, London.

Dulamini, M.F., Morris, G.K., Baxendale, T., (1995). The role of design management in improving the effectiveness of design and build projects. In: International congress on constructing design and build projects – International experiences. Raffles City Convention Centre, Singapore, 5-6 October 1995.

Easterby-Smith, M., Thorpe, R., et al., (2004). *Management Research: An Introduction*. London: Sage.

Edwards, D.J., and Holt, G.D., (2010). 'The case for "3D triangulation" when applied to construction management research'. *Construction Innovation: Information, Process, Management*, Vol. 10 No 1, pages 25-41.

Egan, J., (1998). *Rethinking Construction*, Department of Environment Transport and the Regions.

Egan, J., (2002). *Accelerating Change*. London: Department of the Environment, Transport and the Regions.

El Asmar, M., Lotfullah, W., Whited, G., and Hanna, A., (2010). 'Quantitative methods for design-build team selection'. *Journal of Construction Engineering and Management*, Vol. 136 Issue 8, pages 904-912

Ellis, R.D., Herbsman, Z., and Kumar, A., (1991). *Evaluation of the FDOT design/build program Final Report*. Prepared for Florida Dept. of Transportation State Project No 99700-7543-010, Dept. Of Civil Engineering, University of Florida, Gainesville, Fla.

Ernzen, J., and Schexnayder, C., (2000). 'One company's experience with design/build: labour cost risk & profit potential'. *Journal of Construction Engineering & Management*, Vol. 126 Issue 1, pages 10-14

European Construction Platform (2005). Strategic research agenda for the European construction sector – achieving a sustainable and competitive construction sector 2030. Available at: [www.ectp.org](http://www.ectp.org) - (accessed on 10th August 2010).

Evbuomwan, N.F.O., Anumba, C.J., (1998). An integrated framework for concurrent life-cycle design and construction. *Advanced Engineering Software*, Vol.29 No 7-9, pages 587-97.

Fahmy, S., and Jergeas, G., (2004). 'Ten Critical Principles for Successful Design-Build Projects'. *Cost Engineering*, Vol. 48 No 11, pages 29-34.

Fairclough, J., (2002). Rethinking Construction Innovation and Research: A review of Government R&D policies and practices. Available at: [www.dti.gov.uk/construction/pdf/clough.pdf](http://www.dti.gov.uk/construction/pdf/clough.pdf) - (accessed on 10th August 2010)

Federal Acquisition Regulation (FAR), (1996). Federal acquisition regulation contracting by negotiation, Part 15, sec.15. 605. U.S. Government Printing Office, Washington, D.C.

Federle, M., and Rowings, B., (1996). Optimising Project Organisations. Construction Industry Institute, Austin, TX.

Fellows, R., and Liu, A., (2003). *Research Methods for construction*, 2<sup>nd</sup> ed, Oxford: Blackwell.

Ferreira, F.P., Lima, L.P., Formosco, C.T., and Leite, F.L., (2007). Opportunities for Clients' requirements management in new form of housing provision in Brazil. Proceedings of CIB World Building Congress, Cape Town, South Africa pages 2055-2066.

FIEC (European Construction Industry Federation), (2002). Construction in Europe Key Figures, *Federation del' Industrie Europeenne de la Construction*. Brussels.

Field, A., (2005). Discovering Statistics using SPSS. Sage.

Fredrickson, K., (1998). 'Design Guidelines for Design-Build Projects'. *Journal of Management in Engineering*, pages 77-80.

Gaafar, H.K., and Perry, J.G., (1999). 'Limitation of design liability for contracts', *International Journal of Project Management*, Vol. 17 No 5, pages 301-308.

Gale, A.W., (1992). The construction industry's male culture must feminise if conflict is to be reduced: the role of education as gatekeeper to a male construction industry. In Proceedings of 1<sup>st</sup> International construction Management & Resolution Conference. Fenn, P., and Gameson, R., (eds.), pages 416-427.

Gilb, T., (2005). *Competitive Engineering*, London: Elsevier.

Goftar, V., N., Asmar, M., El., And Bingham, E., (2014). 'A meta-analysis of literature comparing project performance between design-build (DB) and design-bid-build (DBB) delivery systems'. In Proceedings of Construction Research Congress by the American Society of Civil Engineers. Pages 1389-1398.

Golafshani, N., (2003). 'Understanding Reliability and Validity in Qualitative Research'. *The Qualitative Report*, Vol. 8 No 4, pages 597-607.



Goodacre, P., Pain, J., Murray, J., and Noble, M., (1982). Research in building design, *Occasional Paper, No 7*, Department of Construction Management, University of Reading, Reading.

Gransberg, D.D. and Lopez del Puerto, C., (2004). Proposing for design-build success: A primer to marketing design-build professional services, Society for marketing professional services, Alexandria, Va.

Gransberg, D.D., and Molenaar, K., (2004). 'Analysis of Owner's Design and Construction Quality Management Approaches in Design/Build Projects'. *Journal of Management in Engineering*, Vol. 20 No 4, pages 162-169.

Gransberg, D.D., and Molenaar, K., (2001). 'Design-build contracting for transportation'. Instructor's manual, Washington State Department of Transportation, Olympia, Wash.

Gransberg, D.D., and Windel, E., (2008). 'Communicating design quality requirements for public sector design/build projects'. *Journal of Management in Engineering*, Vol. 24 No 2, pages 105-110.

Gray, C., and Hughes, W., (2001). *Building Design Management*, Oxford: Butterworth-Heinemann.

Gray, C., and Will, H., (2000). *Building Design Management*. Oxford: Butterworth-Heinemann.

Griffith, A., (1989). 'Design-build procurement and buildability'. *The Chartered Institute of Building (CIOB)*, Technical Information Service, 112.

Grobber, K., and Pretorius, L., (2002). 'An evaluation of design-build as procurement method for building and civil engineering projects in South Africa', *Journal of the South African Institution of Civil Engineering*, Vol. 44 No 1, pages 13-19.

Guest, G., Bruce, A., and Johnson, L., (2006). 'How many interviews are enough?: An experiment with data saturation and variability'. *Field Methods*, Vol. 18 No 1, pages 59-82.

Hale, D., Shretha, P., Gibson, G., Jr., and Migliaccio, G., (2009). 'Empirical comparison of design/build and design/bid/build project delivery methods'. *Journal of Construction Engineering and Management*, Vol. 135 Issue 7, pages 579-587.

Hampton, R.K., (2001). 'Collaborative multidisciplinary design optimisation', *Leadership Management Engineering*, Vol. 1 No 3, pages 23-28.

- Hassan, Z., (2009). Government Procurement Policy & Procedures 2<sup>nd</sup> Malaysian Construction Summit 2009, 10 Nov 2009, Sunway Pyramid Convention Centre, Selangor.
- Heide, J.B., and John, G., (1990). 'Alliances in Industrial purchasing: the determinants of joint action on buyer-supplier relationships', *Journal of Marketing Research*, Vol. 27 No 1, pages 24-36.
- Hillebrandt, P.M., (1985). *Economic Theory of the Construction Industry*. 2<sup>nd</sup> ed. London: Macmillan.
- Hollway, W., and Jefferson, T., (2000). *Doing Qualitative Research Differently*, London: Sage.
- Hooks, I.F., and Farry, K.A., (2001). Customer-centered products: Creating successful products through smart requirements management. AMACOM, New York, NY.
- Howie, W., (1996). 'Controlling the Client', *New Civil Engineer*, 17 October, page 12.
- Huse, J.A., (1997). *Understanding and negotiating turnkey contracts*. London: Street & Maxwell.
- Hutcheson, J.M., (1990). Forecasting the building market, *Proceedings, CIB 90 Congress*, Sydney, Australia, 1 March, pages 135-143.
- Ireland, V., (1983). The Role of Managerial Actions in the Cost, Time and Quality Performance of High-Rise Commercial Building Projects, Ph.D. Thesis, University of Sydney, Australia.
- Jack, E., and Raturi, A., (2006). 'Lessons learned from methodological triangulation in management research', *Management Research News*, Vol. 29 No 6, pages 345-357.
- Janssens, D.E.L., (1991). *Design-build explained*. London: Macmillan.
- Kagioglou, M., Cooper, R., Aoud, G., Hinks, J., Sexton, M., and Sheath, D., (1998). *Generic Design and Construction Process Protocol: Final Report*, The University of Salford.
- Kamara, J.M., (1999). Client requirements processing for concurrent life-cycle design and construction, PhD thesis, University of Teesside.

Kamara, J.M., and Anumba, C.J., (2000a). 'Client requirements processing for concurrent life-cycle design and construction', *Concurrent Engineering*, Vol. 8 No 2, pages 74-88.

Kamara, J.M., Anumba, C.J., and Evbuomwan, N.F.O., (2000b). 'Establishing and processing client requirements\_a key aspect of concurrent Engineering in construction'. *Engineering Construction and Architectural Management*, Vol. 7 pages 15-28.

Kamara, J.M., Anumba, C.J., and Evbuomwan, N.F.O., (2000c). 'Process model for client requirements processing in construction'. *Business Process Management Journal*, Vol. 6 No 3, pages 251-279.

Kamara, J.M., and Anumba, C.J., (2001). 'A critical appraisal of the briefing process in construction'. *Journal of Construction Research*, Vol. 2 No 1, pages 13-24.

Kelly, J., Macpherson, S., and Male, S., (1992). The briefing process: a review and critique. RICS Research series, Paper No 12, London: Royal Institution of Chartered Surveyors.

Kilian, W.F., and Snyman, G.J.J., (1984). Revised Forecast of the CPAP (Haylett Formula) and the BER Building Cost Index 1983-1987, *Medium-Term Forecasting Association*, Stellenbosch.

Kimani, S.S., and Baum, W.C., (1992). The consulting profession in developing countries, World Bank, Washington, D.C.

Knochar, M.D., Sanvido, V.E., and Moore, S.D., (1997). 'The benefits of design-build contracting in the United States. Construction process re-engineering. *Proceedings of the International Conference on Construction Process Re-engineering*, Griffith University, pages 191-201.

Kubr, M., (1993). *How to select and use consultants?* Geneva: International Labour Office.

Kujala, S., Kauppinen, M., Lehtola, L., and Kojo, T., (2005). The role of user involvement in requirements quality and project success. *Proceedings of the 13<sup>th</sup> IEEE International Requirements Engineering Conference*, 29<sup>th</sup> August – 2<sup>nd</sup> September 2005, Paris, France.

Kulatunga, U., (2008). Influence of performance management towards construction research and development. PhD thesis, University of Salford.

Kumar, R., (2005). *Research Methodology: A Step-by-Step Guide for Beginners* (2nd Edition). London: Sage.

Kumaraswamy, M.M., Ling, F.Y.Y., Rashman, M.M., and Phng, S.T., (2005). 'Constructing relationally integrated teams', *Journal of Construction Engineering Management*, Vol. 131 No 10, pages 1076-1086.

Kutner, J.S., Steiner, J.F., Corbett, K.K., Jahnigen, D.W., and Barton, P.L., (1999). 'Information needs in terminal illness', *Social Science and Medicine*, Vol. 48, pages 1341-1352.

Kvale, S., and Brinkmann, S., (2008). *Interviews: learning the craft of qualitative research interviewing*, London: Sage.

Latham, M., (1994) *Constructing the Team*. Final Report on the joint review of procurement and contractual arrangements in the UK construction industry, London: HMSO.

Lawson, B., (1990). *How Designers Think*, 3<sup>rd</sup> ed., London: The Architectural Press.

Lee, D., and Arditi, D., (2006). 'Total Quality Performance of Design/Build Firms Using Quality Function Deployment'. *Journal of Construction Engineering and Management*, Vol. 132 No 1, pages 49-57.

Lee, Dong-Eun., Lim, Tae-Kyung, Arditi, D., (2009). Automated stochastic quality function deployment system for measuring the quality performance of design/build contractors. *Automation in Construction*, Vol. 18, pages 348-356.

Leitch, C. M., Hill, F.M., et al., (2010). 'The Philosophy and Practice of Interpretivist Research in Entrepreneurship Quality, Validation, and Trust'. *Organizational Research Methods Knowledge Base*, Vol.13 No 1, pages 67-68.

Leite, F.L., Miron, L.I.G., and Formosco, C.T., (2005). Opportunities for client requirements in low income housing building projects in Brazil. Proceedings of the IGLC – 13<sup>th</sup> July, Sydney, Australia pp 333-341.

Levene, Sir Peter., (1995), *The Levene Efficiency Scrutiny into Construction Procurement by Government*, Her Majesty's Stationery Office London.

Levin, R.I., and Rubin, D.S., (1998). *Statistics for Management*, 7<sup>th</sup> Ed, New Jersey, Prentice-Hall International, Inc.

Lewin, K., (1946). Action Research and minority problems. *Journal of Social Challenges*, 2 pp. 34-6.

Li, H., Shen, Q.P., Scott, D., and Love, P.E.D., (Eds) (2000a). 'Implementing IT to gain a competitive advantage'. Hong Kong Polytechnic University Press, Hong Kong, pages 36-53.

Li, H., Love, P.E.D., and Irani, Z., (2000b). 'A preliminary investigation into the relationship between the use of IT/IS and the productivity of professional consulting firms in construction'. *International Journal of Construction Information Technology*, Vol. 8, No 1, pages 15-27.

Light, R.J., and Pillener, D.B., (1984). *Summing it up*, Boston: Harvard University Press, MA.

Lim, C.S., and Mohamad, M.Z., (2000). 'An Exploratory Study on Recurring Construction Problems', *International Journal of Project Management*, Vol. 18, pages 267-273.

Ling, Y.Y.F., (2004). 'Key determinants of performance of design-bid-build projects in Singapore'. *Building Research & Information*, Vol. 32 No 2, pages 128-139.

Ling, Y.Y., and Chang, C.L.K., (2005). 'Design-and-build contractors' service quality in public sector projects in Singapore'. *Build Environment*, Vol. 40 No 6, pages 815-823.

Ling, F.Y.Y. and Kerh, S.H., (2004). 'Comparing the performance of Design-Build and Design-Bid-Build Building projects in Singapore'. *Architectural Science Review*, Vol. 47, Issue 2, pages 163-175

Ling, F.Y.Y., and Poh, B.H.M., (2008). 'Problems encountered by owners of design-build projects in Singapore'. *International Journal of Project Management*, Vol. 26, pages 164-173.

Linowes, J., (2000). 'Marketing design/build'. *Journal of Management in Engineering*, Vol. 16 No 5, pages 10-11.

Liu, B; Hou, T; Shen, Q; Yang, Z; Meng, J; and Xue, B; (2015). 'Which owner characteristics are key factors affecting project delivery system decision making? Empirical analysis based on the rough set theory'. *Journal of management in Engineering*, Vol. 31 Issue 4

Love, P.E.D., and Gunasekaran, A., (1998). Concurrent Engineering: a strategy for procuring construction projects. *International Journal of Project Management*, Vol. 16 No 6, pages 375-83.

- Love, P.E.D., Smith, J., and Li, H., (1999). 'The propagation of rework benchmark metrics for construction'. *International Journal of Quality and Reliability management*. Vol. 16, No 7, pages 638-658.
- Love, P.E.D., Irani, Z., Li, H., and Cheung, E.W.L., (2000). 'An empirical analysis of IT/IS evaluation in construction'. *International Journal of Construction Information Technology*. Vol. 8, No 2, pages 21-38.
- Love, P.E.D., and Li, H., (2000). 'Quantifying the causes and costs of rework in construction'. *Construction Management and Economics*, Vol. 18, pages 479-490.
- Lowe, J., (2011). 'Concentration in the UK construction sector'. *Journal of Financial Management of Property and Construction*, Vol. 16 No 3, pages 232-248.
- Manstead, A.S.R., and Semin, G.R., (1988). 'Methodology in social psychology: turning ideas into action'. In M. Hewstone, W. Stoebe, J-P. Codol and G.M. Stephenson, eds, *Introduction to Social Psychology*. Oxford: Blackwell.
- Marshall, C., and Rossman, G.B., (2006). *Designing qualitative research*, 4<sup>th</sup> ed. Thousand Oaks: Sage.
- Mason, J., (2002). *Qualitative researching*, 2<sup>nd</sup> edition, Thousand Oaks: Sage Publications.
- Masterman, J.W.E., (1996). *An introduction to building procurement systems*. London: E&FN Spon.
- Masterman, J.W.E., (2002). *An Introduction to building Procurement Systems*, 2<sup>nd</sup> ed. London: Taylor & Francis.
- Mcdonough, A.F., (2002). 'Design-build contracting: excellent tool, when wisely used', *CM Advisory* Vol. 16 No 5 pages 5-8.
- McGill, I., Beaty, L., (1995) *Action Learning: A guide for professional, Management, and Educational Development*, Kogan Page.
- Minchin, R.E. Jr., Li, X., Issar, R.J., and Vargas, G.G., (2013). 'Comparison of cost and time performance of design-build and design-bid-build delivery systems in Florida'. *Journal of construction Engineering and Management*, Vol. 139, Issue 10
- Mitchell, A., Frame, I., Coday, A., and Hoxley, M., (2011). 'A conceptual framework of the interface between design and construction processes'.

*Engineering, Construction and Architectural Management*, Vol. 18 No 3, pages 297-311.

Mitchell, A., Canter, M., and Hoxley, M., (2004). Planning the detailed design stage of construction projects and the interface with construction. *Proceedings of RICS COBRA 2004*, Leeds.

Mohsini, R.A., (1989). 'Performance and building: problems of evaluation'. *Journal of Performance of Constructed Facilities*, Vol. 3, pages 235-242.

Molenaar, K.R., and Gransberg, D.D., (2001). 'Design-builder selection for small highway projects', *Journal of Management in Engineering*, ASCE, Vol. 17 No 4, pages 214-223.

Molenaar, K., R., Sobin, N., and Antillon, E.I., (2010). 'A synthesis of best value procurement practices for sustainable design-build projects in the public sector'. *Journal of Green Building*. Vol. 5 No 4, pages 148 -157.

Morledge, R., and Sharif, A., (1996). 'Client Time Expectations and Construction Industry Performance', *Proceedings of COBRA 1996*, University of the West of England.

Moon, J. A., (1999) *Reflection in Learning & Professional Development: Theory & Practice*, Jennifer Moon.

Moore, D.R., and Dainty, A.R.J., (1999). 'Integrated Project Team's Performance in Managing UCE's'. *Team Performance Management Journal*, Vol. 5 No 7, pages 212-222.

Moore, D.R., and Dainty, A.R.J., (2000). 'Work-Group communication problems within UK design and build projects: an investigative framework'. *Journal of Construction Procurement*, pages 44-55.

Moore, D.R., and Dainty, A.R.J., (2001). 'Intra-team boundaries as inhibitors of performance improvement in the UK design and build projects: a call for change'. *Construction Management and Economics*, Vol. 19, pages 559-562.

Morris, P.W.G., (1983). Managing Project Interfaces – Key Points for Project Success in *Project Management Handbook* (ed. Cleland & King), Van Nostrand Rienhold, pages 3-36.

Moser, C.A., and Kalton, G., (1979). *Survey Methods in Social Investigation*. 2<sup>nd</sup> ed. Aldershot: Ashgate.

Murray, J.P., (1995). *Effective Briefing: The key to project success*. *Proceedings of the International congress on construction, design, build projects – International experiences in Singapore*.

Murray, J.P., (1996). Understanding Clients' briefing and the Client's role. *CIB W-92 Procurement Conference Proceedings*, Durban, University of Natal, Durban, South Africa.

Myers, D., (2004). *Construction Economics: A New Approach*, London: Spon.

Nahapiet, H., and Nahapiet, J., (1985). 'A comparison of contractual arrangements for building projects', *Construction Management and Economics*, Vol. 3 No 3, pages 217-231.

Nam, C.H. and Tatum, C.B., (1992). 'Non contractual methods of integration on construction projects'. *Journal of Construction Engineering and Management*. ASCE, Vol. 118 No 2, pages 385-398.

National Audit Office (NAO), (2001). *Modernising Construction*, London: TSO.

National Audit Office (NAO), (2005). *Improving public services through better construction*, Report by the Comptroller and Auditor General, London: HMSO.

National Economic Development Office (NEDO), (1974). *Before you build: what a Client needs to know about the construction industry*, London: HMSO.

National Economic Development Office (NEDO), (1976). *The Professions in the Construction Industries*, NEDO, London.

Naoum, S., (2003). 'An overview into the concept of partnering', *International Journal of Project Management*. Vol. 21 No 1, pages 71-76.

Ndekugri, I., and Church, R., (1996). Construction Procurement by the design and build approach: a survey of problems. *Proceedings of CIB W92 Symposium on Procurement*, Durban, South Africa.

Ndekugri, I., and Turner, A., (1994). 'Building procurement by design and build approach', *Journal of Construction Engineering and Management*, Vol. 120, pages 243-256.

New models of Construction procurement. Available at:  
<https://www.gov.uk/government/collections/new-models-of-construction-procurement> - ( accessed on 15th January 2015).

Newman, R., Jenkins, M., Bacon, V., and Dawson, S., (1981). *Brief formulation and the design of buildings*. Report, Dept of Architecture, Oxford Polytechnic, Oxford.



Ng, S.T., and Skitmore, R.M., (2002). 'Contractors' risks in design, novate and construct contracts', *International Journal of Project Management*, Vol. 20, Issue 2, pages 119 – 126.

Ngoc, D.C., Long, L-H., and Young-Don, L., (2012). 'Critical success factors of large design-build projects in Vietnam'. *Journal of Construction Engineering and Project Management*, Vol. 2, Issue 3, pages 30-39

Oberg, R., Probasco, L., and Ericsson, M., (2003). Applying Requirements Management with use cases, Rational Software Corporation, USA. Available at: [www.compgraf.ufu.br/alexandre/esof/use\\_cases.pdf](http://www.compgraf.ufu.br/alexandre/esof/use_cases.pdf) - (accessed on 5th May 2010).

Odeh, A.M., and Battaineh, H.T., (2002). 'Causes of construction delay: traditional contracts', *International Journal of Project Management*, Vol. 20 No 1, pages 67-73.

Ofori, G., (1990) *The Construction Industry: Aspects of its Economics and management* . Singapore: Singapore University Press.

Opdenakker, R., (2006). 'Advantages and disadvantages of four interview techniques in qualitative research'. *Forum: Qualitative Social Research*, Vol. 7 No 4.

Opfer, N.D., Son, J., and Korman, T., (2002). 'Public Sector Design-Build Selection Criteria'. *AACE International Transactions*, Vol. 4, pages 1-7.

Othman, A.A.E., Hassan, T.M., and Pasquire, C.L., (2005). 'Analysis of factors that drive brief development in construction'. *Engineering, Construction and Architectural Management*, Vol. 12 No1, pages 69-87.

Oztas, A., and Okmen, O., (2004). 'Risk analysis in fixed-price design-build construction projects'. *Building and Environment*, Vol. 39 Issue 2, pages 229-237.

Pain, J., and Bennett, J., (1988). 'JCT with Contractor's Design Form of contracts: a study in use', *Construction Management and Economics*, Vol. 6 Issue 4, pages 307-337.

Palaneeswaran, E., and Kumaraswamy, M.M., (2000). 'Contractor Selection for Design/Build Projects'. *Journal of Construction Engineering and Management*, Vol. 126 No 5, pages 331-339.

Patton, M.Q., (1990). *Qualitative evaluation and research methods* (2<sup>nd</sup> ed.). Newbury Park, CA: Sage.

Perkins, R.A., (2009). 'Sources of changes in Design-Build contracts for a Governmental owner'. *Journal of Construction Engineering and Management*, Vol. 135, No. 7, pages 588-593.

Perkinson, G.M., Sanvido, V.E., and Grobler, F., (1994). 'A facility programming information framework', *Engineering Construction and architectural Management*, Vol. 1 No 1, pages 69-84.

Petersen, D.R., and Murphee, E.L., (2004). The impact of owner representatives in a design-build construction environment. *Project Management Journal*, Vol. 35 No 3, pages 27-38.

Pickard, A., and Dixon, P., (2004). 'The applicability of constructivist user studies: How can constructivist inquiry inform service providers and systems designers?' *Information Research*, Vol. 9 No 3.

Pocock, J.B., Hyun, T.C., Liu, Y.T., and Kim, M.K., (1996). 'Relationship between project Interaction and performance indicators'. *Journal of Construction Engineering and Management*, Vol.122 No 2, pages 165-176.

Post, N.M., (1998). 'Building Teams Get High Marks', *Engineering News Record*, 240 (19), pages 32-39.

Potter, K.J., (1994). *A design-build prequalification system*. Technical Report No 32, CIC, The Pennsylvania State University, University Park, PA.

Preece, C.M., and Tarawnah, S., (1997). 'Why are design and build owners unhappy?', *Construction Manager*, Vol. 3 No 7, pages 24-25.

Remenyi, D., Williams, B., Money, A., and Swartz, E., (1998). *Doing Research in Business and Management*. London: Sage.

RIBA (1980). *Handbook of Architectural Practice and Management*, Royal Institute of British Architects, London.

RICS (2012). Contracts in use survey, 2012. Available at: [http://www.rics.org/Global/CONTRACTS%20IN%20USE\\_FINAL\\_%20Nov2012\\_%20teage\\_081112.pdf](http://www.rics.org/Global/CONTRACTS%20IN%20USE_FINAL_%20Nov2012_%20teage_081112.pdf) – (accessed on 15<sup>th</sup> March 2015).

Ridley, D., (2008). *The Literature Review: a step – by – step guide for students*. London: Sage.

Robertson, S., and Robertson, J., (2005). *Requirements – led Project Management: Discovering David's slingshot*, Boston: Addison-Wesley.

- Robson, C., (2002) *Real World Research*. 2<sup>nd</sup> ed. Oxford: Blackwell.
- RICS (2012). *Rethinking Procurement*. Royal Institution of Chartered Surveyors, Construction Journal, November-December 2012.
- Schon, D. A., (1995) *The Reflective Practitioner: How Professionals Think in Action, Arena*.
- Shen, G.Q.P., and Chung, J.K.H., (2006). 'A critical investigation of the briefing process in Hong Kong's construction industry', *Facilities* Vol. 24 No 13/14, pages 510-522.
- Sidwell, A. C., (1982). A Critical Study of Project Team Organisational Forms within the building Process. Ph.D. Thesis, Department of Construction and Environmental Health, The University of Aston, Birmingham.
- Silverman, D., (2000) *Doing Qualitative Research: A practical Handbook*, London: Sage.
- Slife, B.D., and Williams, R.N., (1995). *What's behind the research? Discovering hidden assumptions in the behavioural sciences*, Thousand Oaks: Sage.
- Smit, J., (1995). *Projecting Success*. New Builder.
- Smith, J., and Love, E.O., (2004). 'Stakeholders management during project inception: Strategic Needs Analysis', *Journal of Architectural Engineering*, Vol. 10 pp 22-33.
- Smith, J., O'Keeffe, N., Georgiou, J., and Love, P.E.D., (2004). 'Procurement of construction facilities: a case study of design management within a design and construct organisation', *Facilities*, Vol. 22 No 1 / 2, pages 26-34.
- Smith, A., and Wilkins, B., (1996). 'Team relationships and related critical factors in the successful procurement of health care facilities', *Journal of Construction Procurement*, Vol. 2, pages 30-40.
- Soetanto, R., and Proverbs, D.G., (1993). 'Modelling the satisfaction of contractors: the impact of client performance'. *Engineering, Construction and Management*, Vol. 9 No 5, pages 453-465.
- Songer, A.D., and Molenaar, K.R., (1996). 'Selecting Design-Build: Public and private sector owner attitudes', *Journal of Management in Engineering*, Vol. 12 No 4, pages 47-53.

- Songer, A.D., and Molenaar, K.R., (1997). 'Project characteristics for successful public-sector design-build', *Journal of Construction Engineering and Management*, ASCE, Vol. 123 No 1, pages 34-40.
- State of the Construction Industry Report (2000) Construction Industry Board. Available at: <http://www.dti.gov.uk/construction/stats/soi/soi11.htm> - (accessed on 5th May 2010).
- Stillman, G.R., (2002). 'Project Management on design-build projects', *AACE International Transactions*. PMI, pages 1-4.
- Stocks, R.K., (1984). *The Building Team: An organisation of Organisations*, MSc Thesis, Heriot-Watt University.
- Sutheerawatthana, P., (1998). *The identification of inherent risks in Design-build Contracts*. M.Eng. Thesis, ST -98-33. Asian Institute of Technology, Bangkok.
- Tan, W., (1989). 'Subsector fluctuations in construction', *Construction Management and Economics*, Vol. 7, pages 41-51.
- Thompson, S., & Thompson, N., (2008). *The critically reflective practitioner*, Palgrave MacMillan.
- Tietz, S., (1999). From Egan to the 21<sup>st</sup> century – commenting on the Egan Report, Rethinking construction (July 1998), *The Structural Engineer – Journal of the Institution of Structural Engineers*, Vol. 77 No 7.
- Travers, M., (2001). *Qualitative Research through Case Studies*. London: Sage.
- Trochim, W., (2006). 'Positivism & Post-Positivism', Research Methods Knowledge Base.
- Tucker, R.L., Kelly, C.E., and Thomas, J.R., (1997). *An assessment Tool for Improving Team Communications*, Construction Industry Institute, Austin TX.
- Turin, D.A., (1975). *Introduction*. In *Aspects of the Economics of Construction*, Turin, D.A., (ed.), London: Godwin, pp. viii-xvi.
- Turner, D.F., (1986). *Design and build contract practice*. London: Longman Scientific and Technical.
- Turner, D.F., (1995). *Design and build construction practice*. London: Longman Scientific and Technical.

Twomey, T.R., (1989). Understanding the legal aspects of Design-build, Kingston: R.S. Means Co., USA.

The Office of National Statistics (2012). Available at:  
<http://www.ons.gov.uk/ons/index.html> - (accessed on 4th September 2012)

Vickers, C., (2000). Report for the 2000 Annual Consultative conference. *Construction Industry Board*, May edition.

Walker, A., (1985). *Project Management in Construction*. London: Granada.

Williamson, K., (2006). 'Research in Constructivist Frameworks using Ethnographic Techniques', bNET.

Wood, G., (2005). 'Partnering practice in the relationship between clients and main contractors', *RICS Paper series*, Vol. 5 No 2, RICS, London.

Woodhead, R.M., and Male, S.P., (1993). 'The conditioning effect of objective decision-making on the client's capital proposal'. *Engineering, Construction & Architectural Management*, Vol. 7 No 3, pages 300-306.

Xia, B., Xiong, B., Skitmore, M., Wu, P., and Hu, F., (2015). 'Investigating the impact of project definition clarity on project performance: structural equation modelling study'. *Journal of Management in Engineering*. Vol. 138 Issue 9. Pages 1061-1070

Xia, B., Molenaar, K., Chan, A., Skitmore, M and Zuo, J., (2013). 'Determining optimal proportion of design in design-build request for proposals'. *Journal of Construction Engineering and Management*. Vol. 139 Issue 6. Pages 620-627

Xia, B., Molenaar, K., Chan, A., and Skitmore, M., (2012). 'Determining the appropriate proportion of owner provided design in design-build contracts: content analysis approach'. *Journal of Construction Engineering and Management*. Vol. 138 Issue 9. Pages 1017-1022

Xia, B., and Chan, A.P.C., (2012). 'Identification of selection criteria for operational variations of the design-build system: a Delphi study in China'. *Journal of Civil Engineering and Management*, Vol. 18 Issue 2, pages 173-183

Xia, B., Chan, A.P.C., and Zuo, J., (2012). 'Comparison of key competencies of clients & design-build contractors in the construction market of the People's Republic of China (PRC)'. *World Construction Conference 2012 – Global Challenges in Construction Industry*, 28 – 30 June, Colombo, Sri Lanka pages 427-433

Xia, B., and Chan, A.P.C., (2010). 'Key competencies of design-build clients in China'. *Journal of facilities Management*, Vol. 8 Issue 2, pages 114-129

Yanow, D., and Schwartz-Shea, P., (2006). Interpretation and method: empirical research methods and the interpretive turn, M.E. Sharpe.

Yates, J.K., (1995). 'Use of Design/Build in E/C Industry', *Journal of Management in Engineering*, Vol. 11 No 6, pages 33-38.

Yin, R. K., (2009). *Case study research: design and methods*, London: Sage.

Yu, C. H., (2005). 'Test-retest reliability', *Encyclopaedia of Social Measurement*, Vol. 3, pages 777-784.

Yu, T.W.A., Shen, Q., Kelly, J., and Hunter, K., (2005). 'Application of value management in project briefing', *Facilities* Vol. 23 No 7/8, pages 330-342.

Yu, A.T.W., Shen, Q.P., Kelly, J., and Hunter, K., (2007). 'An empirical study of the variables affecting construction project briefing/architectural programming', *International Journal of Project Management*, Vol. 25, pages 198-212.

Yu, A.T.W., Chan, E.H.W., Chan, D.W.M., Lam, P.T.I., and Tang, W.L., (2010). 'Management of client requirements for design and build projects in the construction industry of Hong Kong', *Facilities*, Vol. 28 No 13/14, pages 657-672.

Zaneldin, E., Hegazy, T., Grievson, D., (2001). 'Improving design coordination for building projects II: a collaborative system', *Journal of Construction Engineering management*, Vol. 127 No. 4, pages 330-336.

Zeisel, J., (1981). *Inquiry by design: Tools for Environmental – Behaviour Research*, Cambridge: Cambridge University Press.

Zielczynski, P., (2008). *Requirement management using IBM Rational Requisite Pro*, Armonk: IBM Press.

**List of Publications by the researcher – Full papers included in  
Appendices H & I**

Muriro, A. and Wood, G. (2010). 'A comparative analysis of procurement methods used on competitively tendered office projects in the UK', *RICS COBRA Conference*, Paris, 8-9 September.

Muriro, A. And Wood, G. (2013). 'Design and build procurement in practice: Exploration of experiences of key participants in the UK construction industry', *RICS COBRA conference*, Dehli, 10-12 September.

## Appendix A: Average employment by industry sector in the UK in 0000's

Average All in Employment by industry sector - in 000's (not seasonally adjusted)								
Year	Agriculture	Mining	Manufacturing	Construction	Wholesale	Transport	Accommod'n	Info/Comm
2003	270	371	3,543	2,237	4,275	1,549	1,310	1,018
2004	267	388	3,360	2,344	4,264	1,521	1,322	1,041
2005	285	403	3,291	2,407	4,222	1,559	1,294	1,019
2006	283	417	3,242	2,480	4,150	1,561	1,337	1,032
2007	295	458	3,223	2,533	4,095	1,555	1,374	1,043
2008	316	464	3,048	2,538	4,193	1,593	1,353	1,034
2009	319	483	2,788	2,363	4,018	1,487	1,372	1,013
2010	351	470	2,846	2,215	4,009	1,445	1,438	1,010
2011	354	513	2,840	2,195	4,016	1,428	1,458	1,067
Yearly Aver	304	441	3,131	2,368	4,138	1,522	1,362	1,031
% of Total	1%	2%	12%	9%	15%	6%	5%	4%
	Financial	Real Estate	Prof. Services	Admin, Defence	Education	Human Health	Other Servcs	Totals
2003	1,252	209	1,718	1,560	2,563	3,221	1,460	26,556
2004	1,202	237	1,721	1,596	2,698	3,384	1,458	26,803
2005	1,247	242	1,769	1,637	2,734	3,505	1,432	27,046
2006	1,260	252	1,816	1,635	2,800	3,556	1,473	27,294
2007	1,283	260	1,897	1,667	2,792	3,474	1,500	27,449
2008	1,267	256	1,909	1,695	2,820	3,620	1,528	27,634
2009	1,230	264	1,866	1,629	2,940	3,751	1,573	27,096
2010	1,182	279	1,871	1,613	3,082	3,809	1,547	27,167
2011	1,192	297	1,867	1,580	3,036	3,915	1,576	27,334
Yearly Aver	1,235	255	1,826	1,624	2,829	3,582	1,505	27,153
Total	5%	1%	7%	6%	10%	13%	6%	100%



## Appendix B: Respondent consent letter

### Re: Respondent consent letter – research on challenges experienced by participants utilising design and build (D&B) procurement method

Dear Sir/Madam

I am a student undertaking a professional doctorate degree at the University of Salford. As part of my course I am undertaking a research study titled: **Design and Build Procurement method in practice: Key challenges and practice based enablers**. The purpose of the study is to explore further your experience of the D&B procurement method with the objective of developing a framework/guidance document that will be used as good practice in future construction work in the UK for projects utilising D&B as a method of procuring construction work. Because of your experience with the procurement method that we are exploring, we would like to invite you to participate in an interview. We enclose for your information Appendices 1 and 2 being participant information sheet and research participant consent form respectively.

In the near future you will be contacted by Anywhere Muriro to set up an appointment for a brief interview (which is estimated to last an hour at most). We encourage you to participate as your input into this survey will help in the design of important recommendations and guidance that will be useful in future application and use of D&B as a construction procurement method.

The interview will be centred on challenges associated with this construction delivery method that you have experienced as well as sharing some best practice elements of your experience.

We can assure you that any data collected will remain confidential. The research has been granted permission by the ethical approval committee from the University of Salford, Faculty of Business, law and the Built Environment.

The research is supervised by Dr. Gerard Wood who is a lecturer in the school of the built environment at the University of Salford. If you have any questions please me on the e-mail below. We appreciate the time that you will take out of your busy schedule to speak to us. We see this project as an important contribution to the construction industry and your assistance is well appreciated.

Yours sincerely

Anywhere Muriro  
A.Muriro@edu.salford.ac.uk

## Appendix C: Participant information sheet

### Study Title

**Design and Build Procurement method in practice: Key challenges and practice based enablers.**

I would like to invite you to take part in a research study. Before you decide, you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything you read is not clear or if you would like more information. Take time to decide whether or not to take part.

The purpose of the study, as part of my professional doctorate academic research requirements, is to explore the challenges experienced by key participants of the D&B procurement and to get an understanding of how the challenges have been dealt with in practice.

You have been invited to partake in this research based on the league tables published by the Construction News.

It is up to you to decide. We will describe the study and go through the information sheet, which we will give to you. We will then ask you to sign a consent form to show you agreed to take part. You are free to withdraw at any time, without giving a reason.

- Your involvement will be limited to having an interview with either yourself or a key member of your team who has been actively involved with the design and build procurement method
- It will take approximately 1 hour of your time to partake in the interview.

The research will make his own arrangements to travel to your offices for the purpose of conducting the interview. There are neither risks nor disadvantages envisaged on your part by partaking in this study.

We cannot promise the study will help you but the information we get from the study will help to increase the understanding of performance of the design and build procurement method as practiced in the UK

If you have a concern about any aspect of this study, you should ask to speak to Anywhere Muriro or Mr Gerard Wood, Research Supervisor who will do their best to answer your questions.

If you remain unhappy and wish to complain formally you can do this through the University complaints procedure on [helpdesk-isd@salford.ac.uk](mailto:helpdesk-isd@salford.ac.uk) telephone 0161 295 5000

All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves your organisation will have your name and address removed so that you cannot be recognised. The data will be stored safely. Individual participant research data contained in field notes and transcripts will be stored in a locked cabinet, within locked office only accessed the researcher. Electronic data will be stored on a password protected computer known only by the researcher. The data will only be used for the purpose of this research after which it shall be destroyed after 3 years from date of collection. The researcher and the research Supervisor will be the only persons having access to the data during the period of research until it is destroyed.

In the unfortunate event that you withdraw from the study all the information and data collected from you, up to and including the withdrawal date, will be destroyed and your name removed from all the study files.

The results of the study will be published in a thesis to be kept at the University of Salford and if specifically requested the results of the research will be e-mailed to you. The research participants will not be identified in any report/publication unless they have given their consent in writing.

The University of Salford is sponsoring the research

**Further information and contact details:**

1. General information about research (Can be obtained from the School of the Built Environment, The University of Salford, Maxwell Building, Salford, Greater Manchester, M5 4WT)
2. Specific information about this research project (Contact details of researcher are: e-mail; [A.muriro@edu.salford.ac.uk](mailto:A.muriro@edu.salford.ac.uk))

## Appendix D: Research Participant Consent Form

**Title of Project: Design and Build Procurement method in practice: Key challenges and practice based enablers.**

**Name of Researcher:** Mr Anywhere Muriro

**Name of Supervisor:** Dr Gerard Wood

*(Delete as appropriate)*

- I confirm that I have read and understood the information sheet for the above study and what my contribution will be.

<b>Yes</b>	<b>No</b>
------------	-----------

- I have been given the opportunity to ask questions (face to face, via telephone and e-mail)

<b>Yes</b>	<b>No</b>
------------	-----------

- I agree to take part in the interview

<b>Yes</b>	<b>No</b>	<b>NA</b>
------------	-----------	-----------

- I agree to the interview being tape recorded

<b>Yes</b>	<b>No</b>	<b>NA</b>
------------	-----------	-----------

- I agree to digital images being taken during the research exercises

		<b>NA</b>
--	--	-----------

- I understand that my participation is voluntary and that I can withdraw from the research at any time **without giving any reason**

<b>Yes</b>	<b>No</b>	<b>NA</b>
------------	-----------	-----------

- **I agree to take part in the above study**

<b>Yes</b>	<b>No</b>	<b>NA</b>
------------	-----------	-----------

Name of Participant:

Signature:

Date:

Name of Researcher: Mr Anywhere Muriro

Researcher's e-mail address: [A.muriro@edu.salford.ac.uk](mailto:A.muriro@edu.salford.ac.uk)

## Appendix E: Questionnaire to Designers

### Design and Build Procurement method in practice: Key challenges and practice based enablers.

This is part of a research study to explore your experience with the design and build (D&B) procurement method. Your answers to this questionnaire will be treated in strictest confidence and used for academic purposes only. Your response to this questionnaire is highly appreciated.

- |                                    | Position                                     | Years of experience      |
|------------------------------------|--|--------------------------|
| 1. What is your Job Title & number | <input type="checkbox"/> Director            | <input type="checkbox"/> |
| Number of years' experience in     | <input type="checkbox"/> Project Manager     | <input type="checkbox"/> |
| the construction industry?         | <input type="checkbox"/> Development Manager | <input type="checkbox"/> |
| Other (Please specify).....        | Other (please specify)                       | <input type="checkbox"/> |
2. What is your Organisation's area of specialisation?
- |                          |   |
|--------------------------|---|
| <input type="checkbox"/> | Predominantly Building construction           |
| <input type="checkbox"/> | Predominantly Civil Engineering               |
| <input type="checkbox"/> | A Combination of building & civil engineering |
| <input type="checkbox"/> | Other (Please specify).....                   |
3. What is your Organisation's approximate Average Annual Fee Income?
- |                          |                     |
|--------------------------|---------------------|
| <input type="checkbox"/> | Up to £40 million   |
| <input type="checkbox"/> | + £40 - £80 million |
| <input type="checkbox"/> | +£80 - £120 million |
| <input type="checkbox"/> | Over £120 million   |
4. How long has your organisation been involved in the UK construction industry?
- |                          |               |
|--------------------------|---------------|
| <input type="checkbox"/> | 0 - 5 years   |
| <input type="checkbox"/> | +5 – 10 years |
| <input type="checkbox"/> | Over 10 years |

5. In percentage terms approximately what proportion of your annual Turnover in the last 5 -10 years has been generated from projects delivered using D&B as a procurement method?

<input type="checkbox"/> 0 - 10%	50 - 60% <input type="checkbox"/>
<input type="checkbox"/> 10 – 20%	60 – 70% <input type="checkbox"/>
<input type="checkbox"/> 20 – 30%	70 – 80% <input type="checkbox"/>
<input type="checkbox"/> 30 - 40%	80 – 90% <input type="checkbox"/>
<input type="checkbox"/> 40 – 50%	90 -100% <input type="checkbox"/>

6. Below are some of the various types of D&B procurement method configurations. On a scale of 1 to 5 where 1 is least used and 5 is most used please mark the level of usage by your organisation for each type of D&B procurement method

	1	2	3	4	5
Design and manage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Novated design and build	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Develop and construct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Package deal including Turnkey	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Traditional Design and build	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Design, manage and construct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (Please specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. Based on previous related studies undertaken on D&B procurement the following elements were identified as negative aspects or challenges that have been encountered by designers. On a scale of 1 – 10 where 1 is low and 10 is high please rank the following identified challenges in order of severity

**Negative aspect/Challenges**  
**Rank**

- |   |                          |
|---|--------------------------|
| 1. Conflict of interest between professional duty & Contractor's requirements   | <input type="checkbox"/> |
| 2. Difficulties interpreting unclear/incomplete client requirements   | <input type="checkbox"/> |
| 3. Inadequate/lack of communication with end users & other stakeholders   | <input type="checkbox"/> |
| 4. Limited recovery of design costs incurred during tender when the tender is not won by the D&B contractor           | <input type="checkbox"/> |
| 5. Late input of constructability advice from the contractor resulting in Delays to design deliverables               | <input type="checkbox"/> |
| 6. Lack of specialist involvement in the early parts of the design resulting in late changes & delays to construction | <input type="checkbox"/> |
| 7. Cost saving pressures leading to services procured on lump sum basis which may be inequitable to the designer      | <input type="checkbox"/> |
| 8. Lack of transparency in decision processes which underpinned client  |                          |

- requirements leading to requirement misunderstandings ☐
9. Cost saving pressures leading to claims from the contractor alleging 'errors' in design for genuine design development matters ☐
10. Lack of understanding & appreciation from the contractor on the iterative nature of the design process resulting in insufficient time allowances in the programme ☐

8. Please list below any other comments on design and build procurement method that you wish to highlight

- 1.
- 2.
- 3.
- 4.
- 5.

Thank you for taking the time to complete the questionnaire.

## Appendix F: Questionnaire to Contractors

### Design and Build Procurement method in practice: Key challenges and practice based enablers.

This is part of a research study to explore your experience with the design and build (D&B) procurement method. Your answers to this questionnaire will be treated in strictest confidence and used for academic purposes only. Your response to this questionnaire is highly appreciated.

- |  | Position  | Years of experience      |
|--|---|--------------------------|
| 1. What is your Job Title & number<br>Number of years' experience in<br>the construction industry? | <input type="checkbox"/> Director               | <input type="checkbox"/> |
|  | <input type="checkbox"/> Project<br>Manager     | <input type="checkbox"/> |
|  | <input type="checkbox"/> Development<br>Manager | <input type="checkbox"/> |
|  | <input type="checkbox"/> Other (Specify)        | <input type="checkbox"/> |
2. What is your Organisation's area of specialisation?
- |                          |   |
|--------------------------|---|
| <input type="checkbox"/> | Predominantly Building construction           |
| <input type="checkbox"/> | Predominantly Civil Engineering               |
| <input type="checkbox"/> | A Combination of building & civil engineering |
| <input type="checkbox"/> | Other (Please specify.....)                   |
3. What is your Organisation's approximate Average Annual Turnover?
- |                          |                      |
|--------------------------|----------------------|
| <input type="checkbox"/> | Up to £50 million    |
| <input type="checkbox"/> | + £50 - £200 million |
| <input type="checkbox"/> | +£200 - £400 million |
| <input type="checkbox"/> | + £400 million       |
4. How long has your organisation been involved in the UK construction industry?
- |                          |               |
|--------------------------|---------------|
| <input type="checkbox"/> | 0 -5 years    |
| <input type="checkbox"/> | +5 – 10 years |
| <input type="checkbox"/> | Over 10 years |



5. Approximately what proportion of your annual Turnover in the last 5-10 years has been generated from projects delivered using D&B as a procurement method?

<input type="checkbox"/> 0 – 10 %	50 - 60% <input type="checkbox"/>
<input type="checkbox"/> 10 – 20%	60 – 70% <input type="checkbox"/>
<input type="checkbox"/> 20 – 30%	70 – 80% <input type="checkbox"/>
<input type="checkbox"/> 30 – 40%	80 – 90% <input type="checkbox"/>
<input type="checkbox"/> 40 – 50%	90 – 100% <input type="checkbox"/>

6. Below are some of the various types of design and build procurement method configurations. On a scale of 1 to 5 where 1 is least used and 5 is most used please mark the level of usage by your organisation for each type of design and build procurement method

	1	2	3	4	5
Design and manage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Novated design and build	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Develop and construct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Package deal including Turnkey	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Traditional Design and build	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Design, manage and construct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (Please specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7. Based on previous related studies undertaken on D&B procurement the following elements were identified as negative aspects or challenges that have been encountered by clients. On a scale of 1 – 10 where 1 is low and 10 is high please rank the following in order of severity

**Negative aspect/Challenges**  
**Rank**

- |   |                          |
|---|--------------------------|
| 1. Unclear/Incomplete client requirements   | <input type="checkbox"/> |
| 2. Underestimated time needed for approvals   | <input type="checkbox"/> |
| 3. Insufficient time allocated to briefing, tendering & evaluation processes                            | <input type="checkbox"/> |
| 4. Client's interference with the design process  | <input type="checkbox"/> |
| 5. Difficulties working, managing & communicating with design professionals                             | <input type="checkbox"/> |
| 6. Difficulties getting specialist input into the design  | <input type="checkbox"/> |
| 7. Difficulties managing the design iteration process   | <input type="checkbox"/> |
| 8. Costly tender process  | <input type="checkbox"/> |
| 9. Difficulties differentiating scope change from design development change                             | <input type="checkbox"/> |
| 10. Difficulties managing risks passed on by clients which would have been better managed by the client | <input type="checkbox"/> |

8. Please list below any other comments on D&B procurement method that you wish to highlight

- 1.
- 2.
- 3.
- 4.
- 5.

Thank you for taking the time to complete the questionnaire.

## Appendix G: Questionnaire to Clients

### Design and Build Procurement method in practice: Key challenges and practice based enablers.

This is part of a research study to explore your experience with design and build (D&B) procurement method. Your answers to this questionnaire will be treated in strictest confidence and used for academic purposes only. Your response to this questionnaire is highly appreciated.

	Position	Years of experience
1. Respondent's Job Title	<input type="checkbox"/> Director	<input type="checkbox"/>
	<input type="checkbox"/> Project Manager	<input type="checkbox"/>
	<input type="checkbox"/> Development Manager	<input type="checkbox"/>
	<input type="checkbox"/> Other (Please specify).....	<input type="checkbox"/>
2. Organisation type	<input type="checkbox"/> Public	
	<input type="checkbox"/> Private	
	<input type="checkbox"/> Other (Please specify).....	
3. Area of specialisation	<input type="checkbox"/> Speculative property development	
	<input type="checkbox"/> Property development for own use	
	<input type="checkbox"/> Property development for public use	
	<input type="checkbox"/> Other (Please specify).....	
4. Your Organisation's Average Annual spend in property development	<input type="checkbox"/> Up to £50 million	
	<input type="checkbox"/> + £50 - £200million	
	<input type="checkbox"/> +£200 - £400million	
	<input type="checkbox"/> +£400million	
5. How long has your organisation been involved in property development?	<input type="checkbox"/> 0 – 5 years	
	<input type="checkbox"/> +5 – 10 years	
	<input type="checkbox"/> Over 10 years	

6. Construction sector in which you are mainly involved ☐ Housing
- ☐ Industrial buildings
- ☐ Offices
- ☐ Infrastructure
- ☐ Education

7. In percentage terms approximately what proportion (in value terms) of your projects has been delivered using design and build as a procurement method over the last 10 years?

<input type="checkbox"/>	0 - 10%	<input type="checkbox"/>	40 - 50%	<input type="checkbox"/>	80 - 90%
<input type="checkbox"/>	10 - 20%	<input type="checkbox"/>	50 - 60%	<input type="checkbox"/>	90 - 100%
<input type="checkbox"/>	20 - 30%	<input type="checkbox"/>	60 - 70%		
<input type="checkbox"/>	30 - 40%	<input type="checkbox"/>	70 - 80%		

8. Below are some of the various types of design and build procurement method configurations. On a scale of 1 to 5 where 1 is least used and 5 is most used please mark the level of usage by your organisation for each type of design and build procurement method

	1	2	3	4	5
Design and manage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Novated design and build	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Develop and construct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Package deal including Turnkey	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Traditional Design and build	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Design, manage and construct	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (Please specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. Based on previous related studies undertaken on D&B procurement the following elements were identified as negative aspects or constraints that have been encountered by clients. On a scale of 1 – 10 where 1 is low and 10 is high please rank the following in order of severity

**Negative/Challenges  
Rank**

- |  |                          |
|--|--------------------------|
| 1. Lack of/insufficient communication with the contractor's designer                       | <input type="checkbox"/> |
| 2. Difficulty in evaluating D&B tenders  | <input type="checkbox"/> |
| 3. Loss of benefit of designer's independent construction oversight & monitoring           | <input type="checkbox"/> |
| 4. Contractor's designer not meeting/satisfying client's expectation                       | <input type="checkbox"/> |
| 5. Quality criteria/design standards sacrificed to minimum levels by the contractor        | <input type="checkbox"/> |
| 6. Difficult to define requirements clearly & still leave room for contractor's creativity | <input type="checkbox"/> |
| 7. Cost savings realised by the contractor not passed on to the client                     | <input type="checkbox"/> |
| 8. Difficulty in introducing & evaluating change   | <input type="checkbox"/> |

9. The D&B procurement method is more labour intensive & technically demanding than the traditional procurement method ☐
10. Lack of involvement in technical discussions as the design is developed by the contractor ☐

10. Please list below any other comments on D&B procurement method that you wish to highlight

- 1.
- 2.
- 3.
- 4.
- 5.

Thank you for taking the time to complete the questionnaire.

**Appendix H:** RICS COBRA Paper: presented at the RICS COBRA conference in Paris, 8 – 9 September, 2010.

## **A comparative analysis of procurement methods used on competitively tendered office projects in the UK**

Anywhere Muriro  
School of the Built Environment, The University of Salford  
Maxwell Building  
Salford, Greater Manchester  
M5 4WT  
Anywhere.muriro@bamnuttall.co.uk

Gerard Wood  
School of the Built Environment, The University of Salford  
Maxwell Building  
Salford, Greater Manchester  
M5 4WT  
g.d.wood@salford.ac.uk

### **Abstract**

The proliferation of procurement methods used for construction projects has inevitably resulted in comparisons being made between the performances associated with each of them. The challenge for researchers in this field has been largely to do with how to compare procurement systems on a like-for-like basis.

In addition the focus of previous studies has tended to be mainly on the critical success factors as assessed at the post-contract stage with less consideration of the effective benchmarking or measurement of success used in assessing the differences between systems and projects. Because of the limitations in previous studies it is perhaps not surprising that, to-date, there seems to be no general consensus on the optimum procurement method to be adopted for similar construction projects.

With this in mind this paper compares empirical information related to the successful tender for procurement methods used in competitive tendering of office projects in the United Kingdom (UK). It uses numeric/quantitative indicators such as construction costs, construction speed, construction time and

intensity of construction. Several research techniques were used to achieve this goal. The research data was obtained from the BCIS database. The tender analysis data gathered was grouped in frequency distribution tables to facilitate rigorous examination, checking, interpretation and statistical significance testing. Based on this synthesis the paper provides empirical evidence that design and build (D&B) tendered office projects performed better in terms of construction costs, unit costs, construction speed and intensity of construction. This is despite the fact that projects tendered under D&B method were more complex, of greater value and larger than those tendered using traditional methods.

**Keywords:** Procurement methods, success factors, benchmarking, numeric/quantitative indicators.

## **1. Introduction**

The selection of the most appropriate procurement method is critical for both the client and other project participants as it is an important factor that contributes to the overall client's satisfaction and project success. This selection will be dependent upon a number of factors such as cost, time and quality which are widely considered as being the most fundamental criteria for clients seeking to achieve their end product 'at the highest quality, at the lowest cost and in the shortest time' (Hackett et al. 2007). The existence of a wide variety of procurement methods available to project developers on the market today has led to several comparisons being made on how the different procurement methods have performed at the end of the construction phase.

However, there is little evidence from literature reviewed of such comparisons being undertaken at tender stage. In addition previous comparisons tended to focus at comparing procurement methods at a single point in time and no regard was made to analyse differences and similarities over a period of time in order to get a greater understanding of trends in the observed data. Since many variables affect project performance during the execution phase the objective of this paper is to critically analyse construction time, construction speed, unit cost of construction and intensity of construction for new build office projects tendered using different procurement methods in the UK based on secondary quantitative data gathered by the Building Cost Information Service (BCIS).

Since project costs would naturally vary from place to place and the effects of inflation would mean that projects tendered some time ago would have different cost profiles to those that have been tendered more recently, the tenders used in this paper were rebased to a tender price index of 212 (2nd Quarter 2010) and further adjusted to a common location index of 122 representing the Greater London geographical area. Indexing was necessary in order to compare projects tendered in different locations during different years.



## **2. Research methodology and process**

The main goal of the research is to quantitatively analyse and compare the performance of procurement methods used in the tendering of office projects in the UK over the last six years. Several research techniques were followed to achieve this goal. The review of related literature helped to define and differentiate between the most commonly employed procurement methods adopted in the UK over the last decade.

Research data was obtained from the BCIS tender analyses data base. The data gathered was then grouped in frequency distribution tables to facilitate rigorous and effective interpretation, analysis, checking and statistical significance testing. As part of the analysis, univariate comparisons of procurement methods used were also undertaken.

### **2.1 Literature Review**

Review of the literature indicates a plethora of research endeavours undertaken over the years aimed at trying to understand the benefits of project delivery systems/procurement methods that have been used in the last few decades. Both qualitative and quantitative research have been undertaken; Oberlender and Zeitoun (1993) quantitatively studied early warning signs of project cost and schedule growth, Pocock (1996) developed a method for measuring the impact of project integration on the performance of public sector projects, Bennett et al (1996) compared the cost, schedule and quality performance of design and build projects and design/bid/build projects recently built in the UK and Walker (1997) analysed construction time performance by looking at traditional versus non-traditional procurement methods.

Others like Sidwell (1982) used qualitative research methods to assess impact of client decision making upon construction process and project success. Ireland (1983) similarly analysed the impact of managerial action on cost, time and quality performance in building. Elhag et al (1998) compared average tender prices per square metre of management contracts, design and build contracts and traditional contracts.

What is common to previous research reviewed in this study is the importance given to time–cost relationships in the delivery of construction projects. There is a general recognition that construction time is a corner stone measure of project success. Recent literature reviewed also reflects a wide variety of approaches in dealing with the factors affecting construction durations for different types of projects.

There seems to be a general acceptance of the theory that due to the integration of design and construction time and cost savings are more likely to be achieved in design and build than in traditional procurement method. These theories have been used to develop hypotheses of this study.

Obvious gaps in previous research are the fact that pre-contract time – cost relationships utilising tender data seems to have been largely overlooked. While post contract studies undertaken at the end of construction projects are important in undertaking post mortem studies, pre-contract studies are key to an in-depth understanding of project performance attributes associated with procurement methods before the production process. In addition the focus of previous studies has tended to be mainly on critical project success factors post-contract with less consideration of the effective benchmarking or comparative analysis at tender stage in assessing the differences between systems and projects.

Because of the limitations in previous studies it is perhaps not surprising that to date there seems to be no general consensus on the optimum procurement methods to be adopted for similar construction projects.

With this in mind this paper empirically compares procurement methods used in tendering of office projects over a relatively long period of time in the United Kingdom (UK) using numeric/quantitative indicators such as construction costs, construction speed, construction time and intensity of construction. This is in line with the view that performance measurement should be an ongoing exercise involving regular collecting and reporting of information about efficiency and effectiveness of construction projects.

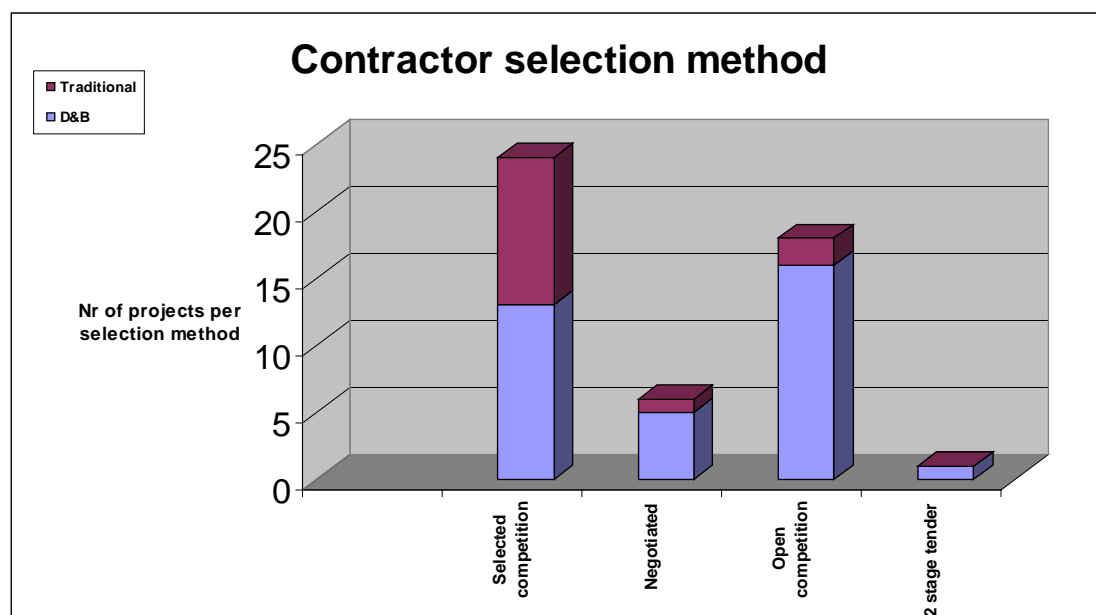
### 3.0 Data collection, main findings and interpretation

Tender data on new build office projects was obtained from the BCIS website. Since project costs would naturally vary from place to place and the effects of inflation would mean that projects tendered some time ago would have different cost profiles to those that have been tendered more recently the researcher rebased the tenders to a tender price index of 212 (2<sup>nd</sup> Quarter 2010) and further adjusted the tenders to a common location index of 122 representing the Greater London geographical area.

Out of 82 projects office projects downloaded from the BCIS website 33 were discounted from the analysis as they were either refurbishment/fit out/conversion/refurbishment type projects or lacked sufficient quantitative data that was required for the research. From the remaining 49 projects 35 were tendered using the D&B procurement method and 14 were tendered using the traditional method.

Contractor selection methods used was varied across the projects reviewed but selected competition was the most common method used (49% of the projects analysed) followed by open competition (37%), Negotiation (12%) and Two stage tender (2%) as represented in Figure 1 below.

**Figure 1: Contractor Selection methods**



The specification for most of the projects reviewed is an average of three storey, reinforced concrete strip and pad foundation, steel frame, face brick/block walls and aluminium cladding.

The high percentage in competitive selection methods used in appointing contractors is in line with perceptions noted in the review of related literature in which clients are viewed as seeking to have their end products at the lowest price. Competition, whether selected or open, is perceived to generate this aspiration.

What is surprising from the research findings is that a larger proportion of D&B contractors were selected using open competition while a larger proportion of traditional contractors were selected using selected competition. It would appear from the literature reviewed that one of the reasons why the D&B delivery method has evolved over the years is an aspiration by clients to tap into the contractor's expertise in not only interpreting the employer's requirements but producing a design fit for that purpose. This being the case one would have expected clients to be selective on which contractor to choose for this key task.

Central tendency and variability characteristics of the research data was computed using univariate analysis. Univariate analysis was undertaken for construction costs, construction durations, construction speeds, unit costs, intensity of construction and gross floor areas of all projects under review and the results, classified by procurement method, is shown in Table 1 below.

**Table 1: Summary of research results classified by procurement methods**

<b>Design &amp; Build office procured projects</b>						
Univariate tool	Construction costs (in £000's)	Construction duration (weeks)	Construction speed (m <sup>2</sup> /week)	Unit Cost (Cost/m <sup>2</sup> )	Intensity (cost/area/wk)	Gross Floor Area (in m <sup>2</sup> )
<b>Median</b>	2,786	43	53	1,134	26	2,690
<b>Average</b>	4,018	47	63	1,184	27	3,057
<b>Standard deviation</b>	4,316	18	38	353	8	2,330
<b>Traditional method office procured projects</b>						
Univariate tool	Construction costs (in £000's)	Construction duration (weeks)	Construction speed (m <sup>2</sup> /week)	Unit Cost (Cost/m <sup>2</sup> )	Intensity (cost/m <sup>2</sup> /week)	Gross Floor Area (in m <sup>2</sup> )
<b>Median</b>	1,157	39	22	1,453	36	758
<b>Average</b>	1,683	41	29	1,413	40	1,311
<b>Standard deviation</b>	1,773	16	24	300	19	1,522

Construction cost in this research is defined as the tender cost of the office project represented by the winning tender sum. Unit cost and intensity are the two cost measures used to further analyse construction costs. Unit cost is defined as tender cost/gross floor area. Construction intensity is the unit cost of construction per unit time. Construction speed is the gross floor area/construction duration.

The null hypotheses postulated in the paper are that there are no differences in unit costs, construction speeds and intensity of construction for the 2 procurement methods while the alternative hypotheses postulated stated that there are differences in the performance metrics measured. Each sample mean for the 2 procurement methods was tested for comparison at a 95% confidence level ( $p=0.05$ ). Therefore no significance is reported unless test values achieve this level of significance. Since one of the 2 samples used in this research is small (less than 30) and since the researcher wanted to test whether one mean of each of the procurement methods performance metrics is significantly higher or significantly lower than the other a one-tailed t test was deemed appropriate.

The null hypotheses were rejected in favour of the alternative hypotheses as the observed differences of the sample means of the 2 procurement methods were all found to fall outside the acceptance region of the critical t value. It can therefore be inferred from the research results that D&B tendered office projects achieved

significantly lower unit costs than similar projects tendered through the traditional method. D&B tendered projects significantly outperformed tendered office projects procured using the traditional method with 63% of the D&B projects achieving scores over 60 m<sup>2</sup>/week compared to only 14% of the traditional projects. Significant differences in intensity of construction were also observed between the 2 procurement methods with over half of the office of the traditional projects scoring almost twice as much as their D&B counterparts.

### **3.1 Unit costs of construction (Total tender cost/m<sup>2</sup>)**

Average unit costs for the projects reviewed were observed to be in the range £1,255 - £1,505/m<sup>2</sup>. This is the classification of unit costs in which the greatest number of projects analysed fall (in this case £1,255-£1,505) was classified as representing average unit cost range of the projects analysed. Unit costs below this range were classified as relatively low and those above the observed average range were classified as relatively high. Table 2 below tabulates the results.

**Table 2: Unit cost of construction per procurement method**

Unit costs						
Unit cost (cost/m <sup>2</sup> )	Design & Build (Nr of jobs)	% of all D&B projects	Traditional (Nr of jobs)	% of all Traditional projects	Total nr of all projects	As a % of Total of all projects
0-250	0	0%	0	0%	0	0%
251-501	0	0%	0	0%	0	0%
502-752	1	3%	0	0%	1	2%
753-1,003	10	29%	2	14%	12	25%
1,004-1,254	10	29%	2	14%	12	25%
<b>1,255-1,505</b>	<b>10</b>	<b>29%</b>	<b>7</b>	<b>50%</b>	<b>17</b>	<b>35%</b>
1,506-1,756	3	9%	1	7%	4	8%
1,757-2,007	0	0%	1	7%	1	2%
2,008-2,258	0	0%	1	7%	1	2%
+2,259	1	3%	0	0%	1	2%
<b>Totals</b>	<b>35</b>	<b>100%</b>	<b>14</b>	<b>100%</b>	<b>49</b>	<b>100%</b>

A summary of the unit cost classifications by procurement method is further tabulated below in Table 3 below.

**Table 3: Unit costs by procurement method**

Classification	% D&B projects	% of Traditional projects
Relatively low	60%	29%
Average costs	29%	50%
Relatively high	11%	21%

Similar observations were done for construction speed and intensity of construction. Similarly projects were classified as average, below and above average depending on the classification range. The findings for these performance metrics are presented in Tables 4 and 5 below.

### **3.2 Construction speed**

Average construction speed for the projects reviewed was observed to be in the range of 21 - 41 m<sup>2</sup> per week. Any construction speed below this average was classified as relatively slow and any construction speed above this average was classified as relatively high.

**Table 4: Construction speed by procurement method**

Classification	% D&B projects	% of Traditional projects
Relatively slow	9%	50%
Average	29%	36%
Relatively fast	62%	14%

### **3.3 Construction intensity**

Similarly average construction intensity range was observed to be £24-£29/ m<sup>2</sup>/week. Observed construction intensities lower than the averages were classified as relatively low and construction intensities higher than the average were classified as high. Table 5 below presents a summary of the results.

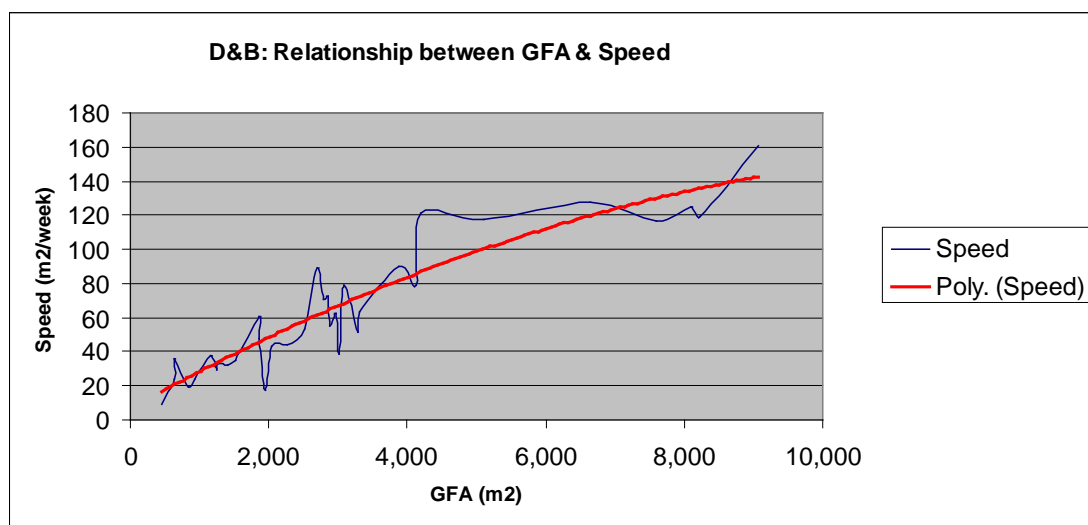
**Table 5: Construction intensity by procurement method**

Classification	% D&B projects	% of Traditional projects
Relatively low	29%	7%
Average	40%	29%
Relatively high	31%	64%

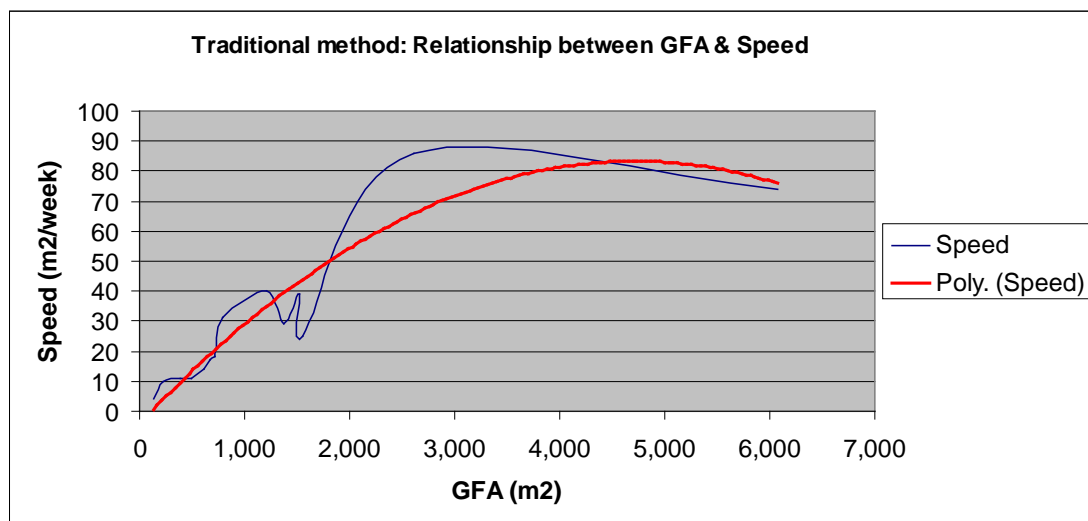
## 4.0 Interrelationships between observed attributes

In addition to identification and classification of research results as aforesaid several time/cost/size relationships over the six year period of analysis were undertaken to gain more insight into interrelationships between observed project performance metrics and other attributes such as project size and year of tender. These relationships are presented below.

**Figure 2: D&B - Relationship between project size & construction speed**



**Figure 3: Traditional: Relationship between project size & construction speed**

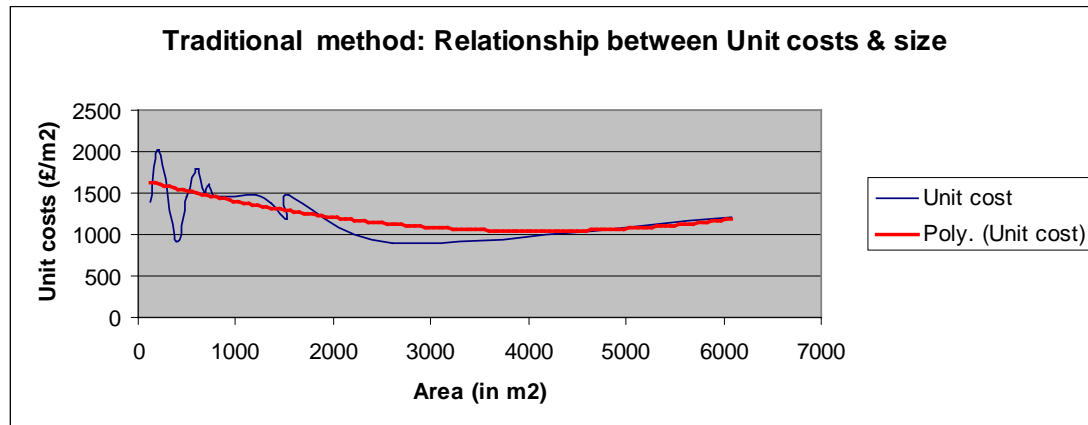


Construction speeds were observed to be significantly faster with increased project size on D&B tendered projects while on traditional tendered projects the relationship

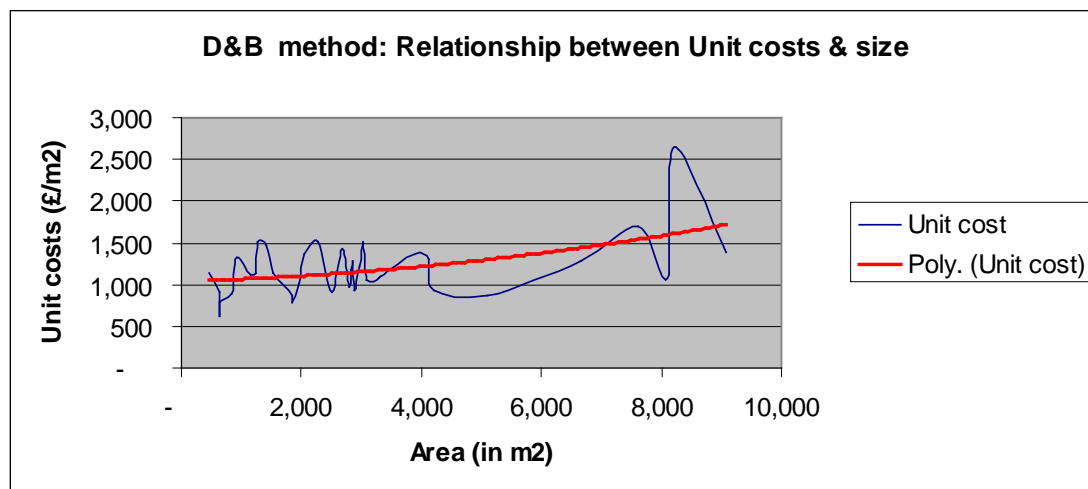


is not as significant. Further it can be observed that traditional projects above 5,500 m<sup>2</sup> in size start to achieve lower construction speeds than similar size projects procured through the D&B method.

**Figure 4: Traditional method: Relationship between project size and unit costs**

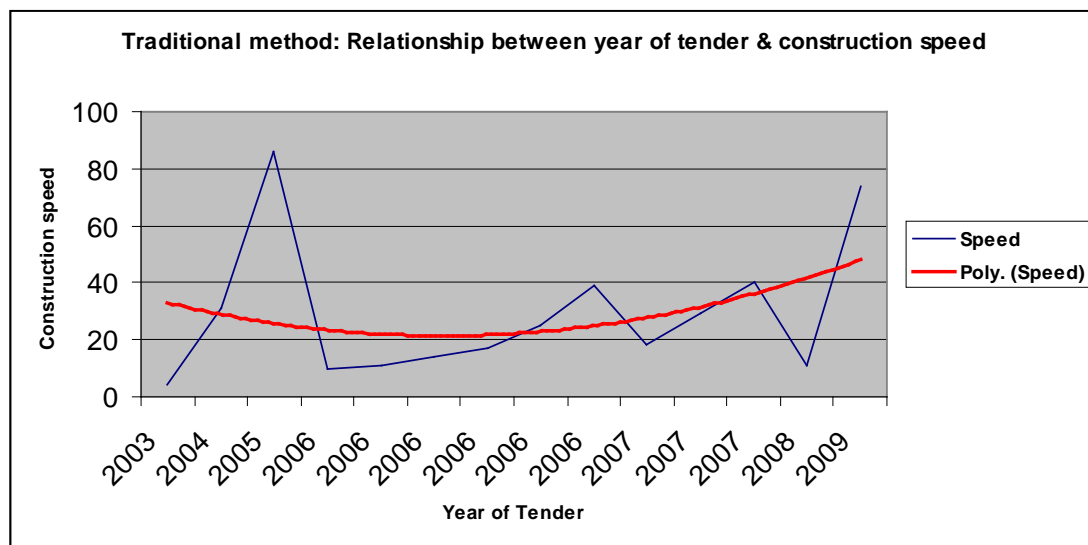


**Figure 5: D&B method: Relationship between project size and unit costs**

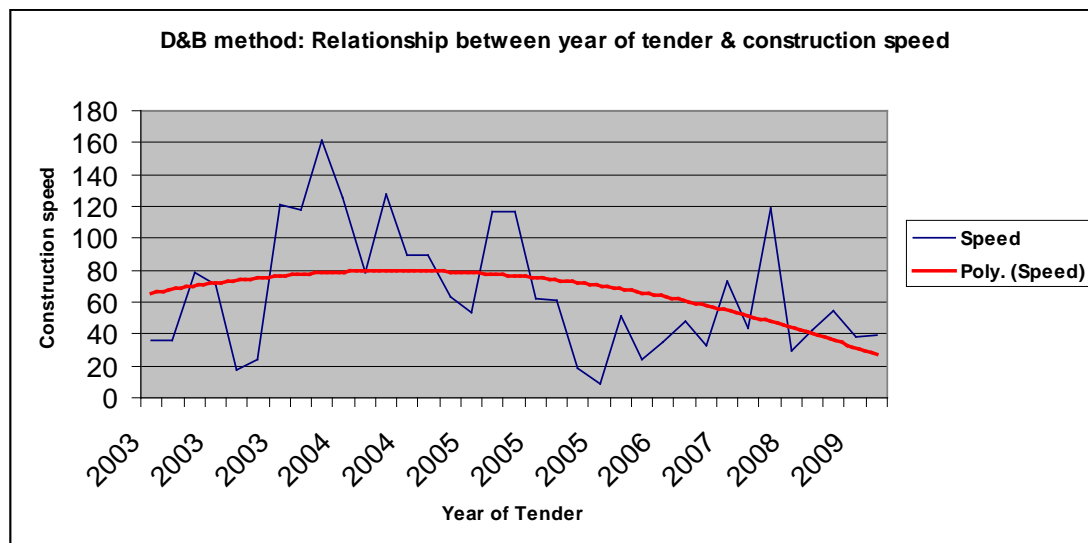


From the above graphical representations it would appear that unit costs gradually reduce with increased project size in traditionally procured projects while the trend is the opposite for D&B procured projects. This may be attributable to the perception that as projects increase in complexity and size unit costs increase as contractors employ sophisticated methods to deal with increased complexity.

**Figure 6: Traditional method: Relationship between year of tender and construction speed**

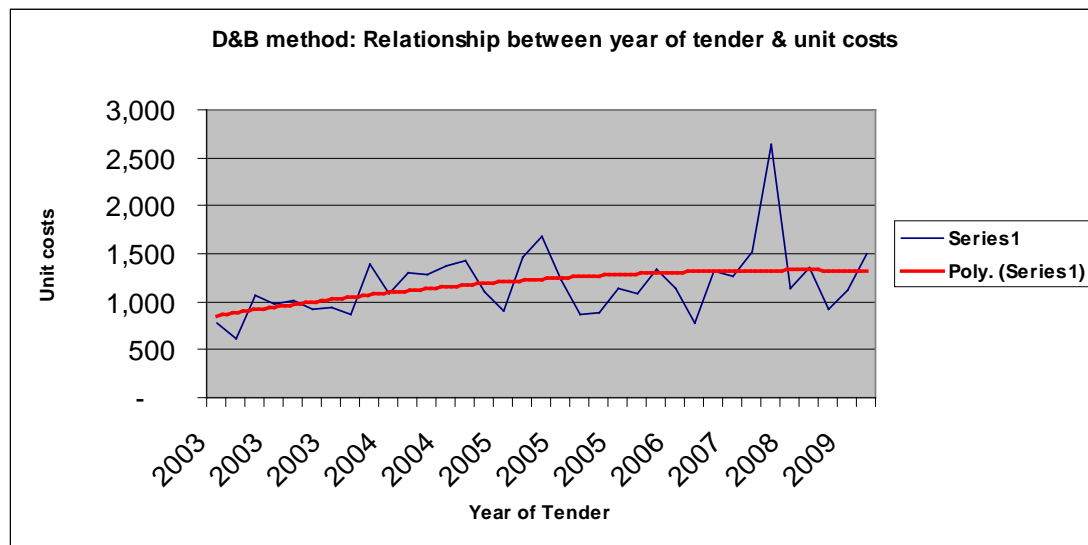


**Figure 7: D&B method: Relationship between year of tender and construction speed**

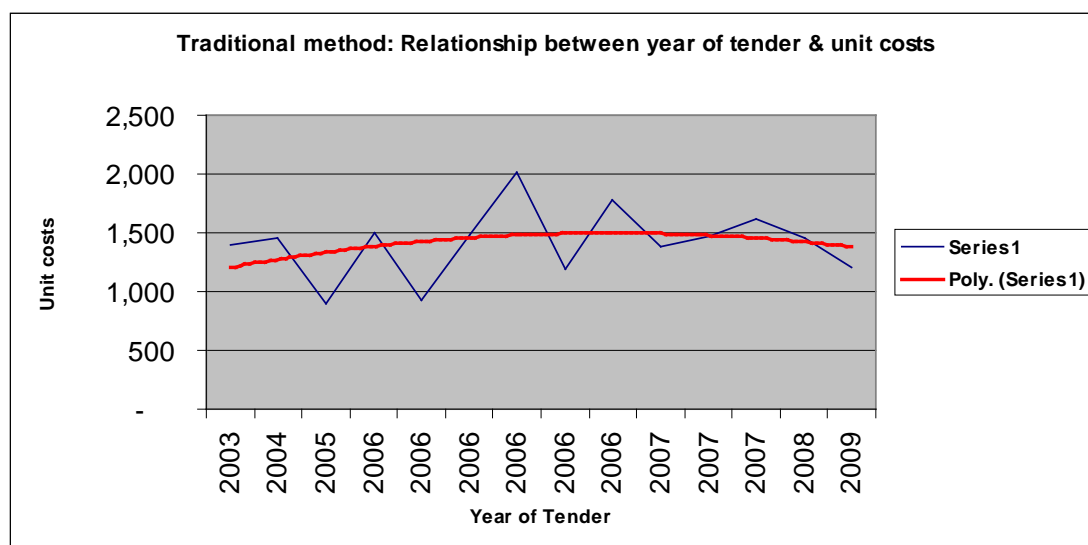


It can be observed from the above Figures 6 and 7 that while D&B tendered projects maintained a relatively steady trend up to the year 2005 and then dropping from late 2006 up to 2009 the trend was different in traditional projects where construction speeds were dipping from 2005 to 2006 but then started to increase from 2007 through to year 2009.

**Figure 8: D&B method: Relationship between year of tender and unit costs**



**Figure 9: Traditional method: Relationship between year of tender and unit costs**



From the above Figures 8 and 9 it can be observed that since 2003 unit costs for both procurement methods have been steadily increasing with the traditional procurement method showing significant increases up to 2007 and started to gradually drop in the period between 2008 and 2009.

## **5. Research limitations/implications**

Data in this research was based on tender base information in terms of project construction costs and durations. The research therefore did not track changes post contract. Such changes play a key role in performance measurement of procurement systems in terms of cost growth and programme growth. Future research should therefore encompass not only the pre-contract project performance data but also post contract project performance data such as client satisfaction, cost predictability and time predictability associated with different procurement methods. In addition quality performance metric measurements were not taken into account which does have impacts on construction speed, intensity of construction and unit costs. Design phase durations were also not taken into account in the measurement of durations used in the research.

## **6. Practical implications**

The selection of an appropriate procurement method is crucial to the successful performance of a construction project with regards to not only cost and time (as analysed in this research) but quality achieved as well. It also ensures a smooth project delivery process and eliminates problems during construction. The research provides comparative quantitative data that should assist project developers to make decisions on procurement strategy and methods. The fact that the research has used a longitudinal section of the sampled data (samples covering 6 years) means that the research results will help foster a better understanding of the role played by procurement method on cost and time attributes.

## **7. Conclusions**

The research presented in this paper is part of an ongoing professional doctorate research to comparatively analyse performance of different procurement methods

used to deliver office projects in central London in the last 5 years. Primary data based on a combination of mailed questionnaires and semi-structured interviews are currently being collected in order to address the overall aims and objectives of the main research.

The primary goal of this research however was to undertake a comparative analysis of different procurement methods used in successful tendered office projects in the UK over the last 6 years commencing in 2003. To achieve this goal secondary data from the BCIS was categorised and examined. The research results presented indicate that D&B procured projects out performed traditional projects in terms of unit costs, construction speed and intensity of construction. This was supported by statistical tests performed on the research results.

However using trend analysis further key findings and patterns were identified and presented graphically. This further analysis show that unit costs associated with traditional projects in the later parts of 2009 appear to be reducing to those levels that were observed in D&B projects. Similarly construction speeds for both D&B and traditional projects tendered in the later parts of year 2009 were not dissimilar. Again while unit costs for traditional projects gradually reduce with increased project size the effect is different on D&B projects whose observed unit costs seem to have been increasing with increase in project size.

## References

- Bennett, J., Potheary, E., Robinson, G. (1996). *"Designing and building a world-class industry."* Rep. No. ISBN 07049 1170 1, University of Reading, Reading, U.K.
- Building Cost Information Service (2010). Retrieved 19 April 2010, from <http://service.bcis.co.uk/v2000/bcis/docs/frames.html?login=indirect>
- Elhag, T.M., Boussabaine, A.H. (1998). *Statistical analysis and cost models development*. EPSRC Research Grant Report, University of Liverpool.
- Hackett, M. Robinson, I., & Statham, G. (2007). *The Aqua Group Guide to Procurement, Tendering & Contract Administration*. Revised and updated (3<sup>rd</sup> ed.). Oxford: Blackwell Publishing.
- Ireland, V. (1983). *The role of managerial actions in the cost, time and quality performance of high risk commercial projects*, Unpublished PhD, University of Sydney, New South Wales, Australia.
- Oberlender, G.D., & Zeitoun, A.A. (1993). *"Early warning signs of project changes"*. Rep. to the Constr. Industry Inst., Source Document 91, April, Austin, Tex.
- Pocock, J.B. (1996). *"The relationship between alternative project approaches, integration, and performance,"* Unpublished PhD, University of Illinois at Urbana-Champaign, Ill.
- Sidwell, A. C. (1982). *A critical study of project team organisational forms within the building process*. Unpublished PhD, Department of construction and environmental health. University of Aston, Birmingham.
- Walker, D. H. T. (1997). *Construction time performance and traditional versus non-traditional procurement methods*. Journal of construction procurement, volume 3 (1), 42 – 55.

**Appendix I:** RICS COBRA Paper: presented at the RICS COBRA conference in New Dehli, 10 – 12 September, 2013.

**DESIGN AND BUILD PROCUREMENT METHOD IN PRACTICE: EXPLORATION OF EXPERIENCES OF KEY PARTICIPANTS IN THE UK CONSTRUCTION INDUSTRY**

**Anywhere Muriro<sup>i</sup> and Gerard Wood<sup>ii</sup>**

<sup>1</sup>College of Science & Technology, The University of Salford, Maxwell Building, Salford, Greater Manchester, M5 4WT, UK

<sup>2</sup>College of Science & Technology, The University of Salford, Maxwell Building, Salford, Greater Manchester, M5 4WT, UK

**ABSTRACT**

Over the recent years the UK construction industry has seen an increasing level of interest in the use of design and build (D&B) as a procurement method. This appears to be mainly driven by an attempt to increase the level of integration in what is generally viewed as a fragmented industry. The key characteristics associated with this procurement method are single point responsibility, early contractor involvement resulting in potential cost savings and earlier completion, easy constructability and minimisation of design and construction risk to clients, elements which are all viewed as advantageous to construction clients and contractors alike.

Despite its perceived increase in adoption over the last couple of decades as supported by the Contracts in use survey in 2007 by the RICS the construction industry is still reported to be experiencing problems associated with D&B procurement. This highlights the need to explore further how this procurement method is administered in practice.

The output from this exploration is a framework for facilitating effective and efficient implementation of the D&B procurement method. Related literature reviews and semi-structured interviews have been used to gain rich insights into this procurement method.

**Keywords:** constraints design and build, framework, procurement method, UK construction industry.

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<sup>i</sup>A.muriro@edu.salford.ac.uk

<sup>ii</sup>G.d. [wood@salford.ac.uk](mailto:wood@salford.ac.uk)

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## INTRODUCTION

Despite the significance and benefits attributable to integrating design and construction within construction procurement systems it would appear from literature reviewed that there are a host of underlying constraints that have been reported to be affecting design and build (D&B) procurement as a construction project delivery method. This could be viewed by some as ironic given that D&B procurement method has been, and is still, perceived to have addressed the problem emanating from the fragmentation of the construction delivery process. Current body of knowledge that has been reviewed brought to light some significant D&B procurement challenges that have been encountered by key participants (identified in this paper as designers, clients and contractors) of the construction industry. For instance Fahmy and Jergeas (2004) highlighted the difficulty that construction clients face in defining requirements clearly and still leave some room for creativity and ingenuity for the D&B contractor. Similarly Bennett et al. (1996) reported that there is a perceived inferiority in terms of the quality of the construction product coming out of the D&B procured project. Cecil (1983) also observed in his research the perception by some clients who felt that by adopting D&B as a procurement route they tend to lose control of the design and construction processes which they thought may be taken advantage of by some D&B contractors. In support of this perception such clients bemoaned the fact that there is no overall design and construction supervision from the owner when utilising a typical D&B procurement method to deliver construction work.

## 2.0 Research Method

The paper's focus on the D&B procurement method and the examination of complex constraints concerning people (key participants involved in D&B procurement), organisations (clients, contractors and designers), construction processes (principally design and construction), situations and ordinary events in their natural settings dictates that the paper is based on an exploratory type data compilation. As highlighted by Robson (2002) such exploratory type studies are characterised by a quest to have a deeper insight in little understood situations; seeking new insights of phenomena; asking questions in order to assess phenomena in a new light and to generate ideas and hypotheses for future research. This therefore demands the use of an explorative mixed methods sequential approach in order to accomplish an exhaustive exploration of the problem. The paper, however, reports on the outcome of qualitative interviews undertaken with key D&B procurement participants.

Due to their ability to 'dig deeper' and get a rich understanding of a problem informal interviews were selected as a research tool for this paper. Using the construction league tables (indicating those contractors, clients and designers actively involved in the UK construction industry) periodically published by the Building Magazine and the Construction News (2012) a cross sectional survey soliciting views from key participant organizations was conducted. Senior staff who indicated that they had undertaken at least one D&B project were targeted and considered for the interviews. The approach adopted was to contact each organization (using the league tables as a guide) initially by letter and e-mail followed by a telephone call and where



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participants were willing and able to partake in the research interview convenient dates and times were arranged for the interviews. Directors, Senior Managers and Project Managers were the targets for the interviews. This means that the respondents were quite senior which provided further validity to the interview results. Out of the 31 participants interviewed 10 were middle level managers (3 Commercial Managers, 5 Project Managers and 2 Scheme Project Managers) with 145 years combined experience; 15 were top level managers (7 Directors, 5 Principal Engineers, 2 Contracts Managers and 1 Design Manager) with 273 years combined experience and 6 were strategic level managers (2 Commercial Directors, 3 Operations Managers and 1 Director) with 174 years combined experience. All in all the interviewees had managed a combined total of £12.5 billion of D&B projects over their combined working experience. Based on this it can therefore be inferred that the respondents' views are noteworthy as they are not only senior managers within the UK construction sector but also very experienced people.

The interview questions were selected on the basis of the findings from the reviewed literature. The literature review can be viewed as providing the basis of the theory that was later tested by the interviews undertaken. An interesting finding out of the reviewed literature is the fact that, although some of the reviewed literature has been undertaken in the 1990's, the challenges reported then are still being experienced by current key participants of the D&B procurement method! This further supports the fact that there are still pertinent challenges out there that needs addressing by further research.

## **2.1 Review of related Literature**

Single point responsibility has been cited as one of the key attributes and perceived advantages of the D&B procurement method. As Twomey (1989) observed the single point responsibility notion comes from the observation that, with this method of project delivery, the construction client enters into contract with a single organization that provides the client with all of the services necessary to both design and construct all or portions of the project. Follow on benefits flowing from this have been cited as better coordination between design and construction activities, elimination of second hand information, elimination of the 'blame culture' that has been associated with the traditional design-led fragmented procurement method, early involvement of sub-contractors and suppliers, one simpler contractual relationship with one D&B contracting organization which means errors/omissions in design are not the client's responsibility. However such benefits have been challenged in the reviewed literature with some researchers coming up with a host of arguments with some appearing to purport that single point responsibility can be disadvantageous to clients.

One such concern has been highlighted by Lee et al. (2009) who opined that single point responsibility is only advantageous when the client's administration of the quality performance of the D&B contractor is assured and secured. How this quality performance can be assured and secured in practice has not been well covered and elucidated. Elsewhere Fahmy and Jergeas (2004) went further to provide further arguments on how such single point responsibility can impact on the client's ability to effectively administer the quality performance of the single D&B organization. They opined that since clients lose the direct control over the design and the fact that the

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designer is accountable to the D&B contractor design decisions usually are inappropriately influenced by the D&B contractor, who in most cases, they went on to opine, may pressure the designers to reduce quality criteria or design standards to minimum levels in order to maximize profits.

Correspondingly such concerns were also echoed by Tietz (1999) when he highlighted that the D&B contractor being the principal agent within D&B procurement and the fact that construction value overshadows design costs the D&B contractor's opinion tends to prevail when quality of design and construction savings come into conflict. This appears to support Lee et al. (2009)'s observations that single point responsibility created by the D&B procurement arrangement is disadvantageous to the client in some respects. Single point responsibility is therefore perceived to bring with it the elimination of third party 'quality control' by the client which is clearly a challenge as the party now responsible for completing the construction work as quickly and as 'cheaply' as possible (the D&B contractor) also has control over the passing of the quality and the quantity of the work!

Combining design and construction functions into a single contracting entity is also said to create constraints with clients as they see themselves losing the checks and balances that exist with the traditional design led fragmented procurement method. Similarly McDonough (2002) commented that the quality of the process and of the finished product cannot be guaranteed as the monitoring of quality is not as transparent as it is in the traditional design-led procurement method again in tandem with observations and comments made by Lee et al. (2009).

Constraints in connection with single point responsibility brought about by D&B procurement method are mirrored by constraints that have been reported to be affecting clients in determining project requirements to enable D&B contractors to price and come up with proposals that align with client requirements. The briefing process has been described by Kamara and Anumba (2000) as including defining, eliciting, analyzing, translating, organizing and documenting requirements and incorporating them into the project. Requirements, according to Gilb (2005), Zielczynski (2008) and Robertson and Robertson (2005), are reflective of targets, desires, expectations or constraints imposed by clients on the project functionality and quality.

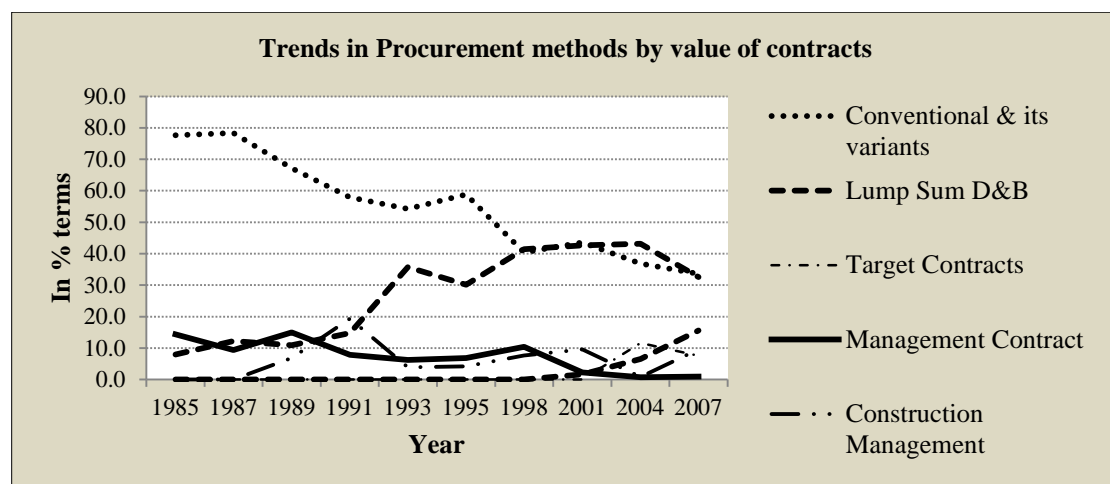
Kamara (1999), in a research in which he carried out an assessment of how the briefing process is carried out in the UK construction industry, observed that although information collected is sometimes documented in formal documents such documents are not normally stored as part of the brief and normally the design organization relies on recollections of verbal communications with the client. Other researchers such as Newman et al. (1981), Goodacre et al. (1982) and Construct IT (1996) similarly came up with observations that mirror Kamara (1999)'s findings. In addition they also came up with additional findings that suggest that the use of the solution (i.e. the design) to clarify the problem can shift focus from client requirements to the preferences of the designer due to the fact that proposed design solutions are usually made before a thorough understanding of the client requirements. It would appear that such findings have led Howie (1996) to comment that due to this underlying challenge it is not

surprising that many client briefs are generated out of design rather than a clear understanding of the client's actual objectives.

Other researchers such as Bowen, et al. (1999) observed that oral presentation is the medium by which the brief is most commonly communicated resulting in considerable potential for miscommunication. This observation reflects Kamara (1999)'s findings which also highlighted the preponderance of verbal communications during the briefing process resulting in possible miscommunication. Correspondingly Bowen et al. (1999) also observed that insufficient time is devoted to the briefing process and in some cases they found that briefing is prematurely initiated before alternatives have been analysed. Apart from the communication challenges highlighted by Bowen et al. (1999) and Kamara (1999) others such as Arayici et al. (2006), Yu et al. (2005) and Shen and Chung (2006) observed that the briefing process only covered a limited perspective of the proposed construction facility as stakeholders overlooked some vital parts of the building. Similarly professionals and clients were found to seldom perceive the project as a whole at the inception stage, an observation that has also been made by Leite et al. (2005) who also added that this lack of holistic view leads to an underestimation of those critical requirements that appear to be negligible at first glance but of great effect in the future.

### 3.0 Results and Discussion

As part of the exploratory survey several in-depth interviews were undertaken with senior members within D&B contractor organisations, designer organisations and client organizations. Organisations that have been actively involved and engaged in delivering construction projects utilising D&B procurement method in the UK over the past decades particularly the late 1990's when D&B procurement has been shown to have been on the increase in terms of usage in the UK construction sector relative to the traditional design-led method of procurement (see Figure 1 below) were targeted interviewees.



**Fig. 1. Trends in procurement methods in the UK by value of contracts: 1985-2007**

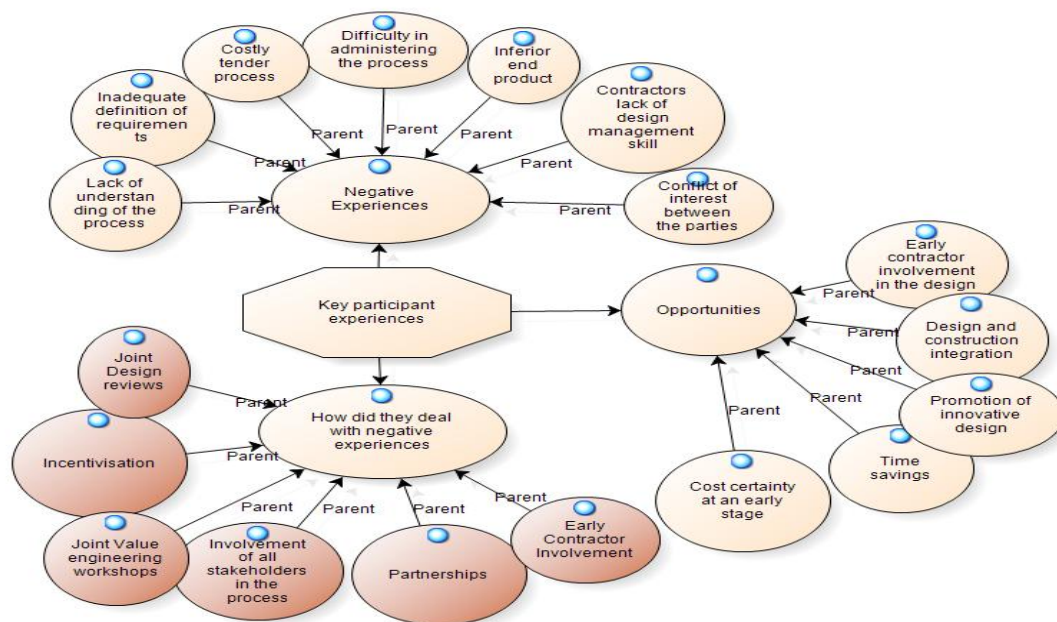
Adapted from: The RICS Contracts in use survey (2007)

Table 1 below summarises the results from the Interview responses and related literature reviews

**Table 1: Summary of results from interviews/Literature reviews**

Constraints encountered by key participants of the D&B procurement method		
Clients	Contractors	Designers
Loss of designer independent construction oversight	Unclear/Incomplete client requirements	Difficulties in interpreting client requirements
Contractor's design not meeting/satisfying owner's expectation	Insufficient time allocated to briefing & tender preparation	Perceived conflict of interest between professional duty & contractor's requirements
Design standards sacrificed to minimum levels	Difficulties working with design professionals	Inadequate &/or lack of communication with end users & other stakeholders
Difficult to define requirements clearly & still leave room for creativity	Difficulties managing the design iteration process	Difficulties getting specialist design input into the design
Lack of/insufficient communication with contractor's designer	The delivery method is technically demanding & more labour intensive than the design led method	Limited recovery of design costs incurred during tender when the tender is not won

Results from the analysis of both the positive and negative experiences culminated in a model shown in Figure 2 below summarises the resultant node hierarchical structure of categories/themes/concepts that came out of the interviews undertaken with key participants. The resultant model was developed through the use of Nvivo 10 data analysis tool and captured not only the constraints encountered but opportunities and some good practice that the interviewed key participants of the D&B procurement method have experienced over the years.



**Fig.2. D&B constraints & opportunities as experienced by key participants**

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### **3.1 Limitations**

The results presented in this paper are part of an ongoing research and therefore should be viewed as interim as they are subject to change due to the ongoing interviews with D&B key participants as well as the pending results from the launched questionnaire survey.

### **4.0 Conclusion**

From the analysis of results from the reviewed literature and interviews undertaken to date with key participants of the D&B procurement method it would appear that key participants of D&B procurement have had a mixture of both positive and negative experiences. It would also appear from the interviews undertaken that there are various methods and processes that have been used by key participants to deal with and manage some of the negative experiences that they have had with this procurement method. In addition the interviews have also revealed lots of opportunities that can further be exploited for the benefit of both key D&B participants and the construction industry at large. These results have been summarised and portrayed in Figure 2 above. Such a model presented in Figure 2 could be the underpinning framework that may well be used in the advancement of easy to follow guidance by D&B procurement users.

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## References:

- Arayici, Y., Ahmed, V., and Aouad, G., (2006). 'A requirements engineering framework for integrated systems development for the construction industry'. IT in Construction (ITcon), Vol. 11 pages 35-55.
- Bowen, P.A., Pearl, R.G., and Edwards, P.J., (1999). 'Client briefing processes and procurement method selection: a South African study'. Engineering Construction and Architectural Management, Vol. 6 No 2, pages 91-104.
- Bennett, J., Potheary, E., and Robinson, G., (1996). *Designing and Building a World Class Industry*, Centre for Strategic Studies, Reading University.
- Cecil, R., (1983). 'Design and build'. Architectural Journal, Vol. 177 No 13, pages 61-62.
- Construct I.T. (CIT) (1996). *Benchmarking Best Practice Report: briefing and Design*, Construct IT Centre of Excellence, Salford
- Construction News (2012). Available at <http://www.cnplus.co.uk/> (Accessed on 3 July 2012)
- Fahmy, S., and Jergeas, G., (2006). 'Ten Critical Principles for Successful Design-Build Projects'. Cost Engineering, Vol. 48 No 11, pages 29-34.
- Gilb, T., (2005). *Competitive Engineering*, London: Elsevier.
- Goodacre, P., Pain, J., Murray, J., and Noble, M., (1982). *Research in building design*, Occasional Paper, No 7, Department of Construction Management, University of Reading, Reading.
- Howie, W., (1996). 'Controlling the Client', New Civil Engineer, 17 Oct, page 12.
- Kamara, J.M., (1999). *Client requirements processing for concurrent life-cycle design and construction*, PhD thesis, University of Teesside.
- Kamara, J.M., and Anumba, C.J., (2000). 'Client requirements processing for concurrent life-cycle design and construction', Concurrent Engineering, Vol. 8 No 2, pages 74-88.
- Lee, Dong-Eun., Lim, Tae-Kyung, Arditi, D., (2009). *Automated stochastic quality function deployment system for measuring the quality performance of design/build contractors*. Automation in Construction, Vol. 18, pages 348-356.
- Leite, F.L., Miron, L.I.G., and Formosco, C.T., (2005). *Opportunities for client requirements in low income housing building projects in Brazil*. Proceedings of the IGLC – 13<sup>th</sup> July, Sydney, Australia pp 333-341
- McDonough, A.F., (2002). 'Design-build contracting: excellent tool, when wisely used', CM Advisory Vol. 16 No 5 pages 5-8.

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Newman, R., Jenkins, M., Bacon, V., and Dawson, S., (1981). *Brief formulation and the design of buildings*. Report, Dept of Architecture, Oxford Polytechnic, Oxford.

Robertson, S., and Robertson, J. (2005). *Requirements – led Project Management: Discovering David's slingshot*, Boston: Addison-Wesley.

Robson, C. (2002) *Real World Research*. 2<sup>nd</sup> ed. Oxford: Blackwell.

Shen, G.Q.P., and Chung, J.K.H., (2006). 'A critical investigation of the briefing process in Hong Kong's construction industry', *Facilities* Vol. 24 No 13/14, pages 510-522.

Tietz, S., (1999). *From Egan to the 21<sup>st</sup> century – commenting on the Egan Report, Rethinking construction (July 1998)*, *The Structural Engineer – Journal of the Institution of Structural Engineers*, Vol. 77 No 7.

Twomey, T.R., (1989). *Understanding the legal aspects of Design-build*, Kingston: R.S. Means Co., USA.

Yu, T.W.A., Shen, Q., Kelly, J., and Hunter, K., (2005). 'Application of value management in project briefing', *Facilities* Vol. 23 No 7/8, pages 330-342.

Zielczynski, P., (2008). *Requirement management using IBM Rational Requisite Pro*, Armonk: IBM Press.

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## **Appendix J: Interview transcript TD3**

### **Interview transcript – TD3**

Date of Interview: 15/08/2012

Time of Interview: 14:00

Venue: Interviewee's office

Position: Director – Top Manager

Nr of years' experience: 20 years

Approximate Nr of construction projects undertaken: 25

Approximate value of DB projects undertaken: £425million

Approximate percentage value of D&B projects undertaken: 50%

Interviewer: Researcher

Interviewee: TD3

### **Start of the Interview**

**Interviewer:** What is your current role within your organisation?

**Interviewee:** I have just been promoted to head a regional office as a design team sector Director

**Interviewer:** Before that what was your role?

**Interviewee:** I have occupied several positions within the company in both the UK and overseas. Just before my promotion I was a Principal Designer in the infrastructure division and prior to that I was a Senior designer. My role has been evolving over the years

**Interviewer:** Thank you for the information. So, how long have you been working in the construction sector?

**Interviewee:** I have been working in the construction sector for 20 years now.

**Interviewer:** That's certainly a long time! Over your 20 year career what would you say is the approximate value of projects that you have worked on?

**Interviewee:** Over the top of my head I would guess this to be over £425 million.

**Interviewer:** Oh! That's a substantial value! How much would you say is the approximate value of D&B projects that you have worked on over your 20 year career?

**Interviewee:** Again this is guess work here; i would guess this to be half D&B projects and half other non D&B projects.



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**Interviewer:** That would equate to 50% of the £425 million that you stated earlier? Is that correct?

**Interviewee:** Yes that's correct.

**Interviewer:** In terms of number of projects undertaken, what would you say is an approximate number of construction projects that you have delivered?

**Interviewee:** Again this will be a guess. I should think this is more like 25 projects as they tended to be high value.

**Interviewer:** Okay thanks. In your own view what are the challenges that you have come across when delivering projects using the D&B procurement method?

**Interviewee:** There are so many challenges that i have encountered with the D&B procurement method. As a key member of my practice i am involved in pricing D&B projects for provision of design services to contractors and i found this to be one of the very first challenge that we as designers encounter with this method.

**Interviewer:** Can you please elaborate on this point please? How does this constitute a challenge?

**Interviewee:** Performance related specification which usually accompanies the initial design requirements from clients is difficult to price from a design service provision point. In most cases the client's requirements are not clear and are not defined clearly in order for us designers to understand what level of service is required. The requirements should be all encompassing and take into account what the project stakeholders need from the end product. Clients should be willing to spend more at the beginning of the process in order to get the requirements right. Preference for us would be to price on the basis of a Target cost but then contractors demand us to provide a lump sum fixed price/Fee which leaves us with significant amount of risk should our interpretation of the client requirements is found to be inadequate during the later stage of the D&B project.

**Interviewer:** I can see why you see this as a risk to you

**Interviewee:** Indeed. It is not so much that we designers can't provide fees on a lump sum basis but the big issue with this is in most situations we are requested to provide lump sum price offers for design services at tender stage when there isn't much information available upon which to base our lump sum fee. Forecasting costs for design services required on the basis of scant information at tender brings with it risks to us. In most cases we end up

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spending more than the lump sum fixed price without any recovery of the additional costs incurred.

This is also linked to the problems associated with pricing for construction support to be provided by designers during the construction stage. Traditionally there was a Clerk of Works and his/her time was recovered on a time basis which wasn't a problem but with the D&B procurement method contractors would want a lump sum price for construction support. This causes us problems as we would have difficulty in interpreting and pricing the extent of the contractors' requirements and this creates a major risk for us.

**Interviewer:** I see your point now. So what else have you encountered that you consider to be a challenge?

**Interviewee:** The other challenge that i have encountered can be summarised as erosion of professional status due to removal of contractual link between the designer and the client resulting in loss of trust that used to be enjoyed by designers when they were directly engaged by clients. Traditionally there is a conception that clients mistrusts contractors and since designers are part of the contractor's team in D&B procurement designers view themselves as being caught up in this historical mistrust that is perceived to be there between contractors and clients.

**Interviewer:** Does this mistrust impact on your relationship with clients?

**Interviewee:** Yes it does. Certainly you can see it from the way clients behave and relate with us in a D&B set up. There is an element of that from my experience.

**Interviewer:** What are the other challenges that you have come across?

The perception that, by engaging contractors on a D&B procurement delivery method, the project should benefit from the ease in which the design is buildable is rarely encountered in my experience due to several reasons such as: Treating professional designers in the same way as they treat their trade sub-contractors creates a situation where the designers and contractors are not joined up in their working resulting in conflict and adversarial relationships. What tend to happen in practice is that contractors react to design situations at the end of the process when the design is complete and ready to be built leading to time and cost overruns and further conflict with designers.

Another big challenge that i have encountered with this procurement method is that of misunderstanding of design development by contractors. Many contractors misunderstand and misinterpret design development. This comes from a common misunderstanding by contractors who don't understand how the design process evolves from one stage to the other. As designers we understand that design development is inevitable and this further development of design is not a change but development of an existing design therefore it is not a mistake in the design that designers are 'correcting'. Contractors, on the other hand, view this as design mistakes and are unwilling to pay for additional construction costs

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associated with design development and in most cases would want to recover such costs from the designer. Such additional costs are contra charged to our accounts.

**Interviewer:** Really? That's really a massive challenge then?

**Interviewee:** Certainly it is.

**Interviewer:** You stated earlier that contractors react at the end of the process. Can you elaborate on this please?

**Interviewee:** I meant that in most situations when designs are issued for construction that's the time when some contractors actually check and then come up with ideas that could have been pursued earlier.

**Interviewer:** What else have you come across this procurement method that has been a challenge?

**Interviewee:** There is another challenge created by the way D&B contractors procure their sub-contractors not only specialist sub-contractors is another challenge for us designers. From my experience specialist subcontractors in most cases are unwilling to provide specialist advice to designers in the early stages of the design when they themselves have not yet been provided with an order to commence works/services by contractors. Designers are therefore left with no option but make assumptions on design elements that they have got little knowledge of resulting in potential future problems when the specialist subcontractor has been formally procured by the D&B contractor and is on board.

**Interviewer:** Thanks for the detailed elaboration of the challenges that you have encountered with D&B projects. How about ways in which such challenges have been dealt with?

**Interviewee:** Where there is better definition of client requirements that designers and contractors can understand the D&B procurement method has a high chance of working well and thus bring out the potential advantages that it can bring to construction projects. Better definition of client requirements can be achieved by clients spending more upfront and involving all the key stakeholders involved in the project.

**Interviewer:** What about dealing with pricing for professional services?

**Interviewee:** When it comes to pricing for design services contractors should consider other options such as Target costing and incentivisation in order to create an environment that is conducive for a good working relationship with designers and the end product is less likely to be disrupted.

**Interviewer:** How about dealing with the buildability issues that you raised earlier?

**Interviewee:** Stakeholders input should be sought and incorporated early in the design process. Designers and contractors design management teams should be embedded to form a cohesive team that not only looks at design delivery but concentrates on methodology,

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buildability and value engineering aspects of the design and timeously informing designers of decisions reached in order to align the developing design with ongoing decisions that are being made as the design progresses.

**Interviewer:** Any other ways that the D&B challenges can be addressed?

**Interviewee:** The other positive that i have experienced with this procurement method is that given that time is always an issue with the D&B procurement method designers and contractors can work together, identify big ticket items that they can closely look at and therefore add value to the process rather than spend lots of time looking at some elements of the project that do not add value at all. Joint collaborative planning from inception to completion is another way that may address the challenges. This potentially goes a long way to address the time risk issues as well as enhancing assurance and quality control.

**Interviewer:** Thank you, I have certainly gained a lot from your experience with the D&B procurement method. I am still collecting data from practitioners like yourself and I hope you don't mind me asking further questions should I come across any ambiguity?

**Interviewee:** My pleasure. As long as you give me advance warning and my diary is free I am more than happy to help you.

**Interviewer:** Thank you for your time. Have a good day.

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## **Appendix K: Interview transcript MC1**

### **Interview transcript – MC1**

Date of interview: 24/08/2012

Time of interview: 11:30

Venue: Interviewee's office

Position: Project Engineer – Middle Manager

Number of years' construction experience: 15 years

Number of construction projects undertaken: 28

Approximate Value of construction projects undertaken: £175million

Approximate percentage value of D&B projects undertaken: 60%

Interviewer: Researcher

Interviewee: MC1

### **Start of the Interview**

**Interviewer:** Can you please confirm your position within your organisation?

**Interviewee:** I am a Project Engineer

**Interviewer:** How many years of experience have you got working in the construction sector?

**Interviewee:** I have got a total of 15 years working experience in the construction sector. This includes a year out experience when I was still a student.

**Interviewer:** Approximately what is the value of projects that you have undertaken over the 15 year period that you have worked in the construction sector?

**Interviewee:** That's a difficult one; I would say probably £175million.

**Interviewer:** Of that value what could you say was the approximate value of D&B projects that you delivered over the years?

**Interviewee:** Most of the projects I worked on were delivered using the D&B method. In percentage terms the value of D&B projects should easily be over 50%. I would say possibly 60%

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**Interviewer:** What is the approximate number of construction projects that you have worked on?

**Interviewee:** I would say over 25 projects. Certainly not 30

**Interviewer:** Would you say between 25 and 30?

**Interviewee:** 28 would be more like the correct number

**Interviewer:** In your experience with the D&B procurement method what would you say are the main challenges that you have encountered?

**Interviewee:** As I have worked for the client organisation in my entire career to date I have been involved in D&B tender evaluation process. This, I found, was a challenge for me as I found it difficult to make an objective assessment of the non-price criteria. Other procurement methods such as the traditional procurement method the contractor provides a price on the basis of fully documented tender documents and makes it easier to assess and evaluate particularly when you are inexperienced in other non-price criteria. In traditional contracts contractors are requested to price the approved detailed design and we do not have to consider additional variables that we would have to consider when contractors are not only providing a price for undertaking the works but providing a design as well.

**Interviewer:** You state that making an objective assessment of the non-price criteria is difficult, what are these non-price criteria?

**Interviewee:** The non-price criteria I am referring to are those elements of the D&B tender that are the main elements in which D&B contractors compete. These are normally aspects of the scope and hence the level of quality of the proposed design.

**Interviewer:** Okay I see. What else have you encountered as a challenge with the D&B process?

**Interviewee:** The D&B tender assessment process that I have highlighted above tend to result in the appointment of possibly not the best tenderer for the work and gives us clients a feeling of some lack of control in the whole process.

**Interviewer:** Can you please explain this lack of control that you stated earlier?

**Interviewee:** The feeling of lack of control kicks in when you get the feeling that perhaps you could have done a more rigorous assessment of the tender if you had demonstrable objective assessment criteria to justify your choice or scoring of the tenderers.

**Interviewer:** What else would you state are the challenges that you have encountered with D&B procurement?

**Interviewee:** It is the way D&B jobs are tendered. What we have been doing in this organisation is that we would engage directly the design team to produce designs up to say outline design and then use the outline design to get the contractor to provide a price for

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taking on that design and develop it through to construction. This halfway house type of D&B procurement process, in my view, tends to result in compromises to constructability and innovation. The whole D&B process is about tapping into the contractor's expertise and knowledge of constructing. By taking away the outline design process from the contractor we are preventing the realisation of such expertise and innovation.

**Interviewer:** Is this not an attempt to define the employers' requirements clearly and accurately?

**Interviewee:** Employers' requirements are still a major issue in my view. We always fail to get them right. What tends to happen is that we pass on both the outline design and the whole documentation associated with employers' requirements to the D&B tenderer. As part of the D&B tender process the D&B tenderer is required to interpret the requirements and ensure that the D&B tender to be provided takes into account of both the requirements and the outline design. In my opinion we, as clients, could do better with employers' requirements. I think they are inadequate. Due to the inadequacies in the definition of employers' requirements different D&B contractors would naturally interpret the requirements differently. This is probably why we end up with poor end products at the end of the D&B construction process.

**Interviewer:** Why would you say that this is probably why you end up with poor end products?

**Interviewee:** I say so because I have actually experienced D&B contractors going for the most basic products which may not necessarily be our preferred choice. You know the result of this don't you? We end up getting what we did not want! The problem is that employers' requirements that are produced by us clients sometimes state in general rather than in specific terms and that's where the problem lies. This leads to yet another problem that I have stated earlier – the quality of the end product not meeting our expectation.

**Interviewer:** Surely there are checks and balances to prevent this happening?

**Interviewee:** Not really because in my view the problem is compounded by the fact that in D&B procured projects there is no independent consultant to check on quality and making sure that the constructed product is compliant with the requirements of the client.

**Interviewer:** Is there anything else that you have encountered as a challenge with this procurement method?

**Interviewee:** There is only one more controversial challenge that I haven't experienced myself but there have been reports of some clients getting good design solutions from D&B contractors without necessarily intending to award the contract and using it to get tenders from other contractors who they believe can be able to deliver the design solution at economical prices and short delivery programmes. This is clearly an abuse of the process and not really fair to the D&B contractors who would have spent enormous amounts of time and resources in putting together D&B bids.

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**Interviewer:** Really? That doesn't sound to be fair to the D&B contractors?

**Interviewee:** I agree but I have heard that it happens out there!

**Interviewer:** What then can be stated as positives from your experience with D&B procurement? By positives I mean enablers that help to address the challenges encountered.

**Interviewee:** D&B procurement method works well when there is a clear understanding of what the client wants and clients should work closely with all parties during the design development process to ensure that the design doesn't deviate from the dictates of the requirements. From my experience D&B procurement method works well where the client develops clear and comprehensive requirements and engages the D&B contractor early in the process in order to get the most from the contractor's experience in constructability advice and perhaps new ideas on other design options.

**Interviewer:** Okay thanks. What else would you say can help to address the challenges that you have encountered?

**Interviewee:** Close working relationship between the parties involved (client, contractor & designer) is good practice which leads to collaboration and low incidence of problems during the project delivery process. Incentivisation should be considered as well as this gives contractors and designers incentives to come up with a design that gives value for money to the client as well as ensuring that contractors gets good returns for the efforts they are putting in the delivery process.

**Interviewer:** Anything else that you will need to add and/or clarify further in connection with D&B procurement

**Interviewee:** Nothing more. As I said before it's all about scope definition, early engagement of the contractor and coming up with collaborative arrangements that rewards hard workers and performers.

**Interviewer:** Thank you for your time. I really enjoyed talking to you in connection with your experience with the D&B procurement method. If you think of anything else please feel free to contact me.



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## **Appendix L: Interview transcript MCN3**

### **Interview transcript – MCN3**

Date of interview: 26/11/2012

Time of interview: 10:00

Venue: Interviewee's site office

Position: Contractor Senior QS – Middle Manager

Number of years' experience in construction: 12 years

Approximate number of projects undertaken: 20

Approximate value of projects undertaken: £250m

Approximate percentage value of D&B projects undertaken: 45%

Interviewer: Researcher

Interviewee: MCN3

### **Start of the Interview**

**Interviewer:** What is your current role?

**Interviewee:** I am a Senior Quantity Surveyor

**Interviewer:** How many years have you been working in the construction sector?

**Interviewee:** I have been working for 12 years within the construction sector.

**Interviewer:** Over your 12 year career what would you say is the approximate value of projects that you have undertaken?

**Interviewee:** The value is easily around the £250million mark.

**Interviewer:** Of the £250 million value what could you say is the approximate value of D&B projects that you have worked on?

**Interviewee:** This should be about 45%

**Interviewer:** What would you say is the approximate number of construction projects that you have worked on over the past 12 years?

**Interviewee:** As a guess this should be about 20.

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**Interviewer:** What would you say are the challenges that you have encountered with the D&B procurement method?

**Interviewee:** The main challenge that I have encountered is that in most cases the changing construction sequence on site is not necessarily reflected by the design process.

**Interviewer:** Can you please explain what you mean by this?

**Interviewee:** This is a problem as, by its nature, construction sequence is prone to change to reflect the changing situations and circumstances that are invariably encountered on site. At the same time the design process is progressing on the basis of the design intent.

**Interviewer:** How then is this dealt with this?

**Interviewee:** There is a problem in dealing with this as consultants still feel that they are working for clients directly and sometimes contact clients directly and by-pass contractors. These results in design decisions being made that are sometimes not reflective of what was contracted. This is a problem to us contractors as the risks associated with pricing Design & Build projects are high particularly in complex projects. When clients award a D&B contract to the contractor for a fixed lump sum they expect the D&B contractor to produce a first class facility that probably would have cost them twice as much and possibly twice as long!

**Interviewer:** So you are suggesting that the expectation from clients is much more than in other conventional procurement methods?

**Interviewee:** Yes, definitely, it appears as such. For instance when requested to approve designs clients often come up with design comments that tend to keep a blind eye on the budget but focus on the highest possible quality standard that can be achieved causing further strains to parties relationships.

**Interviewer:** What could be the possible reasons for this?

**Interviewee:** In my opinion this comes from incomplete employers' requirements. Managing clients' expectations is a major constraint that I have encountered over the years.

**Interviewer:** Can you please elaborate on this constraint?

**Interviewee:** Clients expect a lot from the D&B contractor and sometimes the expectations are unrealistic and difficult to fulfil given the quality and comprehensiveness of the requirements.

**Interviewer:** What is the problem with the quality of the requirements?

**Interviewee:** They are not always clear and sometimes leave out a lot of key information which makes it difficult to understand what exactly is required by the client.

**Interviewer:** Okay thanks for clarifying. Earlier you stated that designers consult directly with clients. What are the challenges coming out from this direct consultation?

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**Interviewee:** I think the fact that at times designers were used to working with clients directly complicates this challenge further as sometimes clients communicate directly with designers and influence design through the back door without going through the change management process for fear of avoiding to pay for the additional costs associated with the additional scope that their comments may bring. This direct consultation with the client results in designers undertaking design solutions that may not necessarily reflect the contractor's budget leading to budget pressures and strained relations with the client if the design solution that they had separately discussed & agreed with the designer is not adopted. The challenge of other stakeholders within the client organisation brings with it another source of strained relationships between the parties.

**Interviewer:** How do other stakeholders within client organisations cause strained relationships?

**Interviewee:** In most client organisations that are experienced property developers there is the project delivery team on the one hand and the facility user team on the other hand who probably may not necessarily share the same objectives. The project delivery team are often tasked with ownership of the budget for the delivery of the project and the facility user team are tasked with taking over the facility after completion and using and maintaining it for the economic life of the facility. The focus of the user group naturally is to get a facility that is aesthetically pleasing and easy to maintain. This may not be accommodated by the project budget. There is a clash of objectives as the project delivery team will naturally want to deliver the project at the set budget and will resist any attempts by the user team to introduce any preferential engineering requirements. This creates a problem for the D&B contractor as in most cases the D&B contractor is caught up in this conflict and sometimes ends up with a situation where any ambiguous requirements are blamed on the contractor leading to more strained relationships.

**Interviewer:** I can see now the connection with other stakeholders with this challenge. Any other challenges that you have encountered?

**Interviewee:** Another problem that comes from design management is timing. Timing of information and management of information is at the centre of successfully managing a Design & Build construction project given that the contractor is now managing both the design and construction processes instead of relying on the client's design team to manage the design process. This causes other problems as contractors usually employ their design managers who will be responsible for managing the design information flow from designers to the delivery teams. However, instead of resolving the problem of information flow this

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creates its own problems as more often than not grey areas and or overlaps will surface. Architects working on a building project more often than not take on the role of lead designers and this involves managing & coordinating the design with other design team members such as civil, structural, mechanical & electrical engineers. The Design & Build contractor, on the other hand, engages a design manager to manage the design information flow from the design team members to the operations teams of the Design & Build contractor. This arrangement, if not well thought out, will cause potential problems between the design coordination function, undertaken by the lead designer, and the design management function undertaken by the Design and Build contractor design manager. Ensuring that all design parties understands the project drivers is important.

**Interviewer:** What do you mean by project drivers?

**Interviewee:** In the Design & Build procurement process the D&B contractor is dealing with many parties and getting all parties to understand what the D&B contractor has been contracted to do and how he/she wants to get there in terms of both the design and construction is what the project drivers are all about. This would require the contractor to communicate effectively and ensure that all parties especially the designers understands the project requirements and translates these into a design that is not only buildable but satisfies the required specifications as well as the cost plan set at the start of the D&B contract.

**Interviewer:** It would then appear from this that this good practice is the one that should be taken moving forward in D&B procurement?

**Interviewee:** Certainly it is because a good starting point in D&B procurement is understanding & communicating the project drivers. If this doesn't happen what will then follow is a long list of problems resulting in dissatisfied clients, strained relationships with design team members and disputes. If the whole team understands the project drivers from day 1 then it's highly likely that problems will be highlighted and resolved jointly with all team members contributing to solutions in a positive way. The DB contractor should explain to the designer how he intends to build the job and when so that the designers can draft their design programmes and resourcing to meet the D&B contractor requirements. It is good practice to work back from the end date and ensure that the programme works and fits in with the requirements of the job.

**Interviewer:** What else can be taken as positives that helped to address challenges with this procurement method?

**Interviewer:** Good relationship with the design team will pay dividends in the end as they will be able to understand and collaborate with the DB contractor when there is a problem that requires their blessing. When everyone is involved in decision making a team atmosphere is created and gives people a forum to discuss project related issues before they become big problems that are costly and time consuming.

**Interviewer:** In practice how can this be achieved?

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**Interviewee:** Over the years we have found that using the early warning system as devised by the NEC form of contracts is a good way to flag up issues between and among the team and giving each team the opportunity to attend periodic early warning meetings to discuss and agree solutions to potential problems before they arise. Rewarding team members when they have done well is good to motivate the team to constantly strive to do well

**Interviewer:** How about your supply chain? How are they involved in all this?

**Interviewee:** Supply chain is involved as early as possible in order to get their input in the design process. At the enquiry stage the supply chain are requested to come up with economically advantageous design solutions for their work packages in order to tap into their innovation, experience and specialist knowledge. It is beneficial to request supply chain for alternative innovative design solutions so that the D&B contractor can capture innovation at the start of the process rather than wait until it's too late to accommodate the innovative idea. At the start of the process it's good practice for the D&B contractor to highlight sections of the work that may require further examination and request all parties to examine and see if there is anything that can be done to these sections or work packages in order to save on time, cost, health and safety, sustainability issues and such other matters.

**Interviewer:** What else do you want to share as positive ways to address the challenges of D&B procurement?

**Interviewee:** Early involvement of the D&B contractor with the client and other stakeholders is beneficial to the project and enables the D&B contractor to understand the required project and helps the D&B contractor to produce an efficient design. Where the client designers have undertaken early designs prior to the D&B contractor appointment it is beneficial to the project if the same designers are appointed, through novation, to develop the design through to construction as the designers have the benefit of understanding the project from the early stages. The D&B procurement method also requires the right people to manage it given the risk structure that it brings to the D&B contractor. The Client should also know what they want and communicate this to the D&B contractor who has skill sets that includes designing to requirements, constructing to the quality standards and managing the whole delivery process.

**Interviewer:** What are other practices that you have come across that have been used to address D&B challenges?

**Interviewee:** I would definitely suggest some sort of incentive mechanisms between the designer and the contractor as an option to encourage the designer and the contractor to integrate. This will promote them to work towards a common goal promoted by the incentive mechanism. In terms of employers' requirements I would recommend setting up a team of people with skill sets and experience in putting requirements together. The team must also include key stakeholders in order to get their buy in from the start of the project through to completion.

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**Interviewer:** Thank you so much for an informative and eye opening discussion on your experiences with the D&B procurement method. I am still in the process of collecting information from other respondents as part of my research. I hope you wouldn't mind me coming back to you should I need further clarification and confirmation of this discussion?

**Interviewee:** You are welcome. No problem if you need anything further please gives me a call.