A CONCEPTUAL FRAMEWORK FOR PROJECT'S TEMPORARY RELATIONSHIPS BETWEEN CONSTRUCTION ORGANISATIONS

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A thesis submitted in partial fulfilment of the requirements of Liverpool John Moores University for the degree of Master of Philosophy

January 2014

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ACKNOWLEDGEMENTS

I would like to express my profound thanks and appreciation to my supervisor, Dr Andy D. Ross for the immense help and encouragement given during this research. I am also grateful to Dr Raymond Abdulai and Professor Ahmed Al-Shamma'a for their support and advice that extended beyond the confines of the academic work. Additionally, I acknowledge the support of staff and postgraduate students at the School of the Built Environment at Liverpool John Moores University.

I am also grateful for the support of my family, who have provided continuous encouragement, patience and tolerance throughout the research programme.

LIST OF ABBREVIATIONS

Abbreviations	Definitions
AHP	Analytical Hierarchy Process
ANOVA	Analysis of Variance
CIOB	Chartered Institute of Building
CPI	Collaborative Performance Index
CBPP	Construction Best Practice Programme
CA	Conversation Analysis
BIS	Department for Business Innovations and Skills
BERR	Department for Business, Enterprise and Regulatory Reform
DA	Discourse Analysis
GLM	General Linear Model
GDP	Gross Domestic Product
GVA	Gross Value-added
IT	Information Technology
KMO	Kaiser-Meyer-Olkin
KPIs	Key performances Indicators

M&E	Mechanical and Electrical
MSA	Measures of Sampling Adequacy
NAO	National Audit Office
NEC	New Engineering Contract
ONS	Office for National Statistics
RBT	Resource-based theory
SMEs	Small and Medium Enterprises
SIC	Standard Industry Classification
SPSS	Statistical Package for Social Science
SFC	Strategic Forum for Construction
SCM	Supply Chain Management
TCE	Transaction cost economics
UCATT	Union of Construction, Allied Trades and Technicians
UK	United Kingdom

ABSTRACT

The importance of effective temporary multi-disciplinary organisational teams has been a central aim of management research in the construction industry for over 50 years. This study contributes to what is known about the formation of a construction project organisation by exploring more in-depth how buying organisations collaborative procurement strategies interact with a range of trade contractors and by identifying the factors that affect contractors' selection of strategy from supply chain organisations during project development.

The research methodology adopted a combined approach to data collection and analysis, and used a theoretical framework adapted from transaction economics and resource-based theory to identify and explicate factors influencing contractor's selection of collaborative integrative strategy. The research method for data collection in the dominant quantitative second stage used a postal survey of 107 professionals working for contracting organisations in the United Kingdom in February 2013. The resultant data set was analysed using descriptive statistics. A multi variable general linear model and principal component analysis defined the parameters of the conceptual framework.

The findings of this research suggested that buying organisations vary their procurement strategies to reflect supplying firms' asset specificities, resources provided and uncertainty associated project under consideration.

CHAPTER ONE: BACKGROUND TO THE SUTDY

1.0 Introduction

It is widely recognised that a project is successful when is completed on time, within budget, in accordance with specifications, and delivers value for money for clients and end-users (Davis and Love, 2011; Eriksson, 2010; Egemen and Mohamed, 2005). Unfortunately, due to a number of factors, construction project success and industry performance needs to improve (Meng, 2010; Karim *et al.,* 2006; Beach *et al.,* 2005; Miller *et al.,* 2002). In the United Kingdom (UK), the construction sector has been criticised for underperforming. Time and budget overruns are common and much efforts and resources are reinvested to correct defects. Poor productivity, decline in construction quality, rise in client dissatisfaction are problematic areas for the sector (Kadefors, 2011; Eriksson *et al.,* 2007; Egan, 1998; 2002). Root causes for these poor performances have over the years been attributed to the sector's features: fragmentation, the uniqueness of construction as a product, outdated procurement methods, and little or no integration between the actors (Eriksson *et al.,* 2007).

The UK construction industry has a long-standing reputation for being adversarial, demonstrated by poor relationships between members of project team, which in turn, presents numerous problems, including poor project performance and limited number of long-term relationships between project participants. Given the severity of the problems and the failing of the industry's approach towards integration of key project team members and processes, Sir John Egan's report (1998) challenged the industry to address its under-performance and the resulting poor image. In a follow up review, the industry's 'Strategic Forum' laid down challenging targets for improving its management practices within its 'Accelerating Change' report (Strategic Forum for Construction, 2002). As Wolstenholme (2009) confirmed, the

industry needs to address its poor performance on project delivery by focusing on integrated supply chains.

Consequently, the prospect of transferring good practice from manufacturing to the construction industry has been suggested in the literature (Errasti *et al.,* 2007; Akintoye *et al.,* 2000). For many manufacturing firms this was achieved by adopting supply chain relationship initiatives and other collaborative processes. Additionally, it has been claimed that the implementation of these initiatives might usefully be extended beyond the boundaries of organisations to include their suppliers (Christopher and Towill, 2001; Gunasekaran and Love, 1998). The construction industry therefore needs to improve its performance in terms of quality, cost and service (Wolstenholme, 2009).

In the UK, the importance of developing robust theories upon which best practice is based is recognised by the government, which has invested considerably in research into the performance of the construction industry to address the need for change to improve performance within the construction industry: the Latham report (1994) and the Egan report (1998). These reports suggest that the industry could achieve expected improvement through greater teamwork at site and organisational levels as well as with clients and suppliers (Akintoye and Main, 2007). As a consequence, increasing number of organisations have taken a critical look at their supply chain relationship to garner the improvements required, raising the use of collaborative arrangements such as long-term/strategic arrangements, partnering, joint venture, supplier partnerships, prime contracting and supply chain management as well as other inter-firm cooperation in order to improve the construction development process.

The concept of collaboration encapsulates a variety of practices intended to facilitate greater inter-firms cooperation amongst those involved to increase the whole supply chain network performance (Goulding *et al.,* 2012; Barlow *et al.,* 1997). In the construction sector, it may be short-term and project-orientated or long-term and strategic in nature (Goulding, 2012; Beach *et al.,* 2005; Barlow and Jashapara, 1998). In the case of the later, it is usually concerned with optimising the relationship's resources through closer collaboration to exploit long-term benefits, whereas the former focus more on agreeing project governance issues to secure immediate project benefits rather than on developing long-term cooperative practices (Errasti *et al.,* 2007; Beach *et al.,* 2005). Collaborative sourcing is often perceived as the best approach to achieving supply chain improvement through the development of more effective customer-supplier relationship (Humphrey *et al.,* 2003).

Unfortunately, whilst there is sufficient evidence to suggest that the collaborative relationships in construction developments have been increasing of recent years, it has been reported that not all the collaborative relationships in construction developments are successful (Ng *et al.,* 2009; Miller *et al.,* 2002; Dainty *et al.,* 2001). Its acceptance amongst the main contractors, subcontractors and their suppliers in the UK construction industry is still not thought to be universal (Mason, 2007; Beach *et al.,* 2005). On the other hand, the industry is affected by macro-economic, organisational and technological forces that serve to bring about change to its structure, practices and products. The external environment is a key factor in the contingent organisation of projects (Hartmann and Caerteling, 2010; Moore, 2002) and has changed dramatically over the last few decades particularly with the increase in work outsourced or subcontracted. Moreover, collaboration requires that firms undertake a range of transactions with other organisations that are informed by the context of their market

sector, the product or service they produce or provide, the resources used, and their procurement processes.

However, the current collaborative procurement initiatives used in the delivery of construction projects fall short emphasising on skills, knowledge and technical competencies for a specific project needs, at a specific point in time, for specific purposes, and by a specified party (Chow *et al.*, 2008; Chandra and Kumar, 2000). According to Bidgoli (2010), modern Supply Chain Management (SCM) concept should incorporates strategic differentiation in order to achieve value enhancement, operational efficiency improvement, and cost reduction. Indeed, the application of supply chain initiatives has been criticised for being generic and without due consideration for different subcontract trades (Ross, 2011), and a need to change traditional thinking across the whole supply chain (Goulding *et al.*, 2012). It is also acknowledged that the level of uncertainty associated with different procurement strategies varies greatly (Dow *et al.*, 2009). Similarly, different subcontract trades have specific attributes and asset specificity[1][1] (Ekstrom *et al.*, 2003). Consequently, it is argued that the procurement strategy used during project development will vary significantly over a range of subcontract trades (Ross, 2011). Thus, there is a call for more in-depth knowledge on how contractors' collaborative procurement strategy interacts with different specialist trade contractors in their supply chain (Ross, 2011; Bidgoli, 2010). In light of the above, the research questions that arise are:

(a) Do buying organisations incorporate strategic differentiation in the collaborative procurement strategy when interacting with a range of subcontract trades within the supply chain networks?

[1] Asset specificity - the ability of suppliers to hold up the programme and disrupt production. (The strength of this asset specificity will relate to the subcontractor influence/power, which must relate to their technology, who employs them and the governance mechanisms, which exist)

(b) Do buying organisations differ in collaborative procurement strategy to reflect on the intrinsic complexity and asset specificity specialist trade contractors?

(c) What factors influence the collaborative procurement strategies used during project development?

1.1 Research aim and objectives

Based on the research questions above, the aim of this thesis is to explore how buying organisations' collaborative procurement strategies interact with a range of trade contractors within the chain networks during project developments.

The realisation of the aim requires the pursuit of the following objectives: (i) to explore buying companies' collaborative procurement strategies during project development with different trade contractors (ii) to examine whether any differences in buying companies collaborative procurement strategy are as a result of different attributes and asset specificity of subcontract trades; (iii) to explore the factors that influence the collaborative procurement of strategy over a range of subcontract trades; and (iv) to develop a framework.

Before examining literature concerning collaborative relations and SCM as well as the specific theoretical areas that are related to this aim, a brief introduction to the general field of study is useful in providing a context to the study of construction organisations and their transactions with supply organisations. The rest of this chapter provides a background to the UK construction industry, the collaborative initiatives and procurement approaches used, the transactional foundation, the role of resource in organising construction activities.

1.2 The Construction Sector

In many countries, the construction industry contributes significantly to their Gross Domestic Product (GDP) and remains one of the most people-reliant industrial sectors (Lowe, 2011; Dainty *et al.,* 2007). For instance, the sector employs almost two million people in the UK and contributes more than 6 per cent of total GDP (Office for National Statistics (ONS), 2013). The main clients of the industry are the private and the public sectors - with substantial public sector investment supporting activity within the commercial and house building sectors. However, the structure of the construction sector is diverse and complex (Lowe, 2011). As a result, it is argued that given its vast size and complexity, the construction industry is not easy to define and there is little agreement as to its size and scope (Dainty *et al.,* 2007).

The construction sector is distinguished from other industries by its finished products which are generally assembled on sites that are geographically some distance from both the construction management and supply organisations. It is also an industry characterised by fluctuations in demand (Jones and Saad, 2003), which also gives it a unique nature. Organisations that carry out the work are dispersed and segmented into their markets that are classified into various sectors as building, infrastructure, repairs and maintenance, and materials manufacture (ONS, 2013; 2012). It has been established that these markets are characterised by the size and type of project, the complexity of the work undertaken, and the geographical location of the project (McCloughan, 2004; Langford and Male, 2001). The entry and exit barriers associated with these markets come in various forms, which is determined by various factors including; asset-specificity of the firm (Eriksson, 2006; Ekström *et al.,* 2003; Williamson, 1981), capital funding that is required to compete and other influencing factors such as size, geographical location, and client demand (Ng *et al.,* 2009;

Chiang, 2009; Beach *et al.*, 2005). Historically, the use of contractual arrangements has been the main way of procuring organisations to provide the necessary resources to meet clients' requirements. These arrangements are structured to incorporate performance, organisational, project and market factors. Collaborative relationships have been recognised as a key means of effecting performance improvement in the industry and have been a focus of various studies and reports (Wolstenholme, 2009; Ochieng and Price, 2009; Smith and Offodile, 2008; Akintoye and Main, 2007; Egan, 1998; 2002).

1.3 Collaborative Relationships and Strategies

The two influential government sponsored reports: Latham (1994) and Egan (1998) stressed the inefficiency of the construction industry and recommended that the construction industry needs to reflect the best practices of the manufacturing sector to provide a satisfactory product and meet client needs. Accordingly, they advocated the use of collaborative relationships for construction development. However, despite the industry reports highlighting these inefficiencies the construction industry still has the tendency to rely mostly upon traditional procurement strategies to obtain new building (Naoum, 2003). Akintoye and Main, (2007) and Black *et al.* (2000) however, observed that there have been significant changes in the development of these approaches over recent years and the adoption of collaborative relationship procurement strategies has been increasingly embraced by industry players since the publication of the Latham and Egan reports. The drivers for these changes are varied and identified to include: the transfer of risk; the need for compliance with public sector initiatives identified as Egan compliance; integration of the design and construction activities; and improvement of information flow (Ross and Goulding, 2007).

The use of collaborative working relationships to deliver construction projects is largely explored in the construction literature (Baiden and Price, 2011; Ochieng and Price, 2009; Akintoye and Main, 2007; Beach *et al.,* 2005; Humphrey et al., 2003; Naoum, 2003; Saad *et al.,* 2002). One of the dominant challenges to the development of the concept of collaborative procurement is the number and diversity of small and medium size organisations involved in construction projects. It has been generally acknowledged that supply chains can exist in many different forms and can vary significantly in their complexity and diversity (Briscoe and Dainty, 2005; Cox, 2004). As observed by Briscoe and Dainty (2005), most main contracting organisations operate "flexible firms" a practice involving extensive subcontracting and an almost exclusive emphasis on management and coordinating roles.

Conversely, the importance of these subcontracting organisations to the construction industry has been long acknowledged. For instance, Ng *et al*. (2009; p. 737) suggested that; "*The performance of the subcontractor is now critical to project success....* ". The importance of the subcontract sector was later echoed by "Constructing the Team" report prepared by Sir Michael Latham (1994) who recommended that *"arrangements (between main contractors and subcontractors) should be the principal objective of improving performance and reducing costs for clients."* The need to improve SCM practices throughout the chain network to include subcontractors was also reinforced by Sir John Egan's report which suggested that partnering throughout the supply chain is crucial to the industry and could result in innovation and sustained incremental increases in performance. In a follow up review, the 'Strategic Forum' laid down challenging targets for improving its management practices with this sector in its 'Accelerating Change' report (Strategic Forum for Construction, 2002). The Government 2025 report, Cabinet Office (2011) and Wolstenholme (2009) recommended full

collaboration at this level by promoting long-term collaborative working relationship and earlier involvement on projects of specialist subcontractors and suppliers.

The reasons for the rise in subcontracting in the construction sector are cited to include: a means by which contractors can manage a volatile workload and buffer to surviving the volatility of construction business cycle (Dainty *et al.,* 2001), resource utilisation and flexibility (Tam *et al*., 2011), the evolvement of contractors into market traders (Ross and Goulding, 2007), the increased technical specialisation and complexity of the construction process (Errasti *et al.,* 2007), the reduction in the ability of professional firm to complete designs (Ross, 2011), and releasing contractors from providing employment driven contractual obligations (Ofori, 1998). The consequent increased dependency on subcontractors has led to increased complexity of construction processes; inter organisational relationships and multiple systems for economic governance.

The adoption of collaborative working relationships to deliver goods and service has been reported by Douma *et al.* (2000) who examined collaborative relations from a strategic alliances point of view and noted that due to the ever-increasing pace of technological developments and access to new technologies, alliances have become a key success factor in many industries. Furthermore, they established that the principal objective for collaborative arrangements has now shifted from "traditional" cost driven alliances to knowledge-intensive alliances, where inter-partner learning is a concern. The normative development guides for the evolution of partnership arrangements are reported by Humphreys *et al.* (2003) and include the internal alignment identification of potential partners, screen and selection of the partners, the establishment of relationships and the evaluation of these relationships.

Brouthers *et al.* (1995) in their research "choose your partner" suggested four conditions under which collaborative arrangements should be utilised. These include: complementary skills by the potential partners; cooperative cultures exist between the firms; compatible goals exist between the firms; and commensurate levels of risk are involved. According to Medcof (1997), the success of collaborative relationship with strategic suppliers depends on:

(1) Capability – the potential partners ability to carry out their responsibilities;
(2) Compatibility – partners' operationally compatible;
(3) Commitment – partners are committed to the common goals of the relationship; and
(4) Control – the control mechanisms for the coordination of activities are suitable.

Crouse (1991) offered the following as potentials of a balanced collaborative relationship: offer the ability to leverage internal investments; emphasis on core competencies; leverage core competencies of other firms; reduce capital needs and broaden products offerings; gain access or faster entry to new markets; share scarce resources; spread risk and opportunity; improve quality and productivity; having access to alternative technologies; provide competition to in-house developers; use a larger talent pool and satisfy the customer. On the other hand, Douma *et al*. (2000) asserted that the need to cooperate is determined by pressure on continuity, market opportunities, time pressure or the number of alternative options.

Anglinger and Jenk (2004) came up with different forms of collaborative relations:

(1) Invasive where the partners share a significant amount of technology, personnel and strategy and derive value from a true combination of perspectives and resources, often accompanied by co-location

(2) Multi-function which involves multiple spots on the value chain and brings together development and market with the view to maintaining or building thrust for commercialisation.

(3) Multi-project which comprises existence of multiple arrangements within a single company to reduce the costs of transaction providing parties a first look at each other's products or right of first refusal.

(4) Coopetition which involves cooperating with competitors with the benefit of sharing development costs, in addition to access to expertise and reduce transaction costs.

(5) Networks which represent a multiple partners grouped in a single alliance to access diverse technologies and skills, share costs, build market momentum and bundle related products into a full customer solution.

Many academic researchers uncover the lack of theoretical and empirical research (Bankvall *et al.*, 2010; Sanderson and Cox, 2008; Eriksson *et al.*, 2007; Khalfan, and McDermott, 2006; Briscoe and Dainty, 2005; Cox and Ireland, 2002; Khalfan *et al.*, 2001; Dainty *et al*, 2001; Greenwood, 2001) within the construction literature that considers the structural, economic and organisational nature of the industry's supply chains involving different subcontract trades and suggest the need to develop a better appreciation of the role of different subcontractors in supply chains in construction.

Vidalakis *et al*. (2011) contend that suppliers and subcontractors role in construction supply chain has been effectively overlooked. Therefore, there is a growing need to integrate all members of the supply chain in order to unlock the innovation that is presently kept isolated by current procurement and management practices (Cox *et al.*, 2007; Briscoe *et al.*, 2001). Furthermore, there is the need to investigate the communication between supply chain

organisations, which seeks to develop a theoretical basis for better economic relations between these organisations.

1.4 Construction and Collaborative Strategies

The adoption of collaboration to deliver construction project involves different parties in the construction industry. This could involve collaboration between a contractor and a client, subcontractor, supplier or consultant involving partnering, project or long term strategic relations. Removing barriers that hinder collaborative working relationship is believed to create opportunities for knowledge integration, learning and performance improvement (Nadim and Goulding, 2010). A fundamental goal in these models is therefore to develop more collaborative relationships between the numerous specialist firms that participate in a construction development. However, a key problem still remains at the core of the collaborative supply chain initiatives, which is the specificity (the ability to replace the supplying organisation) of actors, the need to consider transfer of skills, knowledge and technical competencies between organisations, and the need for differentiation in subcontractor procurement. The traditional view of cooperation into most contractual arrangements is that construction projects are organised to support the administration and coordination of construction activity instead of the process itself.

Fawcett *et al.* (2008) argued that collaborative strategies should move to a better reflection of the technical skills of individuals involved. The current procurement initiative used in the delivery of construction projects fall short emphasising on skills, abilities and technical competencies for a specific project needs, at a specific point in time, for specific purposes, and by a specified party (Chow *et al.*, 2008; Chandra and Kumar, 2000). According to Bidgoli (2010), modern SCM concept should incorporates strategic differentiation in order to

achieve value enhancement, operational efficiency improvement, and cost reduction. The past decades have witnessed numerous reports and recommendations for changes to the way construction processes are organised, coordinated and managed (Kadefors, 2011). All these reports acknowledged that capacity exists between parties and that improvement to establish more effective supply chain integration and collaborative arrangements. It has also been suggested that firms face resource gaps in terms of financial, skills, knowledge and technology (Hashim, 2007); hence, they tend to depend on suppliers capabilities and co-operative relationships (Mudambi *et al.*, 2004; Park and Krishnan, 2001) to access the latest technologies, materials, process and other methods of innovations (Koh *et al.*, 2007). The above findings echoed Lipparini and Sobrero's (1994) findings, who reported that organisations often depend on the supplier relationship as a vital ingredient to connect internal and external capabilities and expertise, as well as improve their innovation. Companies develop strong subcontractors and suppliers relationships to facilitate increase the stability of supply and reduce supply shortage risk (Ellegaard, 2006). By maintaining close relationships with some key subcontractors and suppliers, companies are more in position to satisfy client requirements when the demand is high (Fawcett *et al.*, 2008).

This thesis considers the main contractors' procurement strategies given that they have central role in collaborative relationship upstream with clients and clients' representatives and downstream with suppliers and subcontractors (Akintoye and Main, 2007). One of the main barriers that hinders collaborative working relationship between the main contractors and their subcontractors is the lack of strategy that takes into account different complement skills and competencies, technology, knowledge and competition (Ross and Goulding, 2007). Consequently, Ross (2011) argued that until supply chain collaborative strategies place strong emphasis on skills and technologies related to construction project development and develop

more ‘tailored’ approaches to different specialist trade contractors the benefits of integrated supply chain through collaborative relationships will remain an aspiration for contractors.

Empirical work exploring contracting organisations’ strategies with prospective working partners who provide skills and technology and other resources within their supply chain during the relationship development stage requires more attention. An organisation's approach to its supply chain and how procurement and supply chain technology influences strategy development behaviour should assist with a theoretical understanding of the possible factors that affect contractors’ supply chain collaborative strategies. This understanding may help also appreciate the antecedent processes towards the formation of temporary multi-disciplinary project teams. The area of institutional economics provides a theoretical foundation for organisational economic behaviour and includes transaction economics. This requires explanation in order to elaborate the theoretical framework for this study. The key conceptual difference when studying an organisation using a transactional framework is to consider it not in neoclassical terms as a unit of production rather in organisational terms as a series of governance structures. This is considered as being appropriate given the greater reliance on subcontractors. An examination into the processes used by construction companies will help consequently develop a better understanding of the governance structures that are adopted and the types of relationships that exist between these organisations.

1.5 Transactional Framework

Research suggested that despite many efforts to develop a better understanding of procurement systems, they lack an economic foundation (Ross, 2011; Eriksson and Laan, 2007; Arditi and Chotibhongs, 2005; Ngowi and Pienaar, 2005; Kale and Arditi, 2001) and

that a transaction economic approach may assist in the understanding of the causal relationships that exist between contracting parties (Chiang, 2009; Winch, 2001). Coase (1937) pioneered the theory of transaction cost economics (TCE) and suggested that the allocation of resources in market economies is not only based on market prices but also through entrepreneurial decision making unrelated to prices. As revealed by Williamson (1985), the end product of efficient governance of transactions is to serve competitive advantage, which requires tailoring procurement procedures to transaction characteristics (Eriksson, 2006). It has been observed that long term contract with agreed limits, rather than, a series of contracts could reduce the costs of discovering the relative prices of contract agreements (Kale and Arditi, 2001).This reduction in the contract agreements costs leads to the efficiency of the firm. The term "marketing costs" (price mechanism related costs) used by Coase (1937) used to mean the costs of discovering the relative prices of suppliers and agreeing separate contracts with each supplier. Dietrich (1994) contended that there is possibility for contracting costs reduction if a factor of production (a contractor) did not have to place a series of contracts each time with other factors of production but in fact replaced them with one long term contract with agreed limits. This reduction in the use of the spot markets results in lower cost of contracting and increased the efficiency of the firm.

The TCE has further been developed to explain human and environmental factors costs. These have been identified as bounded rationality (limits to the acquisition and processing of information), opportunism (self-interest seeking with guile) and asset specificity (the investment on specific assets by agents that lock them in to agreements). Williamson (1981) introduced a new term to replace marketing costs and defined it as transaction costs. According to Williamson (1981), the attributes of a transaction determine what constitute the efficient market, hierarchy or relationship. The key properties that affect the transaction

include: bounded rationality, opportunism, small numbers bargaining, and information impactedness. Williamson (1985) argued that these are considered to be transaction difficulties and associated with cost increase when transactions are characterised by: asset specificity, uncertainty, and frequency. Moreover, Williamson (1981) affirmed that the hierarchy (firm) could reduce problems through a reduction in the number of exchanges, which increased frequency resulting in learning. Also, it is suggested that the use of authority as a means of ending prolonged disputes to economise transaction costs (Williamson, 1981). This area is developed within the context of construction in chapter three.

1.6 Transactions and Procurement Strategies

Khalfan and Maqsood (2012) grouped procurement into upstream and procurement downstream procurement strategies. These strategies allocate risks, assign roles and responsibilities and identify processes that are required to develop projects. The processes incorporated by different procurement approaches have been considered to suggest a range of responses by contractors (Smyth, 2005). For each procurement approach there are differing strategies when dealing with risk allocation and uncertainty. Where there is a higher level of product uncertainty at the beginning of a project development would require contractors to develop closer economic bonds with their subcontractors during the early stage in order to bilaterally develop a proposal that recovers the committed cost of tendering. Consequently, Ross (2005) suggested that the specificity of the subcontractor would be higher than if there were low requirements for product development which would imply that subcontractor specificity would be lower.

The asset of transaction is thus suggested as being affected by the procurement route, where a subcontractor is carrying out a design, in order to ensure that the asset is not appropriated by

the main contractor and used to replace the subcontractor at a later stage it is suggested that there may be a limit in the information that is exchanged (Ross, 2005). The use of resources in the form of financial, technology, knowledge and skills for governance ex post may also affect the extent of ex ante relationship exchanged (Ross and Jaggar, 2005).

The specificity of a contractor to a client may differ from that of a subcontractor to a contractor, in that once agreement has been reached, it is generally more expensive to replace a contractor (Ross, 2005). The focus of this thesis is the transactions between the main contractor and the subcontractor. The contractual relationships between contractor and subcontractor are more complex in that contracts are generally not placed until after the main contract with the client has been signed. The resulting contractual status of the selected subcontract quotation is therefore uncertain. Swan *et al.* (2002) asserted that this led to power differentials between the parties which are absent of client-contractor transactions. Additionally, Ross and Jaggar (2005) submitted that the specificity of a subcontractor relates also to the complexity of project, the level of subcontract technology and the relationship that exists with the main contractor. Subcontractors are of various type and offer different resources in the form of skills, technologies, knowledge and competencies. Therefore, by resource-based theory (RBT) is employed to inform the aspect of resources provided by various trade contractors.

1.7 Resources and Procurement Strategies

Penrose (1959) proposed that the firm organises the use of its own resources together with other resources acquired from outside the firm for the production of goods and services at a profit, and assumes that firms try to increase total long-run profits and want to expand whenever profitable opportunities exist. One immediate opportunity of such is to put

resources into use. According to Barney (1991), a resource with the potential to create competitive advantage must meet a number of criteria. Resources can be assets, capabilities, and organisational processes that enable a firm to conceive of and implement strategies to improve its efficiency and effectiveness (Watjatrakul, 2005). RBT suggests competencies represent a bundle of tangible and intangible assets and resources that work together to create competitive capabilities. Resources and capabilities are considered other criteria if they offer a firm the chance to exploit its business environment by balancing opportunities with threats (for example, uncertainty and opportunism) (Watjatrakul, 2005).

1.8 Construction Project Development and Resource Organisation

The development of a construction project team requires professionals to assemble and coordinate supporting units with the aim of creating the desired end product safely and profitably (Cox and Ireland, 2002).The coordinating structure has to take account the technology of the project, the clients' procurement arrangements, the internal environment (resources) of the contractor and the supply organisations involved in the project (Chow *et al.,* 2008; Hashim, 2007; Koh *et al.,* 2007; Ellegaard, 2006). Organising economic activity involves costs minimisation and strategies to access external resources in order to maximise long run profit. Conversely, subcontracting decisions are affected by governance mechanisms, the bounded rationality of the contractor, the content of transactional information, and contractor's general management costs. In addition, the specificity of the subcontractor, the extent of risk due to lack of control of misalignment could also be suggested influential factors during working relationship development.

TCE views firms as institutions for organising economic activity and that subcontracting decision centres on costs minimisation. On the other hand, RBT considers firms outsourcing

decisions as strategies employed to access external resources in order to maximise long term profit. In other words, TCE assumes that key motivation for working exchange or subcontracting is to economise transaction cost and the inherent source of threat is the opportunistic behaviour of exchange parties; whilst RBT focuses primarily on the long term profit maximisation and production skills with the inherent source of threat being the imitation of resources by parties involved.

Apart from evaluating supplier performance, the contractor has to analyse market versus hierarchical mechanisms and decide on strategies available to the organisation when subcontracting is considered the optimal option (Parker and Hartley, 2003). The effects of production skills, knowledge, technology, and level of competition may therefore be considered when developing collaborative procurement and supply chain relations. Ross (2005) examined the institutional economic theory and its application to construction and noted how specificity of different specialist trade contractors could be used for the control and integration of organisations and its importance for developing a robust theory for inter-firms relations.

A number of previous studies have examined contractors and their supply chains (Hartmann and Caerteling, 2010; Ng *et al.,* 2009; Errasti *et al.,* 2007; Mason, 2007; Beach *et al*., 2005; Briscoe and Dainty, 2005; Thorpe *et al.,* 2003; Dainty *et al.,* 2001; Greenwood, 2001). Nonetheless, no recent empirical studies seem to have considered how buying organisations' collaborative procurement strategies interact over a range of subcontract trades.

1.9 Structure of the Thesis

The research proposition of this thesis is that buying organisations adopt different collaborative procurement strategies when interacting with range of specialist trade

contractors during construction projects development. The aim is to examine how these strategies interact with a range of trade contractors during project development and to identify the influencing factors that affect the formation of the temporary multi organisational structure in a construction context. It limits its focus to main contracting organisations relationships with their subcontractors. To achieve this aim, contractors' strategies to developing collaborative relationships within their supply chains are examined. The specificity of the organisations that provide specialist skills and resources are considered by collecting data about the governance approaches that contractors use to secure their services during project development.

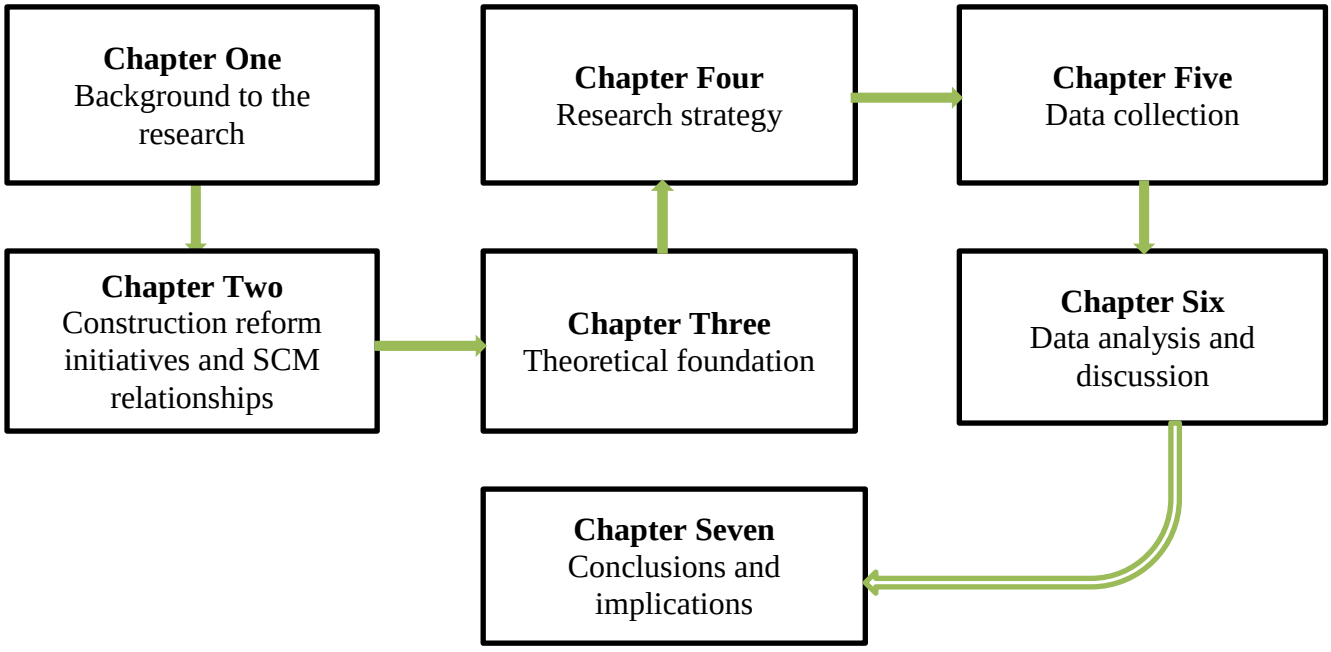


Figure 1.1 The structure of the thesis

The need for more integrated inclusive approaches to the supply chain has been acknowledged as being essential by many researchers in order for the construction industry to improve its performance. It has also been recognised by the industry that the development of procurement approaches that reflect and facilitate better communication between supply chain partners is crucial if the innovation and knowledge held by the supply chain is to be

used effectively. Procurement systems that lead to improved intra organisational knowledge flows are also vital for the industry to develop however for this to happen they need to encourage a more transparent approach to relationship governance. To this end, a framework of the factors that influence contractors' collaborative procurement strategies is developed. It contributes to the construction procurement arrangements, to inform the areas for improvement.

The approach taken for this work is presented in Figure 1.1. The introduction and context of the study is discussed and the research questions are stated in Chapter One, whilst review of construction industry reform initiatives and collaborative procurement relationships presented in Chapter Two. The theoretical foundations for the research are presented in Chapter Three. Drawing upon the research in construction procurement, transaction economics and resource-based theories; the concepts of organisational relationships are defined, and the strategies and forms relationships explored. Previous studies examining the construction relationship development processes, resource exchange and transaction economics applied to construction are reviewed and evaluated to form the theoretical framework of the study.

The philosophical justification for the research stance is presented in Chapter Four, which draws from researchers work on the epistemology of research methods. This is then followed by the development of a research methodology. The chapter concludes by identifying that a mixed methodological approach is suitable for this study.

Chapter Five considers the design of a measuring instrument to collect data on operationalised constructs, and identifies an approach to the administration of the questionnaire to the population sample. This chapter concludes by describing an approach to the analysis of the quantitative data using bivariate and multivariate analysis techniques. A

principal component analysis is used on the data set to identify factors that are categorised, and that can be used to explain organisations collaborative relationship strategies during projects development.

Chapter Six reports the descriptive statistical analysis of the data set, and identifies significant differences that can be drawn from the analysis. A general linear model identifies the effect that the independent variables have upon dependent variables. It concludes by employing a principal component analysis technique to identify the structure and dimensions of factors that affect buying organisations' procurement strategies for a project development. The research findings and contribution of the study are discussed in Chapter Seven, which also considers the limitations of the study as well as suggestions of an agenda for future research.

CHAPTER TWO: THE CONSTRUCTION INDUSTRY REFORM INITIATIVES, SUPPLY CHAIN AND COLLABORATIVE RELATIONSHIPS

2.0 Introduction

The aim of this study is to explore how buying organisations develop collaborative procurement strategies within the supply chain network and to determine the factors influencing these strategies in developing construction projects, which consider firms supply chain response over a range of specialist trade contractors. The factors that affect organisations response are believed to have come, in part, from the procurement approaches, subcontract types and market conditions. These affect the strategies that construction buying organisations adopt to manage supply chain relationships. This chapter explores the UK construction industry official policy initiatives, the development of collaborative practices, and the concept of supply chain management by examining published research and industry-wide studies

2.1 The UK Construction Industry

Construction industry has a wide significance to the UK economy (Her Majesty (HM) Government, (2013). It enables businesses to flourish by creating, building, and maintaining workplaces. According to HM Government (2013), the sector contributes £90 billion annually to the UK economy representing nearly 7% of the national gross domestic product (GDP). It also accounts for nearly 3 million jobs representing 10% of total UK employment (Cabinet Office, 2011). As reported by the Department for Business, Enterprise and Regulatory Reform (BERR) (2008), it generates about £10 billion of exports each year of

which design sub-sector alone accounts more than £3.8 billion of export income per annum. The statistics above emphasised the importance of the construction industry to the economy of UK.

2.2 The Structure of the Construction Industry

The construction sector is defined to include variety of activities, covering the whole construction supply chain (BERR, 2008). It is a diverse industry and its markets broad and varied (HM Government, (2013). It comprises mining, quarrying, production and sale of materials and products (BERR, 2009). It also includes construction contracting - house-building, roads, houses, offices, factories, large-scale civil engineering, or repair and maintenance (Pearce, 2003). A wide range of professional services, including architectural, civil, structural, mechanical and electrical design, and project management are linked to construction, as well as allied services such as finance, information technology (IT) and insurance.

The construction industry is highly disjointed, when compared with other domestic sectors as well as international standards. The supply chain can be hugely complex (HM Government, 2013). According to BERR (2007), the sectors has over 270,000 active enterprises and more than 90% of the 186,000 companies in construction contracting employ fewer than 10 workers, and nearly 72,000 businesses presenting almost 40 per cent operate as one-man business. Conversely, the statistics revealed that less than 130 companies employ a workforce of 600 or more, while generating about a quarter of sector's output by value. Firms in the industry range from large world renowned design companies, to the small sole traders (HM Government, 2013). Consequently, share of the market for firms within the sector is small, even the large companies.

2.2.1 The Industry Clients

The main clients of the construction industry are the public and private sectors. The public sector is the most single largest customer to the sector accounting for almost 40 per cent of the total output whilst the remaining 60 per cent is provided by the private sector (Department for Business Innovations and Skills (BIS), 2011).

Table 2.1 Construction Output in UK in 2011 and 2012

Category		**2011**		**2012**	
		£ million	**%**	**£ million**	**%**
New housing	Public	448.5	8.8	443.4	8.9
	Private	557.9	11.0	469.0	9.4
Infrastructure		449.3	8.9	468.4	9.4
Other new work	Public	430.7	8.5	340.6	6.9
	Private Industrial	394.9	7.8	414.6	8.3
	Private Commercial	404.1	8.0	403.6	8.1
Housing repair and maintenance	Public	489.0	9.6	487.7	9.8
	Private	543.4	10.7	566.5	11.4
Other repair and maintenance	Public	453.1	8.9	457.2	9.2
	Private	453.2	8.9	457.2	9.2
Infrastructure repair and maintenance		453.1	8.9	457.2	9.2
Total		**5077.2**	**100**	**4965.4**	**100**

Source: ONS, 2013

The literature suggests that the public sector client base consists of central government departments, agencies, local governments and other bodies funded either entirely by government or in receipt of capital grants. The government and its agencies or departments therefore have significant influence on the construction industry as sponsors, regulators and procurers as demonstrated in Table 2.1. It provides a breakdown of output by contractors in UK, including estimates of unrecorded output by small firms and self-employed workers, excluding the construction products and professional services parts of the industry.

The statistics in Table 2.1 above emphasises the importance of the public sector as a client to the industry. It shows that the public sector was client to about 36% in 2011 and 35% in 2012 of construction output, making it the single largest customer to the industry. Repair and maintenance contributes the largest share of output in both 2011 and 2012, at 38 and 40% respectively, followed by 'other new work' just over (24% in 2011 and 23% in 2012), new housing (20% in 2011and 18% in 2012) and infrastructure (18% in 2011 and 19% 2012).

2.2.2 The Structure of the Workforce

The industry employs approximately 3 million people, including professionals and operatives (Construction 2025, 2013; Fellows *et al.*, 2004). BERR (2007) estimated that close to 600,000 of the sector's 3 million workers operate in the informal economy. The majority are employed by organisations that employ less than 24 people, and firms classifying themselves as specialist trades, employ approximately 60% of the overall workforce and are considered an important sector for improvement.

The structure of the industry and the makeup of its workforce affect the way it operates. Eriksson *et al.* (2007) revealed that there is relatively little vertical integration in the supply chain therefore making subcontracting a major element of the industry. Ng *et al*. (2009) observed that main contractors bid for work and subcontract the delivery of much of the work. It is noted that close to 85% of the value of the industry's output is delivered by a supply chain, involving specialist contractors, suppliers and manufacturers (Business and Enterprise Select Committee, 2008). Yet despite the fact that the supply chain is an essential determining factor of the success of a project, it often has comparatively little influence over decisions involving procurement, design and costing, which are usually placed in the hands of the main contracting organisation.

2.3 The UK Construction Performance

It has been observed that the construction industry has the ability to deliver multi-million and innovative projects and at its best, the industry is outstanding (Egan, 1998). However, the continuous use of traditional working approaches considerably hinders innovation and reduces performance to sub-standards (Eriksson *et al.,* 2007). The industry poor performance is highlighted by NAO review on projects undertaken by government departments and agencies. According to NAO (2001) government projects are awarded based on lowest price bid which often results in budget overrun and late completion. The Business and Enterprise Select Committee (2008) report also pointed out that the inefficiencies in the traditional methods of procurement and construction management resulted in poor performance of the industry. The government's long-term vision for the construction industry -'Construction 2025,' (2013) further highlighted key features of the sector affecting its performance as low supply chain integration, low level of innovation, lack of collaboration and limited knowledge sharing, and high construction costs

2.4 Past Construction Industry Reforms Initiatives

The government in the Post-War II period has encouraged the construction industry to improve its performance through influential reports, which have sought to shape not only the performance but also attitudes of parties to the construction industry. Table 2.2 presents some of the past influential reports before the publication of Latham's report in 1994. With the exception of Tavistock reports, it can be seen from Table 2.2 that the drivers of the most of the reports have been driven by two groups of clients: public and private seeking to improve the industry performance to meet their needs. The earlier reports (1944 – 1980) were

dominated by the public clients whilst the private clients were more influential in later ones.

The above reports highlighted the sub-optional performance of the construction sector.

Table 2.2 Past Construction Industry Reports (1944 -1980)

Report	Year	Title	Driver
Simon	1944	Placing and Management of Building contracts	Reduce bureaucracy and competition in tendering for public contracts
Philips	1950	The Working Party Report to the Minster of Work	Improve performance through effective management of construction process and increase in labour productivity
Emmerson	1962	Survey of Problems before the Construction Industry	Reduce inadequate design information and competitive tendering. Continuous stream of work for contractors
Banwell	1964	The Placing and Management of Contracts for Building and Civil Engineering Works	Effective regulation of award of contracts and public contract negotiation
Tavistock	1965	Tavistock Studies into Building Industry: Communications in the Building Industry	Understanding organisation
Tavistock	1966	Independence and Uncertainty	Improvement in organisation of projects and the industry and coordination of control
Large Industrial Sites	1970	Large Industrial Sites	Better control of projects by clients and improved industrial relations
Wood	1975	The Public Client and the Construction Industries	Contractors seek more negotiated work and final Contracts
Faster Building for Industry: NEDO	1983	Faster Building for Industry: NEDO	Clients seek faster construction times for industrial properties
Faster Building for Commerce: NEDO	1988	Faster Building for Commerce: NEDO	Reduction in construction times for commercial properties

Source: Langford and Murray (2003)

The key themes of these reports can be summarised as disintegration of construction process, inefficient procurement and processes, unhealthy competition, lack of public insight of the industry, and lack of drive for continuous improvement.

2.5 Recent Construction Industry Reforms

More recently, there have been various drives to improve practices across the sector at the start of the 1990s as indicated in Table 2.3. The first independent review among these reports and initiatives of construction was the publication of Sir Michael Latham's influential *Constructing the Team* report in 1994.

Table 2.3 Some recent key reports and initiatives in construction (1984 - 2009)

Report	Year	Title	Key objectives/recommendations
Latham	1994	Constructing the Team	Industry's traditional methods of procurement and contract management and its adversarial culture caused inefficiency and ineffectiveness. Procurement and relations should be improved for potential for saving of 30 per cent over 5 years.
Levene	1996	Levene Efficiency Scrutiny	Government bodies were partly to blame for the poor performance of the industry. The structure and management of construction projects as well as the skill level of government clients must be improved.
Egan	1998	Rethinking Construction	Improvement in the efficiency and quality of delivery of construction, reinforcement of the impetus for change and to make industry more responsive to customer needs.
National Audit Office (NAO)	2001	Modernising Construction	The need for more coordination between improvement initiatives, demonstration projects and performance indicators to improve procurement and management construction projects.
Strategic Forum for Construction	2002	Accelerating Change	Set out targets to achieve integrated team and supply chains through relationship continuity to unlock the potentials of long-term benefits of integrated construction project team.

Some recent key reports and initiatives in construction (1984 - 2009) Continuation

Construction Excellence	2009	Never Waste a Good Crisis	To review the rethinking construction since its publication in 1998 and recommend further action that needs to be taken.
Government Construction Strategy	2011	Government Construction Strategy	To change in relationship between public authorities and the construction industry to ensure the Government consistently gets a good deal.
Construction 2025	2013	Construction 2025	Developed a clear and defined set of aspirations for UK construction industry to become.

Sources: H.M Government (2013); Cabinet Office (2011); Wolstenholme (2009) and NAO (2001)

It was commissioned jointly by government and the industry. Its main recommendation was that "*the client should be at the core of the construction process*" and that the route to achieving client satisfaction was through "*team work and co-operation*" (NAO, 2001, p. 1). Four years later, the Construction Task Force, chaired by Sir John Egan, restated the same themes in its 1998 report Rethinking Construction. As illustrated by Table 2.3, the key area for achieving improvement in the industry is through coordination of project team players through relationships continuity within the supply chain networks. The above reports and other independent initiatives relevant to this study are discussed below.

2.5.1 Constructing the Team (Latham)

Constructing the Team (1994) also referred to as the Latham's report set the starting point for most recent change agenda. It was the first of the recent reports to address the apparent problems facing the UK construction industry in 1994. The report sampled wide ranging views form key private and public clients as well as contractors. It suggested that the sector needed to be more structured, reduce confrontation, and be more efficient in process. It

further highlighted that the clients are core of the construction process and had varied needs. The following are some the key issues highlighted by the report:

- Techniques for resolving issues in construction projects were inadequate. The report noted that the contractual arbitration was not good enough due to frequent delays and the constant spectre of appeal. Consequently, it proposed the introduction of dispute process which would offer speedy resolution of disputes;
- Contractual payment methods were found to be unsatisfactory. This significantly affects the cash flow and performance of construction projects. The report recommended more favourable methods of payment which guarantee prompt and constant payments;
- Latham (1994) noted that contracts tend to be burdensome and risk sharing between project parties is not proportionate according to their responsibilities, which allow parties to accept and manage project related risks when emerged; and
- The report stated that working practices and procedures of the sector result in adversarial relationships, which stifle the ability of the industry in delivering quality services to the client. It observed that contract documents tend to include the rights and responsibilities of the involved but encourage narrow-minded control with little attention to the requirements of the end-user. There is therefore the need for favourable strategies to promote collaborative working, joint problem solving and win-win situations.

In line with above, the report made a number of recommendations to improve the performance of the industry and summarised as follow:

- A new construction bill should be introduced and passed by parliament in order to outlaw burdensome procurement contracts and compel clients to put capital into trust fund;
- A new family contract should be launched to reflect the need of "modern contract." It also states that key aspects of the contract should include proportional allocation of risk, joint problem identification and solving, teamwork and win-win scenarios. The New Engineering Contract (NEC) was recommended for the use of all civil and building contracts;
- Clients should introduce new mechanism of payments based on project milestone and replace retention payments with performance bonds;
- Adjudication should be introduced as a mechanism for settling disputes in construction projects; and
- Government departments and agencies should commit themselves to leading plans for change by being best practice clients.

Finally, the report put forward a target of 30% real cost reduction over five years if recommendations are implemented effectively.

2.5.2 Efficiency Scrutiny into Construction Procurement (Levene)

Following Latham's (1994) recommendations, the Cabinet Office in 1995 commissioned the Levene Efficiency Scrutiny into Construction Procurement (NAO, 2001). The report reviewed the procurement performance of government departments and agencies and identified following issues: had a one dimensional view of competition;

- often impractical about budgets or timetables;
- unsuccessful in risk management; and

- had no single unified point of contact with the industry with whom to talk about and resolve common problems across a number of departments and agencies.

Following the identification of the above, some recommendations put forward to improve the government procurement system include:

- the introduction of better communication channels with the industry's contractors in order to minimise conflicts;
- there should be an increase in training of civil servants on procurement and risk management; and
- establishment of single point of contact to settle reoccurring problems across departments.

2.5.3 Rethinking Construction (Egan)

The slow uptake of the recommendations put forward by both Latham (1994) and Levene's (1996) reports particularly recommendations about good practice in partnering beyond the first tier of the supply chain, was amongst the reasons which led to the commissioned of the Construction Task Force in 1997. The Task Force membership was drawn heavily from manufacturing and large clients of the industry and led by Sir John Egan. It was to advise the Deputy Prime Minister on clients' views about available opportunities for improving the quality and efficiency of project delivery in the housing sector with respects to meeting clients' requirements. The resulting report commonly known as Egan Report was completed in 1998 and suggested three key areas which require immediate attention – style, culture, and process of construction. It identified five key drivers of change to include: committed leadership, focus on the customer, process and project team integration, quality driven agenda, and commitment to people, as well as four process improvements – product

development, partnering the supply chain, project implementation and production of components. It suggested targets for improvement in areas such as construction time, cost and predictability and accident.

2.5.3.1 Committed Leadership

This requires not only the leadership or management team to believe in but also totally commit to sustained performance improvement and communicating the necessary cultural and operational changes to others (Egan, 1998). According to the Task Force, the change should be led by clients through demonstration projects and a movement for change – clients need to demand best value for money and improved performance from the suppliers. In turn, clients need to demonstrate their commitment to being good employers and procure works in a manner that allows best value to be delivered. Furthermore, clients are required to provide fair reward for good performance. As a regulator and key client of the industry, the government is mandated to provide an environment that encourages its departments and agencies for best practices.

2.5.3.2 A Focus on the Customer

The Egan's report suggested that in order to achieve significant improvement, the construction industry needed to be customer centred. Focussing on the customer necessitates providing a product that the customers want, at the time they want it and at a price which reflects its value as well as eliminating waste. This is necessary if suppliers of construction services are to secure positions in highly competitive markets. This could be achieved through change of culture – from each supply chain member focusing on maximising the efficiency of its contractual obligations with no regards to linking processes to a culture that

places much emphasis on construction as a series of activities and processes designed to provide value to the customer.

2.5.3.3 Process and Project Team Integration

One of the key drivers of the report was to define a process in construction that involved collaborative working. The report challenged the conventional view that construction projects are unique, which seeks to place distinction between design and construction, siting different ground conditions and varied clients' specifications. Egan emphasised the significance of the construction industry learning from other sectors such as manufacturing and retail. The report suggested four key project processes for integration as:

- product development: a sustained development of product with view to meeting and informing the needs of clients and the end-users;
- project implementation: bringing all members involved in a project together to work and deliver a specific project;
- partnering the supply chain: the need to introduce long-term working relationships based on sustained improvement with a supply chain; and
- production of components: a sustained programme for improvement for the production and delivery of components to reduce defects and minimise waste.

2.5.3.4 Quality Driven Agenda

The Task Force also recommended that the industry be embarked innovating methods to improve quality. In other words, programmes to reduce defects in constructed facilities should be introduced to 'get it right at first time' (Egan, 1998). It also includes delivering

projects on time to customers and at a cost which reflects the value of the constructed facilities as well as minimising cost in use and after-sale service.

2.5.3.5 Commitment to People

The report called upon the industry to value its workforce and decent and safe working conditions as working environments were suggested to be deplorable with poor health and safety records. It highlighted the plight of the industry workforce and suggested that they are undervalued and resourced and argued that training and development for all staff should be a priority.

2.5.4 Modernising Construction (NAO)

Modernising Construction builds on the key recommendations put forward in Latham, Levene and Egan reports and was published in 2001 by the NAO. The report mainly looked into the public spending on behalf of the government and suggested essential requirements in six areas for the procurement and management of construction projects. These include:

- Contractor selection;
- Building designing;
- Planning;
- Project management;
- Performance measurement; and
- Suppliers remuneration

By providing common minimum standards for construction procurement, it aims to transform procurement and management of projects and demonstrates how each requirement can be met. However, response to recommendations was once again slow.

2.5.5 Accelerating Change (Strategic Forum for Construction)

Accelerating Change report published in 2002 builds on the recommendations in Rethinking Construction (Egan, 1998). This report was Government's response to the 'slow and patchy' progress of Rethinking Construction recommendations, and in 2001, established the Strategic Forum for Construction (SFC) (Business and Enterprise Select Committee, 2008). Its role was to supervise the implementation of the industry agenda for change through its member bodies, including Constructing Excellence, ConstructionSkills, the Union of Construction, Allied Trades and Technicians (UCATT) and the main Construction Umbrella Bodies. The forum was chaired by Sir John Egan and produced its first results (Rethinking Construction: Accelerating Change) in 2002. Based on the Egan's report in 1998, it sets new targets for achieving industry reform in a range of areas. These include:

- 50% of construction projects by value to be undertaken by integrated teams and supply chains; and
- 50% of construction activities by value to be procured by clients that embrace the principles of the Clients' Charter.

The vision of Rethinking Construction report was to achieve maximum value for all clients, end users and stakeholders through sustained excellent delivery process of products and services that exceeds expectations. It suggested the addition of economic and social value to product design and delivery to improve profitability in order to attract investments. It further suggested more integrated teams and supply processes, respect for people, cultural change, and investment in research and innovation. The report proposed methods of measuring progress against set targets and introduces a toolkit such as payment models and key performances indicators (KPIs) for payments to assist clients and other stakeholders within

the supply chain to bring together integrated teams to mobilise their value streams in order to promote the culture of effective team working within the sector. Finally, the report suggested the introduction of Construction Best Practice Programme (CBPP), which collates and shares tools with Small and Medium Enterprises (SMEs) in order to assist these organisations integration into the supply chain.

The above targets reflect the need to promote economic, social and environmental sustainability in construction while encouraging the industry to embrace best practices in order to raise performance through integrated teams and supply chains to meet customers' satisfaction.

2.5.6 Never Waste a Good Crisis (Wolstenholme)

A decade after the publication of *Rethinking Construction*, *Never Waste a Good Crisis* report was published in 2009. Its team was drawn from various sectors of the industry including academics and was led by Wolstenholme. Using the available evidence – the industry reports produced between 1998 and 2008, KPIs and Construction Excellence demonstration projects, this report sets out to review progress since *Rethinking Construction* publication in 2002. It identified a number of 'blockers' that have stifled the Egan change agenda in the industry to include:

- Business and Economic Models;
- Capability;
- Delivery Model; and
- Industry Structure

It suggested that these factors are about how the demand for construction services shapes the industry and supply issues that affect the industry's ability to respond to changes. As a result, the report put forward eight future actions that needed to be taken. These include:

1. *Understand the Built Environment* - sustainably leverages performance in other parts of the economy to deliver superior products;
2. *Focus Much More on the Environment* – leading sustainability issues while adopting carbon reduction programme into all construction processes;
3. *Find a Cohesive Voice for Our Industry* – presenting effective united front to key stakeholders;
4. *Adopt New Business Models that Promote Change* - move away from models that encourage short-term gain to long-term business relations that incentivise value creation;
5. *Develop a New Generation of Leaders* - new generation of leaders to champion the vision of cultural and behavioural change;
6. *Integrate Education and Training* – bringing together all inter-related disciplines to provide solutions to industry problems;
7. *Procure for Value* – projects procurement must base on achieving best value, but not lowest price; and
8. *Suppliers to Take the Lead* - suppliers to lead and demonstrate value creation.

Wolstenholme (2009; p. 1) was of the view that "*the need for change is as strong today as it was eleven years ago,"* affirming the integration of all participants of temporary construction projects team. Nonetheless, the Government was dissatisfied with the performance of the construction industry due to poor and inconsistent procurement practices, particularly in the

public sector and called for change in the relationship between the Government and the industry in order to ensure the incremental performance improvement.

2.5.7 Government Construction Strategy

The Government Construction Strategy was published by the Efficiency and Reform Group of the Cabinet Office in 2011. There was general consensus across the industry and its customers, that construction under-performs in terms of its capacity to deliver value; and that the Government has failed to exploit the potential for public procurement of construction due to lack of investment in construction efficiency and growth opportunities (Cabinet Office, 2011). Previous reports such as Wolstenholme (2009) highlighted a number of key barriers to growth and the efficient operation of the construction market. In order to improve growth and increase competitiveness by reducing waste and inefficiency whilst stimulating higher levels of innovation, Government Construction Strategy put forward a number of key areas needed to be addressed. These include:

- Procurement reform;
- Building information modelling;
- Supplier relationship management; and
- Client relationship management

In order to address the key issues identified and drive growth across the entire economy calls for clear vision where the industry performance are measured to bring about greater efficiency in operation.

2.5.8 Construction 2025

Construction 2025 suggested where UK construction will be in 2025 and provided the basis for the industry to exploit its strengths in the global market by setting a clear vision for the industry (H. M Government, 2013). The vision statements which the construction industry and Government jointly aspire to achieve by 2025 include:

1. A 33% reduction in both the initial cost of construction and the whole life cost of assets
2. A 50% reduction in the overall time from inception to completion for new build and refurbished assets
3. A 50% reduction in greenhouse gas emissions in the built environment
4. A 50% reduction in the trade gap between total exports and total imports for construction products and materials.

Central to this report is the development of long-term partnerships between Government and the construction sector to deliver significant growth. It outlined the sector's strengths and opportunities for growth. On the other hand, it highlighted key weaknesses of the industry that require real effort to make the most of these opportunities. The weaknesses include:

- Low integration of supply chain;
- Low levels of innovation;
- Lack of collaboration and limited knowledge sharing; and
- High costs of construction

According to the Construction 2025 report, the main barrier to reduced cost and increased growth is the lack of integration in the industry's supply chain, compounded by a lack of standardisation and repetition in the product.

In sum, the review of past and current official policy initiatives or industry agenda for change programmes has shown that there is the need and opportunity for adopting collaborative supply chain relations in construction developments. Lack of integration in the industry's supply chain and procurement reform were highlighted by Construction 2025 and Government Construction Strategy reports. The need to replace adversarial cultures with collaborative ones within the construction supply chains was the main focus of both the Latham and Egan' reports as well as Wolstenholme (2009). Improvements in the procurement and delivery of construction projects were essential part of the good practice guidance promulgated by Constructing Excellence and the industry's Strategic Forum. The review has also shown that construction project teams must work together in a partnership that embraces not just the main contracting organisations but also their trade contractors. The need for more integrated inclusive approaches to the supply chain has been acknowledged as being essential in order for the construction industry to improve its performance. It has also emphasised the need for procurement systems that consider improved intra organisational relations to encourage a more transparent approach to relationship governance. Thus, the structure of temporary multi-disciplinary organisational teams is essential for the effective delivery of construction projects; cost reduction and innovation within the supply chain to maintain market position. Furthermore, it stressed the need for alternative approach towards procurement practices with strong theoretical basis, designed to minimise inefficiency and wastefulness of teams carrying projects.

2.6 Collaborative Supply Chain Relations and Construction Procurement

The industry-wide reports (Construction 2025; Cabinet Office, 2011; Egan, 1998; 2002; Latham, 1994) have not only expressed dissatisfaction with the performance but also highlighted the inefficiency of the sector and recommended that the construction industry needs to reflect the best practices of the manufacturing to provide a satisfactory product and meet customer needs (Akintoye and Main, 2007). A change of supply chain relationships from the traditional adversarial to the collaborative can facilitate incremental performance improvements and innovation (Egan, 1998). Accordingly, the use of collaborative relationships and procurement approaches that reflect and facilitate better communication between supply chain partners has been advocated for construction projects development (Ross, 2011).

The issue of collaborative procurement relationships has attracted a growing body of academic research in recent decades (Baiden and Price, 2011; Ochieng and Price, 2009 Akintoye *et al.,* 2000). This increased attention reflects the importance effective management of such relationships between project parties in securing project success and customer satisfaction through mutual cooperation and harmonisation (Miller *et al.,* 2002). For instance, Akintoye and Main (2007) explored factors relevant to collaborative relationships in the construction environment and identify complementarities of skills, cooperative culture, shared goals and objectives. Based on a case study, Kadefors (2011) examined formal models for relationship management in construction projects and professional knowledge may be needed to achieve a more consistent and adequate relationship management that utilises both formal partnering processes and core project processes. Similar factors of collaborative relationship development have been identified as open and effective communication and corporate culture (Chen and Chen, 2007). Meng (2010) assessed various forms of

collaborative relationship in construction using literature review and expert group discussion. Meng further suggested procurement - selection criteria, procurement route and form of contract as one of the dominant factors. The more complex the projects are the more important collaborative arrangement to manage it successfully (Kadefors, 2004). Various collaboration models such as relationship development by Humphreys et al. (2003); inter-organisational relationship range (Jones and Saad, 2003); supply chain maturity assessment grid (Strategic Forum for Construction, 2003); and partnering ladder (Li *et al.*, 2000) have been developed with the aim to improve construction relationships.

Unlike the construction industry, the manufacturing and service industries have been successful in the utilisation of collaborative approaches. Douma *et al.* (2000) asserted that increasing pace of technological developments and access to new technologies are among reasons for collaborative relations. According to Medcof (1997), the success of collaborative relationship with strategic suppliers depends on: (i) capability – the potential partners' ability to carry out their responsibilities; (ii) compatibility – partners' operationally compatible; (iii) commitment – partners are committed to the common goals of the relationship; and (iv) control – the control mechanisms for the coordination of activities are suitable. Similarly, Anglinger and Jenk (2004) presented different forms of collaborative relations as: (a) invasive where the partners share a significant amount of technology, personnel and strategy and derive value from a true combination of perspectives and resources, often accompanied by co-location; (b) multi-function which involves multiple spots on the value chain and brings together development and market with the view to maintaining or building thrust for commercialisation; (c) multi-project which comprises existence of multiple arrangements within a single company to reduce the costs of transaction providing parties a first look at each other's products or right of first refusal; (d) Coopetition which involves cooperating

with competitors with the benefit of sharing development costs, in addition to access to expertise and reduce transaction costs; and (e) networks which represent a multiple partners grouped in a single alliance to access diverse technologies and skills, share costs, build market momentum and bundle related products into a full customer solution. Humphrey *et al.* (2001) argued that market opportunities, costs reduction, quality improvement, flexibility and technology are some of the reasons for the emergence of new procurement role.

Furthermore, Douma *et al.* (2000) asserted that the need to cooperate is determined by pressure on continuity, market opportunities, time pressure or the number of alternative options. Crouse (1991) offered the following as potentials of a balanced collaborative relationship: offer the ability to leverage internal investments; emphasis on core competencies; leverage core competencies of other firms; reduce capital needs and broaden products offerings; gain access or faster entry to new markets; share scarce resources; spread risk and opportunity; improve quality and productivity; having access to alternative technologies; provide competition to in-house developers; use a larger talent pool and satisfy the customer. Brouthers *et al.* (1995) in their research "choose your partner" suggested four conditions under which collaborative arrangements should be utilised. These include: complementary skills by the potential partners; cooperative cultures exist between the firms; compatible goals exist between the firms; and commensurate levels of risk are involved.

In the context of buyer-supplier relationships and building on streams of existing literature, many authors have asserted that the value of factors such as operational or organisational capabilities (Bankvall, *et al.*, 2010; Artto *et al.*, 2008), bilateral dependence (Briscoe, 2005; Love *et al.*, 2004; Cox and Ireland, 2002), price (Hartmann and Caerteling, 2010; Xie *et al*., 2010; Humphrey *et al.*, 2003; Miller *et al.*, 2002), and complexity (Segerstedt and Olofsson, 2010) to achieve effective collaboration between the main contracting organisation and

subcontractors. Latham (1994) claimed that procurement contractual conditions for trade contractors are unfair and suggests appropriate procurement contract conditions, based on collaborative principles. Briscoe and Dainty, (2005) noted that developing mechanisms for problem resolution through the tiers of the supply chain can generate added-value into projects. Dainty *et al.* (2001) argued that adverse relationships can result in serious payment problems for Subcontractors. They further suggested that many trade contractors complain of an inadequate knowledge management by the main contractors, affecting the quality of their collaborative working relationships.

There seem to have uncovered research in the area of construction procurement that considers how main contractor's collaborative procurement strategy interacts with different specialist trade contractors in their supply chain. The assumption has been that contractors will develop a contingent approach to the management of their supply chain and there has been little investigation into the factors that influence this approach. This was identified as a clear gap in current knowledge and a better understanding of these factors will assist in the design of collaborative framework, which takes into account of the main units of production, the supply chain, and their relationship with different subcontract organisations. The literature review also highlighted the lack of collaborative procurement strategies based upon subcontract trades attributes and how specific they are to an organisation and project.

2.7 Construction Industry and Supply Chain Relations

Supply chain working relation has been advocated as being the most appropriate approach to integrate the construction team. The construction industry is said to behind other sectors such as manufacturing and service in its application (Cox and Ireland, 2004). There is no

consensus among researchers with regard to the definition of the concept of SCM (Skitmore and Symth, 2009). However, Christopher (1992, p. 18) defined SCM as:

"the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole."

In effect, SCM is viewed as a means of bringing together all the team members to share common goals, fostering involvement in the entire project lifecycle and developing the benefits of better management and more innovative design solutions. Supporters of the collaborative supply chain relations have identified many benefits to include: allowing key project actors to be involved at early stage and provide different and perhaps innovative solutions to help win a project not necessarily just with the cheapest price therefore providing sustainable profit margins (Bankvall *et al.,* 2010), if selected optimally, it offers the opportunity to deliver projects on time, within budget, safely and provide the required quality that can help in diffusion of innovation and overcome those problems that are currently experienced in the industry (Eriksson *et al.,* 2007), increasing market share and enhancing competitive position since strong supply chain can help to provide a cheaper and better product delivered more efficiently (Cox and Ireland, 2002), facilitating continual improvements and innovation (Egan, 1998), can help to reduce conflict and time wasting on claims and disputes if same chain members are used during both pre and post construction phases (Humphrey *et al.,* 2001), allowing key participants to contribute to the joint objectives of the project and thus securing project success and customer satisfaction through mutual cooperation and harmonisation (Eriksson *et al.,* 2007; Eriksson, 2010), and offers the opportunity to focus more on subcontractors, thereby ensuring improvement of health and safety (Cheung *et al.,* 2003).

Morledge *et al*. (2009) on the other hand argued that SCM while useful does not readily translate to a construction environment due to production characteristics in construction projects. These features are categorised into five main areas: disjointed procurement systems, adversarial relationships, project uniqueness, separation of design and production, and competitive tendering (Morledge *et al.,* 2009).

2.7.1 Uniqueness of construction project

As with other industries, the construction has been shaped by its characteristics and history. The sector in comparison with other industries is mainly project-based with projects designed and constructed to meet clients' specifications (Dubois and Gadde, 2002). Segertedt and Olofsson (2010) compared the construction industry with manufacturing, and noted that whilst the later involves 'continuous' processes and relationships, the former is project-based and 'discontinuous.' Olofsson (2010) further observed that whereas manufacturing involves 'make-to-stock', this feature is non-existence in construction. In the construction sector, each project is unique and the degree of uniqueness is determined by a number of factors, which in turn, determines the resources needed for the project, and selection of the most appropriate supply chains or procurement needed to deliver clusters of resources and services (Morledge *et al.,* 2009). The finished products are generally assembled on sites that are geographically some distance away from both the supply firms and construction management organisations. The industry can thus be represented as a site specific project-based (Dubois and Gadde, 2002). As observed by Egan (1998, p.16), the industry is *"dealing with the project process as a series of sequential and largely separate operations undertaken by parties with no commitment to long-term success of the product".* Consequently, each construction project requires reorganisation of skills and technologies resulting in the temporary nature of

relationships among project participants and coordination of diverse and complex relationships in the supply networks (Goulding, 2012; Jones and Saad, 2003).

2.7.2 Fragmentation

Another notable feature of the industry is its fragmentation (Egan, 1998; Errasti *et al.*, 2007). The fragmentation is seen both in terms of market and dispersion of firms that undertake works. For instance, the market sector has divided into building, infrastructure, repairs and maintenance, and material manufacture with sub-division of their markets. Langford and Male (2001) revealed that these markets are characterised by the size and types of project. Furthermore, different forms of entry and exit barriers exist in these markets, especially in connection to a firm's capability to adopt new technologies or methodologies as well as human and physical resources needed to compete. It has been noted that the degree of fragmentation in construction is unparalleled in any other sectors, with significant impacts on low productivity, poor value for money, low clients satisfaction, cost and time overruns, conflicts and disputes (Bankvall, *et al.,* 2010; Fearne and Fowler, 2006; Egan 1998). Cox and Ireland (2002) also lamented that the widespread use of subcontracting system in the industry further compound fragmentation and the need to develop a stronger theoretical understanding of the role that the supply chain plays in project teams has been highlighted by (Ross, 2011).

2.7.3 Arms-length relationships

Traditionally, the nature of relationships in the construction sector is highly transactional involving numerous potential suppliers (Errasti *et al.,* 2007). Beach et al. (2005) suggested that relationships are also adversarial with contracting parties keeping each other at arm's-length and dominated by defensive behaviour. Furthermore, Briscoe and Dainty (2005) submitted that relationships are characterised by a tender system that leads to a focus on

standardisation of outputs, the ability to compare prices and choose the lowest price per product, competition between 'identical' and independent suppliers, and the use of different suppliers in each construction project. Relationships are filled with low trust and opportunistic behaviours (Kadefors, 2004; Kale and Arditi, 2001). The corresponding lack of cooperation has thus been seen as a major contributing factor for the low level of innovation and performance in the sector (Eriksson *et al.,* 2007). As a result, supply chain members try to shift risks to one another whilst every effort is made to gain maximum reward leading increased transaction costs and low clients' satisfaction (Pryke, 2009). The high transaction cost has been attributed to drafting and negotiating contractual agreements, which are incurred trying to define responsibilities and roles as well as contracts monitoring mechanisms and disputes settlements. However, most tools available to contractors for the selection of the optimum procurement approach have focused upon quantitative methods, which are based on how contracts control time, cost and quality (Ross and Goulding, 2007; Love *et al.,* 2004).

2.7.4 Separation of design and production

The design and construction process of the industry have been relatively disintegrated (Vrijhoef and de Ridder, 2007). This separation of the design and production process has long been noted (Egan, 1998; Latham, 1994). It has further been recognised that top tiers of the construction supply chain are much more integrated, whereas the lower tiers are generally overlooked and left out in the integration process (Mason, 2007; Beach *et al.,* 2005; Cheung *et al.,* 2003). Accordingly, alternative approach towards procurement of suppliers and subcontractors that incorporates strategic differentiation in order to achieve value enhancement, operational efficiency improvement, and cost reduction has been advocated (Bidgoli, 2010).

2.7.5 Competitive tendering

The procurement arrangement of the industry is predominantly dominated by contractual arrangements in which competitive tendering has been the traditional practice for basis of selection (Khalfan and McDermott, 2006). The contractual culture has been found to influence the form of relationships adopted to meet client requirements (Dubois and Gadde, 2002). Competitive tendering guarantees no incentive for future work and remains essentially adversarial with continuing reliance on price (Miller *et al.*, 2002; Saad *et al.*, 2002; Vrijhoef and Koskela, 2000).

In spite the above arrangements, it is essential that the construction industry develops its supply chain practices to improve performance and deliver value to the client, instead of simply seeking to generate short term cost savings (Briscoe and Dainty, 2005).

2.8 Construction Procurement and Relationships Development

Traditionally, execution of a construction project requires bringing together of a large array of subcontractors and suppliers with the aim of creating the desired end product safely and profitably. Invariably the teams created have never worked together before and a significant part of the process is taken up with developing a working relationship and building trust between the parties. The traditional approach has been for the client to appoint an architect to produce a design, which is then tendered to a main contractor with the responsibility of managing construction delivery. In turn, the main contractor then sublets the work to specialist contractors who are largely responsible for making the architect's original design a reality. The use of partnering as a way to promote co-operative contracting has attracted much public attention (Egan, 1998; Latham, 1994). Moore (1999) discussed various types of contracting relationship in a spectrum. The spectrum starts with spot buy where transactions

are purely incidental and ends with partnership under which the contracting organisations work cooperatively as a team to achieve the transaction objectives. Partnering is regarded as an important management tool to improve quality and programme, to minimise disputes between parties, therefore ensuring an open and non-adversarial working environment (Cheung *et al.*, 2003).

Pryke (2009) examined working relations in construction and identifies four categories: internal supply chain, dyadic-exclusive relationships, management of a chain, or the management of a network of businesses. Pryke (2009) suggested that integration requires the sharing of information and creating unique investments networks. Kadefors *et al.* (2007) observed that trust between the network parties is crucial for collaboration. Another key factor for the success of integration has been identified as commitment (Eriksson and Laan, 2007). Wu *et al.* (2004) investigated supply chain relations in software industry and concluded that high degree of relationship investments, dependence and product saleability are antecedent conducive factors to raise the affective commitment, continuance commitment and normative commitment among supply chain parties. These requirements particularly for relationship investment in processes or products are lower in construction than other industries, consequently, adapted models are required (Wu *et al.*, 2004). London and Kenley (2001) discovered that repeated transactions requiring moderately specialised assets and recurrent transactions requiring highly specialised assets and operations under moderately high-to-high uncertainty are essential requirements. Thus, successful relationships recognise bilateral dependence which requires closer relationship that is difficult to maintain between construction organisations due to the sector's unique features and business environment. However, there are benefits to be derived from maintaining closer relationships with suppliers.

In construction however, the wider use of partnering is still not thought to be universal among all supply chain members. For example, Beach *et al.* (2005) noted that partnering is generally centred on upstream (client-contractor) relationships and the role suppliers and subcontractors in construction supply chain have been effectively overlooked. Likewise, Errasti *et al.* (2007) observed that the implementation of SCM principles has not been extended beyond the boundaries of organisations to include their suppliers. Miller *et al.* (2002) acknowledged the current practice places very little emphasis on the development of the subcontracting sector. Miller *et al*. (2002) further claimed that contractors normally aim at maintaining contact with a variety of different specialists and offer intermittent employment, matching the skills of the specialist to those required for the successful completion of a project.

Conversely, Gray and Flanagan (1989) have long acknowledged the importance of subcontracting organisations to the construction industry and classified subcontractors into four types: (i) design/manufacture/supply/fix (ii) design/supply/fix (iii) supply/fix (iv) fix only. Gray and Flanagan (1989) also recognised that the market would become structured into large national subcontractors that would be specialised by niche and who would have control over their business. Gray and Flanagan (1989) further acknowledged that there would be a large number of smaller firms that would be used as a buffer to the volatility of varying workloads. Latham (1994) and Egan (1998) have also admitted the importance of the system of subcontracting to the construction sector. Latham (1994) and Egan (1998) suggested the need to improve relationships throughout the chain network to include subcontractors by means of partnering to ensure innovation and sustained incremental increases in performance. More recently, Wolstenholme (2009) noted the significance of the subcontract sector and recommended their earlier involvement in projects through long-term collaborative working relationship.

Eriksson *et al.* (2007) investigated contractor-subcontractor relation and suggest a change in the approach to the development of project teams based on subcontractors. Eriksson *et al.* (2007) further assert that main contractors' role have become mainly coordinating and managing subcontractors. The relationships that a firm has with its supply organisations have been suggested to be a function of its management strategies. These management strategies are said to be affected by the size of organisations (Miller *et al.,* 2002) as large companies have access to latest technologies, materials, process and other methods of innovations which enables them to dominate the production and market environments and occupy favourable positions along industry value chains (Chow *et al.,* 2008; Koh *et al.,* 2007). Consequently, large organisations have been referred to as market makers for their supply chains (Miller *et al.,* 2002). The smaller firms lacking the necessary resources to compete in more sophisticated segments of the market are subsequently limited to strategies that are focused upon price competition and cost reduction (Eriksson *et al.*, 2007).

The presence of differing communities therefore makes the application of supply chain initiatives challenging. Although there has been a growing body of academic research on procurement practices within the supply chain during the last few decades, the current position of construction procurement research is that organisations' collaborative procurement strategies have to take account of the nature of the structural characteristics of the supply chain and develop procurement approaches that reflect their nature (Ross, 2011; Bidgoli, 2010).

2.9 Contractor-Subcontractor Supply Chain Relationships

The official government policy initiatives (Egan, 1998; Latham, 1994) suggested ways for improving the performance of the construction industry and emphasised a need to focus on

integration of process across organisations, and on building close relationships. It is acknowledged that some of the principles outlined in the reports, have made little or no change, especially further down the supply chain. Wolstenholme (2009) observed that some minor changes have been realised but the radical change recommended to the construction industry has not been fully implemented. Similarly, Greenwood (2001) found no evidence of subcontractor partnering and stated that the traditional arms-length, cost driven approach is adopted from the commencement of business relationships. Dainty *et al.* (2001) also identified open book negotiations are not used for mutual benefit, but used as a method for reducing margins and that competitive tendering remained the principal approach to a subcontracting organisations selection. Dainty *et al*. (2001) further commented that there are significant barriers to supplier integration and to the development of supply chain alliances due to mistrust. On the other hand, trust has been considered to be an essential factor in contractor-subcontractor relationships (Humphreys *et al.,* 2003). Dainty *et al.* (2001) suggested that clients should provide leadership to drive the integration process and also to move towards a more transparent approach to the governance of supply chain relationships. However, McIvor (1997) recognised that a conflict of interests within the main contracting organisation could inhibit integration of subcontractors into the chain networks.

The concept of relationship building comprises a variety of practices intended to facilitate greater collaboration amongst participants (Errasti *et al.,* 2007). In construction however, it is widely acknowledged that little emphasis has been placed on contractor-subcontract relationships development (Bankvall *et al.,* 2010; Eriksson *et al.,* 2007). Mawdesley *et al.* (1998) are of the view that to move away from the traditional adversarial to collaborative, relationships between the two parties has to be maintained throughout procurement and construction to ensure a strong interface within the project team. Artto *et al*. (2008) stressed

the need to focus on inter-firm relationships and not just focus on the individual capabilities. Kale and Arditi (2001), however, found in their study of inter-organisational relationships between contractor and subcontractors, that there is a positive and strong relationship between economic performance and quality of relationship, with elements of longevity, openness of communication and mutual trust. Kale and Arditi (2001) suggested that these business relationships are strategic assets to a contractor.

2.10 Contractor – Subcontractor Economic Transaction Organisation and Types of Strategies

Construction projects are organised in a network of suppliers and customers in which they obtain production capacity from external sourcing and can be viewed as temporary multi-organisational teams (Ross, 2011). The development and management of long-term buyer-supplier relationships at the cross project-level is therefore difficult, as project teams and product designs change from project to project (Bemelmans *et al.,* 2012). The use of temporary nature of these buyer-supplier relationships has come under criticisms from various academic researchers (Eriksson *et al.,* 2007; Mason, 2007; Briscoe and Dainty, 2005; Beach *et al.,* 2005; Vrijhoef and Koskela, 2000). For instance, Arditi and Chotibhongs (2005) identified the timeliness of payments by main contractors, the process of selecting subcontractors, subcontractor bonding, construction insurance, safety issues on the construction site, partnering arrangements, and productivity issues as factors affecting contractor- subcontractor transactional exchange. Li *et al.* (2006) suggested that relationship between contractor and their subcontractors is influenced by past performance and experience, project characteristics, market conditions, client procurement route and organisational quality. Hartmann and Caerteling (2010) maintained that price, trust and quality issues are key factors influencing contractor-subcontractor business relations.

Furthermore, communication, trust and dependence are found to impact on type of business bond contractors have with their suppliers (Bankvall *et al.,* 2010; Fearne and Fowler, 2006; Briscoe and Dainty, 2005; Love *et al.,* 2004; Humphrey *et al.,* 2003).

According to Eriksson (2006) and Ekström *et al.* (2003), an optimum exchange can be viewed as function of asset specificity. This involves redefining asset specificity in terms of ``fitness of purpose'' of skills, expertise and transactions in attaining a justifiable position for the supply chain (Mclvor, 2009). Moreover, the dispersion of knowledge and technological resources which dictate organisational specialisation can be a key influence (Kale and Arditi, 2001). Additionally, the growing need for greater effectiveness and efficiency in their operation has forced more main contracting organisations to concentrate on their core competencies, and subsequently relying heavily on subcontractors, resulting in increased interdependency (Eriksson *et al.,* 2007; Cox and Ireland, 2002). As observed by Ng *et al.* (2009), market position, human resource, ability to adapt to new technologies/methodologies and project-related factors are key determinants of subcontractor success. Ross (2011) noted that the strength of relationships between main contractor and subcontractor is affected by specificity of subcontractor, procurement route of client and project complexity/technology. The specificity of subcontractor originates from number of competitors, price, information availability, uniqueness of project and technology specificity. The characteristics of the supplier, such as competence, capacity, past experience, reputation and history of the supplier are considered essential regarding collaboration and nurturing of the relationship (Eriksson and Laan, 2007). Hsieh (1997) concluded that economic considerations and technological advancements play an important role in determining the contractor-subcontractor relationship and is bounded by the areas of specialty available and the production economy of subcontractors in the construction market. Lee *et al.* (2009) claimed that for contractors to

successfully develop effective business relationships with their subcontractors, they must select the appropriate strategy by considering the different characteristics of the subcontracted work packages.

Different forms of buyer-supplier strategies have been subject of much research in the manufacturing and service industries (Svahn and Westerluud, 2009; Douma *et al.,* 2000), but the construction industry lacks behind in their applications (Bemelmans *et al.*, 2012; Barlow and Ozaki, 2005; 2003). For example, Bemelmans *et al.* (2012) tackled collaborative relations and noted the following issues in determining the effectiveness of buyer-supplier supply chain relationship management as:

(1) Optimising supply base – the process of determining the correct number and most suitable suppliers;
(2) Management of supplier relationship – the process of managing and optimising the relationship with strategic suppliers;
(3) Integration of suppliers into the operational process – set of strategies and activities directed at simplification, standardisation, and synchronisation with the operational processes of the buying company;
(4) Integration of suppliers into the value-creation process – using the knowledge of suppliers to develop products, process or services that are aimed at performance improvement in relation to costs, time, and quality
(5) Development of suppliers – identifying possibilities for performance improvements through constant performance monitoring.

Kraljic (1983) developed a purchasing model in which purchased items are classified into four different categories: strategic, bottleneck, leverage, and noncritical items. Each of these categories requires a different purchasing strategy. Bensaou (1999) examined portfolios of buyer-supplier relationship and suggests that purchasing strategy should take account of suppliers' portfolio. According to Zolkiewski and Turnbull (2002) portfolio approach provides a framework for relationship management at both the strategic and the tactical

levels. Zolkiewski and Turnbull (2002) further suggested that adopting a portfolio approach is fundamental to successful relationship management.

Williamson (1975) viewed structures of exchange relationships as a continuum on which different forms of interactions are plotted, with markets on the one end and hierarchies on the other end. At the extreme pole lies the hierarchical form under which there is completely vertically integrated firm, where all activities from sourcing raw materials up to the sale are coordinated by a single company. Conversely, spot market is described as discrete exchanges wherein the identity of parties, the time dimension and the product characteristics do not actually matter (Williamson, 1975). Other forms of relationships such as cooperative subcontractor relationships and buyer-supplier partnerships are identified as hybrid forms of the hierarchy-market dimension (Artto *et al.*, 2008). Lee *et al.*, (2009) observed two types of relationship in terms of supply chain management - transactional-type relationships and partnership-type relationships. According to the author, whilst the former is based on contracts and rules the latter involves sharing of risks and benefits. Thus, the transactional exchange can be considered as arms-length, competitive type of relationship and the latter as collaborative, embedded and cooperative relationship (Artto *et al.*, 2008).

2.11 Difference between Main Contractor and Subcontractor

The differences between large construction firms and small subcontracting firms can be seen in terms of size, style of management, structure, profitability, stability, market segments, and organisational governance (Miller *et al.*, 2002; Ross, 2005). According to Eriksson *et al.* (2007) main contractors have access to resources which enables them to dominate the production and market environments and thus providing them relative stability and occupying favourable positions along industry value chains. Hence, large construction firms have been

considered to act as market makers for their supply chains (Miller *et al.,* 2002). Moreover, large construction firms have more formalised management practices and comprehensive organisational structures than the small subcontracting firms.

While lacking huge capital resources needed to compete in more sophisticated segments of the market, most small subcontracting firms have distinct skills/capabilities to carry out complex projects (Chan *et al.,* 2004). In addition, small subcontracting firms are able to react quickly to changes and adopt innovative techniques than their larger counterparts (Chow *et al.,* 2008). According to Mason (2007), for a number of subcontractors the issues of survival and continuity dominate their decision-making process. Hence, maintaining close relationship can convince the two actors that they can improve their chances of survival.

2.12 Types of Subcontractors and their Importance

Subcontractors are of various types and each speciality provides key service to the production process of the construction industry. Although there is no fast and hard rule on how to group subcontractors, research on subcontracting firms has provided many kind of typologies and categories. For instance, whereas Ng *et al.* (2009) categorised subcontract trades into 'equipment-intensive and labour-intensive,' Lavelle *et al.* (2007) grouped them as 'general,' 'specialist' and 'non-specialist.' The Standard Industry Classification (SIC) provides comprehensive list of items for subcontractor groupings to include: turnover, market of operation, level of technology, number of employees or size of the firm, profitability, stability, and project. These groups vary in terms of resources, technological knowledge, skills, size and markets of operation.

The notion that small and medium size subcontracting firms are the backbone in construction are repeatedly emphasised in the literature (Hartmann and Caerteling, 2010; Errasti *et al.,*

2007; Mason, 2007; Humphrey *et al.*, 2003; Miller *et al.*, 2002; Dainty *et al.*, 2001). On construction projects, specialist trade contractors are involved in various tasks – planning, designing, preparation, testing, delivery, assembling and production across different projects. As observed by Dainty *et al.* (2001), to quantitatively measure the importance of subcontracting to the industry is a difficult task if not impossible. This is due to the fact that it is difficult to obtain accurate and up-to-date data. However, the extent of significance of subcontracting can be derived from published government agencies statistics. Table 2.4 presents data taken from ONS and shows the importance of subcontracting to the construction industry.

Table 2.4 The structure of private contracting in United Kingdom for 2013

Size of firm (No. of employees)	No. of firms (%)	No. of employees (%)	Amount of work completed (%)
1	52.8	7.1	5.5
2-3	25.5	10.2	8.8
4-7	12.5	13.2	8.1
8-24	4.6	9.5	7.7
25-114	2.4	8.7	8.5
>115	2,2	49.1	61.5
Totals	256,441 Firms	122.2 Employees	£114,430 Million

Source: ONS (2013)

Table 2.4 presents information on size and distribution of the firms on ONS' register. The information indicates that small firms with workforce between one and seven dominate the industry. These enterprises represent approximately 91% of the total firms in the sector (ONS, 2013). The majority of specialist subcontractors fall within these firms.

Table 2.5 also presents statistics on work distribution by trades and demonstrates the crucial role of subcontracting to the production capabilities of the industry, since the sector depends on these small and medium size firms for about a third of its workforce.

Table 2.5 Construction work distribution by main trades in United Kingdom in 2013

Construction main trades	Percentage of work done
General trades	**52**
Building contractors	21
Civil engineering	7
General contractors (Civil and building)	24
Specialist trades	**48**
Electrical contractors	15
Plumbing & Heating contractors	7
Joinery installation contractors	5
Roofing contractors	3
Painting contractors	2
Scaffolding contractors	2
Floor and wall covering contractors	2
Other specialists	12

Source: ONS (2013)

It also presents the distribution of works carried out in the industry by the main trade of firms providing further information on the nature of work executed by subcontracting firms and significance to the industry production capabilities. The statistics show that approximately half (48%) of the key construction services are discharged many of the firms among the subcontracting enterprises to the main contracting organisations.

The above groups of specialist trade contractors operate in various markets with distinct characteristics. According to Ng *et al.* (2009), market condition can be related to the analysis of the marketplace in which a firm operates or has interest in developing its position. Ng *et al*. (2009) further suggest that ‘‘market position” of a firm comprises ‘‘reputation”, and ‘‘company history” considered to be key business problems for small and medium subcontracting firms. Table 2.6 presents different forms of market and their key features summarises the features of each market form and compares with the other. For instance, Lowe (2011) suggested that in competition market the levels of entry and exit are usually high whereas, entry and exit levels are low in low competition market. To improve their

chances of securing new works, firms need to understand the market environments in which they operate and own. Building up good reputation, and establishing a sound image and identity are crucial for maintaining market share (Egemen and Mohamed, 2005). This also helps an organisation to become a sectoral brand in its market.

As revealed by Ng *et al*. (2009) a good market condition increases the prospects of winning jobs to even weak firms whilst assisting to raise some potential organisations. Conversely, a poor market position would knock out some firms with relatively poor performance through vigorous competition (Lowe, 2011). Therefore, the market environment of an organisation can influence its position within the supply chain and thus collaborative performance.

The relationships that the contracting organisations had with its subcontractors can be affected by the size of the project and the subcontract trades (Ng *et al.,* 2009). Miller *et al.* (2002) observe that some organisations are considered as market makers resulting in power differentials. Furthermore, Ross (2011) maintains that the availability of particular trades, entry and exit barriers and the churn of subcontractor by main contractors can influence the choice strategy adopted by buying organisations. Likewise, the work by Williamson (1981) identified that small numbers would have an effect upon the governance structures adopted by contractors. The small numbers would provide an impetus for partnering. The small numbers of subcontractors with the capability to undertake complex projects combined with the costs of tendering would create conditions whereby the subcontractor can influence their project specificity. On the other hand, both Lowe, (2011) and Ng *et al.* (2009) suggested market conditions to influence development of closer relationships. The intensity of a market as a factor could affect the propensity of specialist organisations to provide prices, and in some cases become market makers for particular trades. Consequently, these trade

contractors can use their power judiciously in their geographic position of the contracting organisation to create environment that encourages an intensive use of the market.

In summary, past research has consistently indicated the importance of integration in the industry and greater efficiency in procurement processes. Furthermore, subcontractors are identified to play crucial role in the success of construction programmes and projects. However, no recent empirical studies seem to have considered how main contractors' collaborative procurement strategies interact with different specialist trade contractors in their supply chain. The assumption has been that contractors will develop a contingent approach to the management of their supply chain and there seem to be no investigation into the factors that influence this approach. This was identified as a clear gap in current knowledge and a better understanding of these factors will assist in the design of collaborative framework, which takes into account of procurement approaches that reflect and facilitate better communication between supply chain partners, the structure of temporary multi-disciplinary organisational teams, and strategic differentiation in order to achieve value enhancement and operational efficiency within the supply chain. The literature review also highlighted the lack of collaborative procurement strategies based upon subcontract trades attributes and how specific they are to construction programmes and projects. In Chapter Three, the theoretical foundation underpinning this study will be explored.

CHAPTER THREE: ORGANISATION RELATIONSHIPS AND THEORETICAL FOUNDATION

3.0 Introduction

In construction literature, varieties of frameworks have been used in attempt to examine relationships development. These include relational contract theory (Macneil, 1978), contingency theory (Thompson, 1967), resource-based theory (Penrose, 1959) and transaction cost economics (Coase, 1937). However, this work employed the concepts of asset specificity and uncertainty from transaction cost economics and strategic resources from resource-based theory as theoretical foundation. The selection has been informed by research aim and pilot study.

3.1 Resource Based Theory (RBT)

RBT was first published in 1959 from Penrose's seminal work: *The Theory of the Growth of the Firm*. Penrose (1959) put forward factors contributing to the growth of the organisation and discussed the growing boundary and heterogeneity of the organisation. On the basis of Penrose's work, many researchers have focused on contributing to and extending the theory. Researchers, such as Foss (1996), Collis (1994), Peteraf (1993), Barney (1991, 1989), Dierickx and Cool (1989), Teece (1986), Wernerffelt (1984) and Rumelt (1982), further developed RBT and considered that the characteristics of resources leading to competitive advantages were resource heterogeneity and imperfect mobility.

However, RBT critics argued that the concept of RBT is ill-defined (Collis, 1994; Priem and Butler, 2001) and pointed to heterogeneous use of terms such as resources, capabilities and competencies. Priem and Bulter (2001) suggested that there is no general acceptance of

description and categorisation of resources. Priem and Bulter (2001) further lamented that RBT considers nearly anything associated with the firm as a resource, and this therefore can hinder the prescriptive effects of the theory. Accordingly, Foss and Foss (2005) suggested that any application of RBT to relationship development is aided considerably if resources that are relational and performance specific and potentially manifest at least some of the desired RBT attributes can be identified. Furthermore, it has been suggested that the unit of analysis of RBT is narrow and therefore lacks unlimited number of analysis (Foss and Foss, 2005: Srivastava et al., 2001). For instance, Williamson (1999, p.1095) identified a number of units of analysis including *'resources, core competence, isolating mechanism, and routines'* and suggested that for each shift in level takes the analysis farther from the empirical level and thus from any practical implications. Connor (2002) also asserted that the RBT only applies to large firms with significant market powers since the small and medium firms' sustained competitive advantage cannot be based on their static resources and therefore they fall outside the bounds of the RBT.

Notwithstanding the criticisms of RBT, its central proposition is that if a firm has to achieve sustained comparative advantage it must acquire and control valuable, rare, inimitable, and non-substitutable resources and capabilities. Likewise, subcontractor's influence on construction programmes and projects increases as the skills and knowledge (resources) it provides are rare, inimitable, and non-substitutable.

Penrose (1959) proposed that the firm organises the use of its own resources together with other resources acquired from outside the firm for the production of goods and services at a profit, and assumes that firms try to increase total long-term profits and want to expand whenever profitable opportunities exist. One immediate opportunity of such is to put resources into use. According to Barney (1991), a resource with the potential to create

competitive advantage must meet a number of criteria, including valuable, rarity, imperfectly imitable, and non-substitutability. For instance, Peteraf (1993) developed a model wherein resources are responsible for creating competitive advantages. Peteraf (1993) further suggested that competitive advantages were produced by heterogeneity, ex post limits to competition, imperfect mobility, and ex ante limits to competition.

Each subcontracting firm has a bundle of potential productive services and only the services, not the firms themselves, are the inputs in the production process (Penrose, 1959). A productive service refers to the capacity of achieving a specific job function (Tsang, 1998). The capability of a main contracting firm is its capacity to perform an activity as a result of organising and coordinating the productive services of groups of specialist trade contractors (Eriksson *et al.*, 2007).

A firm's capabilities are considered valuable if they it the chance to exploit its business environment by balancing opportunities with threats (Watjatrakul, 2005). The rarity criterion is linked to the number of competitors that possess a valuable resource (Mclvor, 2007). Where a limited number of subcontractors possess a valuable resource, then it is likely to serve as a source of (competitive advantage) to that group of trade contractors leading to full integration. The property of imitability is related to the ease with which other group of subcontractors can replicate a valuable and rare resource possessed by a subcontractors. In effect, this analysis is about determining the sustainability of the competitive advantage (the extent of integration and coordination) (Mclvor, 2007). Finally, Barney (1991) argued that a subcontracting firm must be organised to exploit its resources and capabilities.

3.2 Transaction Cost Economics (TCE)

Coase (1937) pioneered the early works of TCE. Coase (1937) suggested that TCE is occupied with how resource allocation takes place in market economies and that existence of hierarchies economise allocation of resource which are more efficient than the market. The original dichotomy of markets and hierarchies was extended (Williamson, 1985; p.83) to include "*transaction forms in the middle range*" between markets and hierarchies and suggested that transaction cost is more appropriate than hierarchies. Williamson (1981; p.552) defined transaction as "*whenever a good or service is transferred across a technologically separate interface*." Williamson's transaction cost was criticised as being difficult to operationalise (Heide and John, 1992). Heide and John (1992) further maintained that TCE is concerned with the conditions that determine the structuring of relationships instead of specifying the mechanisms that provide the ability to implement the structures. The definition of cost was modified and redefined as the "*costs of running the economic system*" (Williamson, 1999: p.1088).

TCE seeks to explain the existence of firms and how firm boundaries are determined through transaction analysis (Coase, 1937; Williamson 1975; 1981). It has been extended to analyse the firm as economic institutions for organising economic activity, problem of contractual relationships between organisations and markets, based on the cost of establishing relationships or governance structures associated with relationship development decisions (Williamson, 1981). The transaction is the key unit of analysis. Features of the transaction are the main variables for understanding the results of different governance mechanisms. Williamson (1991) argued that these governance mechanisms may extend from market to hierarchy, with bilateral or hybrid modes falling in between.

The theoretical work of Williamson (1981) focused upon the transactions that take place between organisations and suggested that in order to develop more meaningful economic theory; the transaction between organisations should be the focus for research. TCE had been developed to include Coase's (1937) searching and contracting costs but also built on the work of Simon (1947) to explain costs in terms of human and environmental factors. These are bounded rationality, opportunism and asset specificity and are recognised as the theory's rationale (Barthon and Jepsen, 1997). Williamson (1999) affirmed that the firm can reduce problems through a reduction in the number of exchanges (i. e. increased frequency) resulting in learning and the use of authority to end prolonged disputes.

The two major assumptions behind TCE are 'bounded rationality' and 'opportunism.' Bounded rationality assumes that exchange partners are intendedly rational, but their rationality is limited by their inability to process information without error (Williamson, 1981). In a relationship context, while relational parities might want to act rationally, they are limited in their ability to receive, store, retrieve, and communicate information without error. This limits the extent to which rational behaviour can be conducted (Grover and Malhotra, 2003). In its essence, TCE views bounded rationality as a problem related to conditions of uncertainty (Alaghehband *et al.,* 2011). These conditions make it difficult for parities involved to wholly determine the conditions surrounding an exchange, thus causing an economic problem. Without bounded rationality, all contingencies can be incorporated into a contract and the parties involved in the exchange will not have to incur continuous renegotiation costs. But the parties' rationality is limited, leading to the minimisation of transaction costs through a correct choice of governance.

Opportunism is the second assumption, and specifies that parties in the exchange relationship will be guided by considerations of 'self-interest with guile' (Williamson, 1981;

Alaghehband, 2011). It implies actors in the exchange relationship are willing to engage in lying, cheating and other forms behaviours in order to complete a transaction that will give them an advantage. The existence of opportunism gives rise to transaction costs in the form of monitoring behaviour and safeguarding assets to prevent the other party from engaging in opportunistic behaviour (Grover and Malhotra, 2003). Both bounded rationality and opportunism become complicated under high degrees of uncertainty because firms have greater difficulty of creating strategies for detecting all possibilities in advance (Williamson, 1985). Hence, both assumptions (bounded rationality and opportunism) encourage firms to closely monitor and control their exchange partners (Ryu *et al.,* 2008). Such monitoring and control costs lead to increase in transaction costs. Consequently, governance structures are needed to organise these transactions. In a perfect market opportunism can be avoided but not when there are small numbers of exchangers.

The important transactional features are asset specificity, uncertainty and frequency (Williamson, 1985). Transactions characterised by high asset specificity and high uncertainty need a more complex governance mechanism than standard transactions with low asset specificity. The significance of frequency is in relation to the costs incur. Complex governance mechanisms may incur large costs, which must be recovered in future transactions. If transactions are infrequent, it is unlikely that the actors will invest in expensive and complex governance mechanisms.

Asset specificity is defined as the ‘‘degree to which the assets used to conduct an activity can be redeployed to alternative uses and by alternative users without sacrifice of productive value’’ (Williamson, 1996, p. 105). According to Williamson (1985, p. 95), four different types of transaction specific asset investments can be identified:

- site specificity, which is related to the geographical location of an investment;
- physical asset specificity, which is related to specialised equipment and tools;
- human asset specificity, which is associated with employees' knowledge, expertise and learning by doing; and
- dedicated asset, which represent a discrete investment in generalised production capacity that would not be made but for the prospect of selling a significant of product to a specific customer.

Barthon and Jepsen (1997) asserted that TCE predicts that as asset specificity increases, market mechanisms are gradually replaced by organisational mechanisms based on authority and integration.

Governance mechanisms are used by contracting organisations to safeguard opportunistic behaviour. Therefore, contracting organisations attempt to align activity structures with the market within which they procure resources of subcontracting firms. Whereas the spot market is inappropriate for complex transactions due to the risk of contract breakdowns, complex governance is too costly for simple transactions. Winch (2001) acknowledged different types of governance mechanisms based on incentive intensity, contract law regime and administrative controls. Hence, uncertainty associated with contractor – subcontractor transactions gives rise to differentiation in subcontractors' procurement in order to reduce transaction costs. Governance such as markets, firms and hybrids have unique characteristics. Furthermore, it has been observed that different levels of asset specificities are associated different governance structures Lui *et al*., 2009; Ross, 2005). Ross (2005) revealed that more integrated governance structures are associated with a higher degree of asset specificity, greater uncertainty, more complex transactions. To economise transaction costs, transactions with different properties are matched with governance modes.

3.3 Transaction Cost Economics and Contractor-Subcontractor Relations

The concepts of asset specificity and uncertainty from TCE have employed by researcher as drivers of subcontracting decisions (Hartmann and Caerteling, 2010; Ngowi and Pienaar, 2005; Sozen and Kayahan, 2001; Eccles, 1981). One of the means of coordination and treatment of uncertainty is managerial hierarchy provided by transaction economics. There are various ways in which uncertainty manifests itself in contractor-subcontractor relationships. First, is regarding the coordination and integration of the outputs of specialist trade groups which carry out interdependent tasks. Secondly, subcontracting work packages implies that main contractors depend on subcontractors to meet their objectives and success of the projects. Since the capabilities and quality of resources of subcontractors are yet to be determined, it requires main contracting organisations to have a degree of confidence in their subcontractors for the services yet to be provided (Hartmann and Caerteling, 2010; Ngowi and Pienaar, 2005). Third, it is not yet known if contractual agreements will be fulfilled by the two parties. Furthermore, there are uncertainties regarding weather and soil conditions, and fluctuations in construction demand. Additionally, there is uncertainty associated with securing continuous jobs in the case of the subcontractor, which can be mitigated by the establishment of enduring long-term relationship between the two parties (Sozen and Kayahan, 2001).

Eccles (1981) contended that project complexity and size and market extent have resulted in increasing adoption of subcontracting system, rather than seasonal fluctuations. Eccles (1981) further acknowledged the source of the complexity to be that of specialisation of building skills. Similarly, Williamson (1975) noted that the system of subcontracting is a response to uncertainty arising from complexity, given bounded rationality of the firm. Gonzalez-Diaz *et*

al. (2000) also concluded that greater utilisation of subcontracting is as a result of increases in output heterogeneity.

Moreover, there is human asset specific investment (Sozen and Kayahan, 2001). High human asset specificity[2] is a direct result of the production technology used in the construction process, which commonly is classified as craft technology (Kale and Arditi, 2001). Even where bilateral relationships have been developed from project to project based on some form of negotiation may be occasionally tested by competitive bids from other subcontractors (Hartmann and Caerteling, 2010). Eriksson and Laan (2007) observed that procurement procedures – the main contractors' strategy is tailored to transaction relationships.

3.4 Construction and Transaction Cost Economics

TCE is a common theoretical framework for examining procurement strategies and inter-organisational relationships in general (Eriksson, 2006) and particularly in construction (Eriksson and Laan, 2007; Ngowi and Pienaar, 2005; Turner, 2004; Rahman and Kumaraswamy, 2002; Winch, 2001; Kale and Arditi, 2001; Voordijk *et al.*, 2000; Eccles, 1981). The theoretical framework of transaction economics can assist in the understanding of the inter-firm relationships that exist between parties prior to the formation of a contract. Proponents of TCE argued that competitive advantage results from efficient governance of transactions (Williamson, 1985), which requires tailoring of procurement techniques to transaction characteristics (Chiang, 2009; Eriksson, 2006). Previous studies such as Eriksson (2006), Turner (2004) and Winch (2001) tackled the governance of construction projects and the relevance of TCE and offer a useful framework for the understanding of relationships between organisations, their communicative behaviour and their treatment of uncertainty. For

[2] Human asset specificity refers to learned knowledge as a result of the transaction

example, Winch (2001) identified three fundamental features that influence inter-organisational relationships during an exchange of a good or service across a technologically separable interface to include: (i) contingency – factors which are related to a transaction and comprises uncertainty, frequency and asset specificity; (ii) behavioural – factors which include bounded rationality, learning and opportunism; and (iii) context.

Under the context of long-term relationship continuation, any investments for the relationship can be viewed as a form of long-term investment where cooperation yields high returns and ensures the parties to benefit in the future from mutual adaptation (Tang *et al.,* 2006). Furthermore, it is argued that goods and services are produced more efficiently when partners invest in the relationship (Williamson, 1981). However, some investments have a "lock-in" effect, because they cannot be easily put to other use without incurring economic losses. These investments are called transaction-specific assets, which are those assets that have little or no value outside the main exchange relationship (Williamson, 1985). These assets can include human capacity specificity (knowledge or skills development), physical asset specificity (development of specialist equipment), site or location specificity (location), dedicated capacity (to protect from surge) or brand name (this can relate to franchises), temporal specificity that has been identified as being similar to sequential interdependence (Ekström *et al.,* 2003). The value of the transaction-specific asset depends on the continued existence of the buyer/seller relationship; consequently one party that hasn't invested in the relationship may appropriate value by using the asset in another context. The greater the asset specificity, the greater the loss becomes if a partner decides to change the relationship (Eriksson, 2006). Thus, the willingness of behaving opportunistically is minimised (Tang *et al.,* 2006). Moreover, since transaction-specific asset investments create delayed payoffs, it forces the investing party to safeguard the continuity of the relationship so as to secure these

payoffs. Consequently, if the investor is unsure as to the safety of the value yielded from the relationship, the investment may not be made. On the other hand, the invested party will demonstrate commitment to the partner and desist from producing opportunistic behaviours against the partner in order to guarantee the continuity of the exchange relationship (Ngowi and Pienaar, 2005). Thus, asset specificity can offer a control mechanism to decrease opportunistic behaviours (Heide and John, 1992).

Moreover, Winch (2001) proposed that the most appropriate choice of governance mode occupies a three dimensional space as a function of contingency factors. These are learning (which relates to frequency), asset specificity (which relates to opportunism) and uncertainty (which relates to bounded rationality). Winch (2001) further suggested that in a project context, projects start with very high levels of uncertainty at inception until the completion of the project when all the information concerning the project is assembled and embodied within the project.

Construction is teamwork that involves a large number and a wide variety of craftsmen and technicians, which can be viewed as temporary organisations through which project goals are realised (Turner, 2004). In complex construction projects, the main contractor tends to interact with varieties of specialist trade contractors. It has been suggested that make or buy decisions are made based on transaction costs, and that the only way of economising on transaction costs in construction is to increase the contractor's economic incentive to cooperate (Chiang, 2009; Parker and Hartley, 2003). This could be achieved only through long-term relationship with their subcontractors and suppliers, sharing risks in alliance agreements, increasing the importance of reputation and cooperative skills in relation to procurement (Teece *et al.,* 1997). Mclvor (2009) also asserted that developing a unique set of firm-specific, trust-building and value enhancing relationships with their suppliers and

subcontractors can help organisations not only in creating but also sustaining their competitive advantages that are difficult to imitate.

Williamson (1996) constructed a governance structure continuum on which different forms of transactions that affect the organisations are plotted. The continuum begins with open spot market where transactions are purely incidental through complex contracts, relational contracting where the contracting organisations function cooperatively as a team to accomplish the transaction objectives. Each governance structure has its strengths and weaknesses. The use of on open spot markets has been identified to offer the most incentive to maximise the net value by economising on the units of production. On the other hand, spot market involves low asset specificity, which means that the seller can be easily replaced leading to low levels of trust. The use of contracts can provide safeguards to both buyer and seller, however they are incomplete and parties may pursue potential gains through opportunistic behaviour. In essence, more complex governance mechanisms are necessary to manage the uncertainty, settle disputes and adapt to new conditions. Although optimum governance structure is impossible to attain, the asset specificity of a selling organisation may help to understand the relationship that exists between it and the buying organisation.

3.5 Contractor-Subcontractor Working Relationships and Asset Specificity and Uncertainty

Asset specificity relates to the ability to replace the supplying organisation. Contractor-client relationship specificity may differ from that of contractor-supplier relationship. This is because a contractor has to enter into post-contract negotiations with subcontractors in order to improve profit margin. Also, the difference stems from the contractual relations that exist between the parties. At pre-contract, the specificity relates to the dependence that the

organisation places upon the other whereas post-contract can be related the temporal specificity. The buying organisation therefore faces two extremes of the subcontracting decision – "variable boundary or fixed boundary" of the firm (Cox *et al.*, 2006). The primary concern is determining the boundaries between these two extremes (Mclvor, 2000). TCE assumes that the decision will always be considered taking into account the scope for cost reduction and the importance of asset specificity.

Williamson (1981) distinguished between six types of asset-specificity of which many of them can be applied to a construction project. Because construction projects usually involve a large number of professionals, transactions concerning assets specificities also differ. According to Ekström *et al.* (2003), the analysis of the subcontracting of the trades that form a construction project team from the lens of a transaction cost should start from categorising them in terms of asset-specificity. Ekström *et al.* (2003) suggested that when products or services are carried out by "somewhat more specialised" trade contractors the transactions involve human asset-specificity, whilst trade contractors that are highly specialised give rise to temporal asset-specificity of sequential interdependence. Eriksson and Laan (2007) also argued that TCE considers three main governance mechanisms - price, authority and trust and maintain that the suitability of these mechanisms mostly depends on the levels of asset specificity and frequency in the transaction.

Adversarial relationships have been associated with price where both buyers and suppliers adopt a short-term view on business development, with little interest in enhancing their long-term relations (Cheung *et al.*, 2003). For each transaction, the buyer chooses the supplier with the best trade-off between product, price and availability (Ekström *et al.*, 2003). In a transaction governed by authority, the buyer can get the desired product or service from the supplier through control of behaviour (Eriksson and Laan, 2007: Kim and Mahoney, 2006).

Furthermore, the development of trust is considered crucial in cooperative relationships (Kadefors, 2004). Level of influence of asset specificity on each transaction varies and thus requires the main contracting organisation to take different causes of actions during the stages of the buying process. When asset specificity of subcontracting firm is high, the main contracting organisation in the exchange is "locked-in" in the transaction (Williamson, 1985). Furthermore, the greater the transactional uncertainty and uniqueness with projects and the lower the transactional frequency, the potentially higher the transaction costs that are placed upon the contracting organisation.

	Asset specificity		
	Low	Medium	High
Type of procurement	None specialised	Somewhat specialised	Highly specialised
Example of trade	Concrete/painting	Groundwork	Steelwork/mechanical/electrical
Sources of asset specificity	Locational	Locational Human	Locational Human Temporal
Frequency of transaction	Occasional	Occasional/recurrent	Recurrent
Emphasis on relationship indicators	Price: high Trust: low Authority: low	Price: medium Trust: medium Authority: medium	Price: low Trust: medium/high Authority: high/medium
Type of governance structure	Free market/ hybrid	Hybrid	Hybrid/integrated

Source: Eriksson (2006) and Ekström *et al.* (2003)

Figure 3.1 Framework for analysis of trade contractors' collaborative procurement strategies

Figure 3.1 identifies construction transactions in terms of asset specificity and choice of governance mechanisms available to the buying organisation. It illustrates different causes of actions that could be taken by organisations during the stages of the buying process. The

various work packages are characterised by differing levels of asset specificity and uncertainty. Thus, asset specificity can influence procurement strategies and bilateral dependence.

In summary, TCE predicts that two conditions which can influence main contracting organisations' collaborative procurement strategies. The first involves high asset specificity and uncertainty. When asset specificity and uncertainty are high, main contracting organisations may not be able to measure and evaluate subcontracting firms' performance. Consequently, subcontracting firm can engage in opportunistic behaviours. Additionally, hold-up costs arise due to high asset specificity. TCE thus predicts that organisations will employ internal governance structure to minimise transaction costs (Wang *et al*., 2006). Secondly, under high uncertainty main contracting organisations are unable to predict future contingencies and, thus cannot provide for these contingencies in a market contract. The market is ineffective as a governance structure of reducing opportunistic behaviour (Wang *et al*., 2009; Eriksson, 2006). Hence, main contracting organisations may use internal governance structure to minimise transaction costs. TCE can provide the theoretical lens through its asset specificity and uncertainty to understand contractor-subcontractor complex working relationships.

3.6 Contractor-Subcontractor Working Relationships and Resources

In relationships, the exchange of resources is considered critical to its success (Hunt and Morgan, 1994). Therefore, the quality and effectiveness of contractor-subcontractor relationship depends on both parties as they play a key role in ensuring the overall success (Sánchez-Rodríguez, 2009). Strategic initiatives have been identified as a critical precursor of supplier involvement in the buyer's product development process (Carr and Pearson, 2002),

conceptualised and operationalised as the interrelationship of wide range of activities that include both technical and functional as well as interpersonal relationship management efforts within overall supply chain networks (Humphrey *et al.*, 2009). Likewise, capabilities and performance of the supplier has been recognised as key factor influencing collaborative buyer-supplier relationships (Barnes *et al*., 2005; Parker and Anderson, 2002; Krause and Ellram, 1997).

According to Dyer and Singh (1998), if resources are combined in unique a way it may lead to a competitive advantage through four important mechanisms: joint investments, knowledge exchange, combining valuable and scarce resources, and more effective governance. In addition, McHugh *et al.* (2003) identified cooperation, and interdependence necessary to sustain successful relationships. It has been acknowledged that any effort on the part of the buying firm to realign the supplying firm's capabilities with the buyer's needs should be part of the buying firm's planned strategy if they are to contribute to the attainment of the firm's overall goals (Sánchez-Rodríguez, 2009). Therefore, contractor-subcontractor working relationships stem from many interactions between the two parties which are nested in more complex inter-firm relationships. As observed by Nataraajan and Bagozzi (1999), an integrative approach that considers these different levels of explanation is necessary to provide a better understanding of business exchanges.

The perspective of RBT is that collaborative supply chain strategies are achieved through complementary organisational resources (learned knowledge, skills, technologies and competencies) which forms can leverage to gain advantage (Melville *et al.*, 2004). Thus, it can be argued that RBT can provide lens through which collaborative exchange framework can be assessed.

3.7 Collaborative Procurement Strategy Development

Parties to an exchange involve in collaboration relationships for variety of reasons. One of the difficulties organisation face is trying to develop a relationship strategy that takes into account the technical demands of the project and its environment (Ng *et al.,* 2009).The strategy has to take account of the external environment, the technology of the project, the procurement arrangements of the clients, the internal environment of the contractor and the external parties involved in the project (Ross, 2005). Technology as relationship indicator has attracted the greatest attention. Lansley (1994) argued that it is not easy to measure and compare technology across a large range of organisations and suggested that researchers should not only focus on the technology but also on the environmental constraints that surround the firm. The certainty associated with the project technology can be measured as complex (high requirement for external party input and potential for high costs), simple and interdependence (Goulding, 2012; Ross, 2005). Furthermore, Ekström *et al.* (2003) submitted that technology may help to decrease uncertainty and complexity of business transactions. Timely use of technical expertise could lead to market opportunities and economic advantage. Technology, however, is not independent. Instead, it can be further reflected by some other detailed relationship indicators such as resource efficiency and client requirement. The role of technology within project development is essential and can be used as collaboration indicator within competitive environments such as construction (Chow *et al.,* 2008).

Moore (2002) reported varieties of construction environment and their extent of impact on project developments. For instance, Akintoye and Main (2007) identified some of the reasons for collaborative relationships to include: the need of the customer, market opportunity, reduction in project risk and changes in technology. According to Chow *et al.* (2008),

collaboration can drive remarkable changes in business processes and result in many benefits such as improved working relationships, effective information exchange, less conflicts and risks, higher productivity, cost savings, improved quality, faster processes and better customer responsiveness. In construction, the external environment can be considered as a number of interacting factors which can range from stable to dynamic, simple to complex and friendly to hostile. As considered by Li *et al*. (2006), organisations become competitive only in environments of supportive suppliers and service providers; the more efficient and developed these networks of firms, the easier it is for firms to focus on their core competencies, which in turn adds to the overall competitiveness of the entire supply chain.

Effective and efficient collaborative procurement strategy seeks to reduce the cost of transactions and uncertainty where possible. It is also essential in the development of relationships. Likewise, an efficient supply chain network can be viewed as an efficiency enhancer that adds to flexibility of operations by reducing lead time and helps in joint product and process development. Lack of technologies and organisational capabilities has been identified as the real problem in attracting a relationship partner (Ekström *et al*., 2003). Similarly, Chow *et al*. (2008) suggested that improvement in the "technological capacity" of supplier organisation can lead to an increase in competitive advantage. Improved technological capacity, therefore, could enhance the attraction of a supplier. Barney (1991) confirmed that firms develop capabilities and competencies in order to be competitive in their market of operation. Project technological requirements can therefore determine the type subcontractor to be selected.

Specialist trade contractors vary in terms of resources, technological knowledge, skills, size and markets of operation (Goulding, 2012). The availability of particular trades and entry and exit barriers of a group of subcontractor can influence the choice of strategy adopted by main

contracting organisations (Ross, 2011). The numbers of subcontractors with the capability to undertake complex projects can also affect the contractor's procurement strategy. Likewise, collaborative relationships are formed with supply partners not just to share risk, but increase opportunities for market share (Eriksson *et al*., 2007).

Table 3.1 Variables influencing contractor-subcontractor relationships

Variables
(1) Procurement route **(2)** Subcontractor workload **(3)** Market intensity **(4)** Limited numbers **(5)** Safety Programme **(6)** Subcontractor type **(7)** Project complexity **(8)** Organisational capability **(9)** Reputation **(10)** Bilateral dependence **(11)** Interdependency **(12)** Project location **(13)** Technological advancement **(14)** Price

Variables **Authors**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Akintoye and Main (2007)													√	
Artto et al. (2008)								√						
Bankvall *et al.* (2010)												√		
Briscoe and Dainty (2005)									√					
Chan *et al*. (2004)					√		√							
Chow *et al.* (2008)													√	
Cox and Ireland, 2002										√				
Dainty *et al*.(2001)		√					√							
Dow *et al*. (2009)	√													
Ekström *et al*. (2003)						√						√		
Eriksson (2006)						√					√			
Eriksson and Laan (2007)									√		√			
Goulding (2012)													√	
Hsieh (1997)					√								√	√
Humphrey *et al*. (2003)									√					
Kadefors (2004)							√							
Kale and Arditi (2001)		√						√		√				
Lavelle *et al*. (2007)		√												√
Love *et al*. 2004					√				√					
Lowe (2011)			√											
Malik *et al*. (2006)	√										√			
Mawdesley *et al*. (1998)	√													
McHugh *et al.* (2003)										√	√			
Mclvor (2009)								√					√	
Ng *et al*. (2009)			√	√										
Ross (2011)				√							√		√	
Winch (2001)									√					

Differences in size of organisations affect the relationship of strategies and the form of relationships (Briscoe and Dainty, 2005). The capacity of a supplying firm to meet the requirements of project and other inputs for the focal organisation is necessary to ensure timely completion. An organisation strategy depends on the drivers, linkages and interdependence between the supplying firms and overall organisational attributes (Mclvor, 2009; Ross, 2005). Thus, organisational characteristics must be understood and assessed, and critical factors need to be identified and incorporated into the decision-making process for procurement strategies development. Fundamental to handling construction projects is therefore size of a firm.

The variables included in this work were identified from existing literature and considered to influence contractor-subcontractor relationships and inference. They were then piloted in semi-structured interviews to ensure their importance on the aim and objectives of the study. Fourteen variables were arrived at after the pilot interviews. Table 3.1 presents these variables. Theoretical support for the constituent these variables is provided by TCE and RBT, which can be used to develop a framework explaining the contractors' collaborative procurement strategies with different specialist trade contractors within their supply chain networks.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.0 Introduction

Chapter One provided the imperatives for carrying out the research, while the literature reviewed in chapter two and chapter three identified the theoretical background for the investigation. However, an appropriate research strategy and design is required so as to investigate the stated hypotheses. The methodology section is one of the key features in the process of research design and provides insight into the current issues in the chosen field. The selection of the strategy is influenced by factors that relate to the epistemological background to the area, the nature of the research question, the opportunity to collect and analyse relevant data, and the availability of resources that can be employed during the research process.

4.1 Epistemological Background

Schon, (1995) defined epistemology as *''conceptions of what counts as legitimate knowledge and how you know what you claim to know''* (p. 27). It therefore refers to the nature of knowing and construction of knowledge. Epistemology refers to the philosophy of knowledge and addresses how we come to know the reality (Creswell, 2009). Krauss (2005) asserted that epistemology is closely related to ontology and methodology and poses the following questions: What counts as knowledge? How do we know what we know? What is the relationship between the researcher and what is being investigated? According to Gabrielian *et al.* (2008), epistemologists generally recognise four different sources of knowledge:

- rational foundationalism- the school of thought which is based on the view that all knowledge comes purely from reason;

- natural foundationalism- the foundationalism philosophy which argues that all knowledge comes from empirical data found in the world;
- coherentism – a philosophical foundation with the view that fundamental foundations are not required (i. e. that although every argument requires premises there is nothing that is a premise to every argument); and
- scepticism- the view that there is no knowledge.

As a result, there are different beliefs, ideas, academic values and ways in which research studies are conducted. Nevertheless, there are certain principles and rules that guide a researcher's beliefs and actions. Such standards or principles can be referred to as a paradigm (Gorard, 2003). A paradigm is a theoretical framework which includes a set of assumptions and beliefs that constitute a good way of carrying out research (Newman, 2007). Research paradigms define not only what views are adopted, but also the approach to questioning and discovery (Fellows and Liu, 2008). Thus, a researcher's methodological choices and structure of inquiry can be affected this intellectual terrain reflecting patterns of beliefs and practices, ideas, and academic values.

The two conflicting and competing perspectives often cited by methodologists when supporting competing paradigms for studying the social and natural world on the philosophical nature of knowledge are positivism and interpretivism. The two paradigms have at their core, criteria for the evaluation and reliability of the knowledge that is derived from conducting research. Therefore, Krauss (2005) notes that a theoretical paradigm identifies the underlying basis that is used to construct a scientific investigation or, as Bogdan and Biklan, (1982; p. 30) put it "a loose collection of logically held together assumptions, concepts, and propositions that orientates thinking and research."

4.1.1 Positivism

The positivist paradigm originates from the philosophy known as logical reasoning and is based on rigid rules of logic and measurement, truth, absolute principles and prediction (Gorard, 2003; Gauch, 2002). According to Fellows and Liu (2008), it recognises only non-metaphysical facts and observable phenomena. Hence, it is strongly related to rationalism, empiricism and objectivity (Bryman, 2008). Positivism asserts that the social world (observable facts) can be observed and measured by a researcher in a way that is uninfluenced by the researcher (Fellows and Liu, 2008); it emphasises on numerical measurement of facts (Newman, 2007). It recognises that universal, or natural laws are completely independent of the researcher; and that social or observable phenomena are seen as an ontologically objective and verifiable fact, and so, there is only a single truth which is objective (Gabrielian *et al.,* 2008; Creswell, 2009). Clearly, it is closely related to quantitative approaches.

4.1.2 Interpretivism

Proponents of interpretivism hold an opposing view to the positivist approach to research regarding it as applicable to the natural sciences and thus do not submit wholesale adoption of the positivist approach in conducting social science research. This paradigm argues that social reality is complex and situated in time and space, and that causal explanations can never encompass this complexity and dynamic. Interpretive approach is of view that the main subjects of research (individuals and institutions) and natural science phenomena are dissimilar, and thus related approach to studies should involve different set of logic or procedure to reflect the difference or uniqueness (Bryman, 2012; Newman, 2007). Proponents of this approach suggest that individuals interact and respond to situations based

on their beliefs about reality rather than what is objectively real (Creswell, 2008; Newman, 2007). Consequently, the social world can be better understood by studying the way individuals uniquely perceive it. In other words, inductive approach should be taken to research the social world, in that explanation is through the subjects meaning systems and understanding is central to the approach. This paradigm is closely associated with qualitative enquiry. The key differences between the two paradigms are illustrated in Table 4.1.

Table 4.1 Differences between quantitative and qualitative research

Quantitative	Qualitative
Paradigm: positivism, empiricism	**Paradigm:** subjectivism, interpretivism, constructivism
Methodology: scientific method, hypothesis focused, hard reliable data, deductive, valid, objective, generalisation	**Methodology:** phenomenology, ethnography, inductive, subjective, deep rich data, contextual understanding
Methods: large scale, surveys, theory testing	**Methods:** small scale, interviewing, observation, theory emergent
Research design: more structured, rigid, fixed, predetermined	**Research design:** unstructured, flexible
Analysis: numbers or statistics	**Analysis:** words or thematic examination
View point: the researcher	**View point:** the participant
Setting: artificial	**Setting:** natural

Source: Bryman (2012) and O'Leary (2010)

The methods available to researchers and have come to present a whole set of assumptions can be categorised as 'qualitative' or 'quantitative' (O'Leary, 2010). While quantitative and qualitative traditions represent a fundamental and important debate in the production of knowledge and proponents of each tradition point to key differences, both can be used in positivistic or interpretive studies. Quantitative research has tended to be favoured by the former whilst qualitative by the latter. A key feature of quantitative research is that it is often

characterised as an objective of positivist search for singular truths that relies on hypotheses, variables, and statistics, is generally large scale but without depth (O'Leary, 2010). Quantitative research is generally based on logical deductive approach to investigate social reality. This involves testing stated hypotheses against hard empirical evidence with the help of quantitative variables and statistical procedures (Bryman, 2012). It is preoccupied by causality, generalisation and replication. In quantitative research, the measurement and groupings of requirements of the information that is collected demand that designs are more structured, rigid, fixed and predetermined in their use to ensure accuracy (Kumar, 2011).

Denzin and Lincoln (2005b, p. 3), defined qualitative research as a *''situated activity that locates the observer in the world,''* where the researcher is *''attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them*'' in natural settings. As observed by Kraus (2005), the most appropriate way to comprehend social phenomenon is to look at it within its own context. Thus, qualitative approach assumes subjectivity of social phenomenon based upon changing perceptions. According to O'Leary (2010), multiple realities exist in the social world instead of single truthfulness. Under qualitative tradition, the researcher interacts with the subject under investigation in order to explore in-depth and understand the interactions, processes, experiences and belief systems that are part of the social world from the view point of those who actually experience it (O'Leary, 2010; Creswell, 2009). Consequently, this method is viewed as value laden as the researcher's own values and beliefs, priori knowledge and bias impact on the research process and results through the interaction with the subject being examined. Simply put, the background of the researcher influences the interpretation and meaning of the study.

The inductive approach commends with gathering of information or observation, interviews, classification of data, identifying patterns and comparing patterns with existing theories. The

resultant product from this whole process is hypothesis and analysis (Kumar, 2011; O'Leary, 2010; Creswell, 2009; Bryman, 2012). Unlike quantitative research, qualitative tradition involves explaining social reality by providing holistic description of the setting, process, or relationship and thus qualitative data generally involve written or spoken words, symbols and visual aids and less use of numbers (Silverman, 2010; Newman, 2007).

Proponents of quantitative and qualitative approaches have built up criticisms against each other. For instance, Gabrielian *et al.* (2008) argued that there is no consensus as to what are exactly qualitative research methods. Furthermore, there is no unanimous agreement on their inherent features, underlying epistemology, and compatibility with quantitative methods. Conversely, quantitative approach is criticised as failing to acknowledge the inherent difference that exists between natural and social worlds (Creswell, 2008). Whilst under quantitative tradition researchers are seen as not involved in the subject being investigated as well as presenting the social world as being static through the process of analysing the relationship existing between variables, the qualitative method has been criticised as lacking generalisation of findings relevant to population (Marshall and Rossman, 2006; Bryman, 2012).

4.2 Mixed Method

The preceding discussions point out the limitations of both quantitative and qualitative methodologies. In order to overcome these weaknesses, a third methodology – pragmatic or mixed methods has emerged which emphasises the need to focus on the research problem employing all available approaches to produce better understanding of the subject under investigation (Greene, 2007; Creswell and Plano, 2006). It is the combination of qualitative and quantitative approaches to undertake a given study. This method therefore affords the use

of different paradigm views as well as variety forms of data collection and analysis. It is also referred to as a methodological triangulation (Fellows and Liu, 2008). According to Creswell (2006), 'one size does not fit all' and thus no research question fits perfectly into any one paradigm. Consequently, one approach may be more suitable for one question than the other (Bryman, 2012). As revealed by Fellows and Liu (2008), in using both quantitative and qualitative approaches in a study one approach may dominate the other. However, both approaches should be considered compactible and complementary to one another. This work adopted the mixed method approach due the following qualities it offers.

The adoption of mixed method offers the researcher a robust data collection strategy while allowing contradictions or new perspectives to emerge as well as providing the possibility for converging results (Plowright, 2011). Furthermore, it offers grounds for the limitations associated with each method to be compensated by using other methods concurrently. Likewise, Creswell (2009) argued that it permits research questions under investigation to be comprehensively addressed compared to using any single approach in isolation. Additionally, mixed method provides the means of cross-checking results obtained from one approach with the other (Creswell and Plano, 2006).

Notwithstanding its advantages, mixed method has its own weaknesses. The most cited weakness methodological triangulation is its expensive and time consuming nature (Fellows and Liu, 2008). Also, Creswell (2009) highlighted the inability of the researcher to possess the necessary skills to use both quantitative and qualitative methods. Although mixed method employs two or more research techniques, which are recognised as being different and complementary – each with particular strengths, weaknesses and contributions to make, the selection of appropriate methodology for a given study is influenced by factors such as the researcher's own worldview, and experience and training; the research audience; and nature

of the research problem or research objectives being investigated (Creswell, 2009; Fellows and Liu, 2008).

4.3 Strategies of Enquiry

According to (Marshall and Rossman, 2008) a research strategy allows data to be collected and analysed in any research project. The selection of research strategy is influenced by some key factors. For example, Saunders *et al*. (2009) observed that the choice of a strategy depends on the research philosophy as well as the nature of research problem or objectives. It also determines by the available resources and time at the disposal of the researcher (Greene, 2007). However, Saunders *et al*. (2009) suggested some strategies are related with quantitative technique whereas others are more associated with qualitative technique. Saunders *et al.* (2009) further stressed that depending on the problem being examined or the research objectives a strategy may be more appropriate than the others. However, one strategy is not superior to the other and that all are mutually inclusive.

4.3.1 Quantitative Research Strategies

Under quantitative research, two main strategies are identified namely; surveys and experiments. According to Creswell (2009) survey or non-experimental research provides numeric descriptions such as trends, opinions, or attitudes of the population through the generalisation of the findings from the study the sample. Although surveys are generally associated with quantitative research, they can also be used in qualitative studies and/or combined with other qualitative strategies (de Vaus, 2001). A survey can be either cross-sectional where data is collected on different cases at different times (Corbin and Strauss, 2008; Creswell, 2009).

Conversely, experimental research emphasises on causal relationships between two variables. It seeks to determine whether a specific manipulation affects an outcome (Creswell and Plano, 2006). Generally, subjects being investigated are randomly assigned to groups while one or more independent variables are manipulated to determine the impacts they have on the outcome if any whilst holding all other factors that could influence the results constant (Silverman, 2010; Creswell, 2009). However, Newman (2009) argued that such treatments are achievable under qualitative research. According to Newman (2009), under qualitative studies the observed participants are grouped into two with each group given the same treatment. The researcher however introduces a specific condition of interest to only a group and measures the responses of the two groups. Any variation in the responses of the two groups is therefore attributed to condition of interest introduced by the researcher. Experiments are therefore suitable for comparative studies where two or more entities of interest are under investigation.

4.3.2 Qualitative Research Strategies

In qualitative research, the forms of strategies include: ethnography, grounded theory, case studies, phenomenology, and narrative research (Silverman, 2010; Creswell, 2009; Saunders *et al.*, 2009; Corbin and Strauss, 2008; Marshall and Rossman, 2008). Each of the above mentioned strategy has unique feature that distinguishes it from the others and descriptions are summarised below. Ethnography is where the researcher stations him/herself into the group under investigation whilst observing and asking questions over a period of time. It refers to the act of describing a particular culture and understanding the behavioural aspects from the view point of the group. Ethnographic research involves collection of data via observation over considerable period of time. As stressed by Creswell (2009, p. 13), grounded theory is a research design where the researcher seeks to derive a *"general,*

abstract theory of a process, action, or interaction grounded in the view of the participants." This strategy of enquiry involves the use of numerous phases data collection process, refining and grouping data to establish relationships through comparisons of data with emerging categories and theoretical sampling of different categories (Blaikie, 2007).

On the other hand, case study research seeks to explore in detailed of a particular phenomenon within its context using multiple data collection methods. The use of two or more cases simultaneously affords the researcher to the opportunity to make comparison. Phenomenological strategy of enquiry is employed when the researcher seeks to explore in depth description of human experiences of a phenomenon from the perspective of the participants. It is more interested in the experiences of the participants rather than generalisation of the phenomenon being investigated.

Finally, narrative research is an enquiry strategy involves the researcher studying the of some individuals through asking such individuals to tell stories about their own lives and then the researcher re-narrates the stories in chronological order as were told by the participants (Creswell, 2007).

4.3.3 Mixed Method Strategy

Creswell (2009) identified three key strategies usually associated mixed method research design as sequential, concurrent, and transformative. With concurrent strategy, both qualitative and quantitative data are collected simultaneously. The transformative strategy requires the researcher to use theoretical framework as principal perspective for both qualitative and quantitative data. Sequential strategy, on the other hand, requires that the findings of one method are expanded upon using another method. For instance, the design

may begin with qualitative (interviews) and follow up with quantitative (survey) for generalisation purposes.

4.4 Sampling and Data Collection Methods

There are various forms of sampling and data collection techniques available to researchers. However, the selection of a technique is influenced by the nature of the research questions, the opportunity to collect and analyse relevant data, and the availability of resources that can be employed during the research process.

4.4.1 Sampling Techniques

The concept of sampling refers to the process of selecting a small group of participants from the larger target to become the basis for predicting the prevalence of unknown information or result about the larger group (Kumar, 2011). A sample is therefore a subgroup of the population of interest to the researcher. The aim of sampling in quantitative research is to maximise accuracy of the representative sample of the population whilst reducing bias to allow precise generalisation (Bryman, 2012; Gilbert, 2008; Kaplan, 2004). There are mainly two sampling techniques – probability and non-probability. The probability sampling techniques include simple random sampling, systematic sampling, stratified sampling and cluster sampling. Nonprobability, on the other hand, include haphazard, quota, purposive, and snowball sampling techniques. However, there are differences between sampling in quantitative and qualitative studies, and are guided by the opposing philosophies. Kumar (2011), for example, asserted that in quantitative studies researchers attempt to select a sample in order that it is unbiased and reflects the characteristics of the population from which it is selected, whereas in qualitative research is concerned with numbers – the ease in accessing potential respondents; judgement about the respondent knowledge about the issue

under investigation may influence the selection. Similarly, in quantitative research sample is designed to draw inferences about the population from which the sample is selected, whilst the in qualitative the aim is to gain detailed knowledge about the problem being investigated. Accordingly, Newman (2007) observed that quantitative studies tend to lean towards probability/ random sampling techniques, while qualitative research often uses non-probability sampling techniques.

The key difference between probability and non-probability sampling techniques is that unlike the latter, the former seeks to present equal opportunity to each potential participant of being selected in order to reduce bias. Probability sampling therefore depends much on sampling frames that define the elements in the study population from which sample is drawn. It is however be noted that in some cases sampling frame may not exist or cannot be closely estimated, and thus quantitative sampling may have to rely on non-probability sampling techniques (Kaplan, 2004).

4.4.2 Probability Sampling Techniques

For a sampling technique to be called probability sampling, it is important that each element in the study population has an equal opportunity of being selecting in the sample. The first and most common used method of selecting a probability sample is simple random sampling, where a sample frame is developed and a random process is used to select elements from the frame. It is where the researcher identifies all the sampling units or elements in the population, decides on the sample size (n), and select n using a table of random numbers or computer programme (Bryman, 2012; Kumar, 2011).

With systematic sampling, the sampling frame is divided into various sections referred to as intervals. Then, using simple random sampling technique, an element is selected from the

sampling frame. For instance, if in the initial interval it is the tenth element (e.g. 10th person) for inclusion into the sample, the tenth element of each successive interval will be selected (Kumar, 2011).

Stratified sampling involves dividing the study population into sub-groups so that the population within a sub-group or stratum is homogeneous regarding the features selected as a basis for stratification. This affords the researcher the opportunity to make sure that each sub-group is represented in the final sample (Newman, 2007). The procedure to selecting stratified sampling is to first identify all elements or sampling units in the sampling population. This is follow by deciding different sub-groups into which the researcher wants to stratify the study population. The researcher then places each unit into the appropriate sub-group. Every sampling unit in each sub-group is then numbered separately. The researcher then decides the total sample size and finally determines the number of elements to be selected from each stratum (Kumar, 2011).

The final probability sampling technique is the cluster sampling which is used when the study population is large and dispersed and becomes difficult and expensive to identify each sampling unit. The population is first divided into various clusters. A number of clusters are randomly selected and units within each cluster are further selected using the simple random sampling technique (O'Leary, 2010; Marshall and Rossman, 2008).

4.4.3 Non-probability Sampling Techniques

As the name implies, non-probability sampling techniques do not follow the theory of probability in the selection of sampling units from the study population. According to Kumar (2011), these techniques are used when the number of elements in a population is either unknown or difficult to individually identify. Newman (2007) identified four main types of

non-probability sampling techniques and are summarised below. The first technique is the quota sampling where the primary aim of the researcher is easy access to the sample population. Under this technique, the study population is divided into different groups of interest such as male and female and a predetermined number of elements in each group are selected to represent the composition of the population (Newman, 2007). Apart from being less expensive to use, quota sampling is also convenient. Next, accidental or haphazard sampling which involves selecting cases in any convenient manner. This technique makes no attempt to select people who possess an obvious characteristic; instead participants are selected because they are at right place and at the right time. Purposive sampling is another technique where the main consideration of the researcher is to decide as who can provide the best information to meet the objectives of the study (Kumar, 2011; O'Leary, 2010). It is generally used to select unique informative individuals or institutions. This type of sampling is extremely useful if the numbers of the population are difficult to reach or specific individuals are considered key informants to the problem under investigation. Finally, snowball sampling is a method of choosing a sample using networks (Kumar, 2011). It is also convenience sampling which often starts with few respondents. The first respondents are asked to provide the researcher with contact details of other people in the group, and further respondents are selected form them to become part of the sample. Snowball technique is mostly used where no sampling frame is available or for ease access to the population (O'Leary, 2010).

4.4.4 Sample Size

The sample size is the number of respondents from whom the required information is gathered. The size of the sample depends on factors such as the shape and form of the information required for the study, adopted technique and goals for analysis, characteristics

of the study population, and the need for accuracy for a given purpose (O'Leary, 2010; Newman, 2007). It is recommended that for more accuracy and highly dispersed population larger sample size should be considered whilst where the population is more homogeneous a smaller size may be acceptable (Newman, 2007). It must however be noted that a good sample is not necessarily one with larger size, because a large sample is not surety of precision (Bryman, 2012).

4.5 Data Collection Methods

Generally, there are several methods of collecting data. However, it is vital to design a research tool or instrument that can precisely captured the required information. The choice of a method depends on the objectives of the study, the availability of resources and the skills of the researcher (Kumar, 2011; Silverman, 2010; Bryman, 2012). Another important determinant is the demographic characteristics of the population. As with research strategies already discussed above, there are data collection methods that are usually associated with quantitative and others to qualitative research traditions. However, there are no fast rules regarding which methods are peculiar to which research paradigm and thus these methods are mutually exclusive.

4.5.1 Quantitative Data Collection

Apart from being enquiry strategies, surveys and experiments are also tools for gathering information in quantitative studies (Webster and Sell, 2007; Gorard, 2003). According to Kumar (2011), a purposeful and systematic observation is also a quantitative method for collecting data. Surveys techniques under quantitative research usually take the form questionnaires where respondent s are asked various questions involving attitudes, intentions, behaviour, perception, motivation and demographic characteristics (Creswell, 2009; Fowler,

2008). Questionnaires are generally involved the use of closed questions with a set of predetermined responses where the respondents read and record their answers and open-ended questions (Saunders *et al.*, 2009). On the other hand, in experiments, the researcher conducts the experiment to gather data which are then analysed.

The administration of questionnaires also takes different forms. According to Saunders *et al.* (2009) questionnaire can be self-administered or interviewer administered. The former is often completed by the respondents and administered either through the post (mail/postal questionnaire), electronically (internet based questionnaire), or delivered by hand to the respondents and collected at later date, whereas the latter responses to questions are recorded by the interviewer either through telephone or face-to-face interviews. Thus, quantitative traditionally researchers employ structured interviews using predetermined set of questions with pre-coded responses. The researcher reads out the questions and records the respondents' answers.

The use of these methods of data collection has their own advantages and may also suffer from a number of problems. Dillman (2006) argued that interacting face-to-face with respondent allows the researcher to clarify anything not understood to ensure right answers are provided which does not exist in other techniques. Furthermore, Rea and Parker (2005) contended that questionnaire is less expensive and comparatively convenient especially when it is administered collectively or through the internet, or other electronic means. In addition, mail and electronic techniques can reach respondents spread over wide geographical area. However, questionnaires are limited in application as only population who can read and write may participate (Kumar, 2011). Also, response rate tends to be very low. Besides, the choice of data collection techniques is influenced by the nature of the investigation, the type of population, the sample size, the amount of time and financial resources available.

4.5.2 Qualitative Data Collection

The main tools or methods under qualitative studies include unstructured interviews, observation, and secondary sources – the use of documents and audio-visual materials (Silverman, 2010; King and Horrocks, 2009; Gillham, 2005). As revealed by Saunders *et al.* (2009), unstructured interviews are in-depth interviews which are not uniform but informal. It is used when the researcher wants to explore in depth a general area of study and there is no clear predetermined set of questions on the issues of interest. Interviews can also take the form of semi-structured where questions are drawn from lists of themes and asked during the interview. The questions asked and the order in which they are asked may differ from one interviewee to another (Gillham, 2005). These types of interviews can be conducted once or repeated in which the research returns to the same interviewee or for a number of times or a group based interview as in the case of focus group (King and Horrocks, 2009).

Observation, on the other hand, involves observing, recording, describing, analysing and interpreting people's behaviour. In this form of qualitative data collection, the researcher "plants" himself or herself into the group of people or institutions being investigated (Bryman, 2012). It affords the researcher opportunity to involve in the activities and understands the issues as he or she experiences the issue being explored. All information is gathered through informal settings and is collected by keeping a diary of the things the researcher experiences and observes.

4.6 Data Analysis

The method of data collection usually determines procedures for analysis and the activities the researcher performs within each procedure. In quantitative studies, data analysis is usually

assisted by the user-friendly programmes such as Statistical Package for Social Science (SPSS) whilst Nvivo is used in qualitative data analysis.

4.6.1 Quantitative Data Analysis

Techniques used to processing data in quantitative research invariably influence by the nature of the data collected or the level of measurement (i.e. whether data collected are nominal, ordinal, interval or ratio). Nominal data cannot be ranked and therefore cannot be used to perform mathematical calculations. Responses to questions allow respondents to select an option or a category from a set of multiple choice answers involving nominal level measurements (Kaplan, 2004). The main function of nominal data is to allow the researcher tally responses in order to understand population distribution (O'Leary, 2010). Ordinal measurement involves ranking of data and orders categories in some meaningful manner. A typical example of the ordinal measurement is the Likert scale (Newman, 2007). O'Leary (2010), however, notes that many researchers treat Likert scales as interval because it permits them to accomplish more precise statistical test. Unlike nominal data or measurement, it is possible to determine whether one category is better than the other. However, the levels of difference cannot be determined (Newman, 2007; Gorard, 2003). In addition to ordering data, interval measurement uses equidistant units to measure the magnitudes of difference (O'Leary, 2010). Finally, not only is the difference or distant between variables can be measured, but there is also absolute zero in ratio scale. Newman (2007), however, argued that in practice differences between the interval and ratio makes little difference.

For data to be analysed statistically under quantitative studies, data should be as either parametric or non-parametric. The conditions under which each technique operates differ from the other. As revealed by Field (2013), to use parametric technique, data must meet the

criteria of parametric data. These assumptions are that data must be measured at least at interval level. This suggests that both nominal and ordinal data cannot be analysed using parametric technique. The second requirement is that data must be independent (i.e. data from different respondents must be independent from one another). Finally, data must be normally distributed and there should be homogeneity of variance. If these requirements are not met, then nonparametric technique is recommended since it operates on fewer assumptions about the nature of the data. The parametric statistics tests include the Pearson's correlation (r); t-test; Analysis of Variance (ANOVA) and many others. It must however be noted that each parametric test that can be carried out there is equivalent non-parametric test. Hence, statistical tests that can be conducted under non-parametric include; the Spearman's rho, Mann-Whitney test, Wilcoxon rank sum test, Wilcoxon single rank test, Kruskal-Wallis test and Friedman's ANOVA (Field, 2013; Tharenou *et al*., 2007).

A brief explanation of these statistical tests in parametric are provided below. Both t-test and ANOVA techniques are used to compare sets of quantitative data to determine whether they are similar or whether a significant difference exists between the groups. The t-test examines the difference between two sets of quantitative data. Independent sample t-test is used where different groups are assigned to differing experimental conditions, whilst the paired sample t-test technique is used when the groups of respondents are placed under two different experimental conditions. Field (2009) provided the formula for t-test is as:

$$\mathrm{t} = \frac{D - Ud}{Sd\sqrt{N}}$$

Where *D* is the observed difference between the two samples means; *Ud* is the expected difference between the population means given that that the null hypothesis is true (*Ud = 0*); and the denominator ($Sd\sqrt{N}$) represents the estimated standard error of the differences

between the two sample means. The expected means are expected to similar, if the two samples means are from the same population. Using the computer programme Statistical Package for Social Science (SPSS), the estimated probability value of t is 5% (0.05); if *t* value is less than 5%, it implies that there is very little possibility that the observed difference occurred by chance. Therefore, there is a significant difference exists between the groups.

Just like the t-test, ANOVA is conducted to compare whether there a similarity or difference exits between groups. There are two forms of ANOVA; the one way independent ANOVA where groups are independent of each other and dependent ANOVA where the same group of respondents are put through three or more experiments. ANOVA, however, compares the means of three of more groups. The result of this statistical operation is the F-statistic or ratio which compares the systematic variance in the data to the unsystematic variance. It must however, be noted that *F-statistic* does not pinpoint where exactly the difference may exist among the groups. A post hoc test is therefore conducted to overcome this problem by performing *t-test* for all possible pairs in the groups.

Furthermore, relationships between variables can be tested using correlation or regression analysis. There are different types of correlations that can be performed. First, positive correlation is where the variables move in the same direction or change. Second, negative correlation where variables move in opposite direction and thus no relationship exists between them. The range of the correlation coefficient is from -1 to +1. Under parametric test, Pearson's correlation coefficient, Spearman's *rho* or Kendall's *tau* can be performed depending on the nature of data collected. Correlation values of 7 to 10 are considered to be strong, 3 to 6 moderate, and 0 to 2 weak. Unlike correlation, regression analysis helps in determining causal relationships that exist among data sets.

In nonparametric data, the following can be conducted. First, Mann-Whitney test and Wilcoxon rank sum which operate almost on the principles. Both tests are carried out to determine difference, if any, between two independent samples. The Mann-Whitney test assists (*U*) in differences in the ranked positions of scores in two data sets. The scores are ranked from lowest to highest and thus the group with the lowest mean rank is said to have the highest number of low scores. By comparing the mean ranks of the groups, it can be determined whether difference exists between them. Conversely, the Wilcoxon test (*z*) is conducted where the scores of two sets of data are obtained from the same group.

Just like the independent ANOVA, the Kruskal-Wallis test is performed to find the difference between three or more groups. The Friedman's ANOVA, on the other hand, is conducted to find differences between several related groups. The test statistic for Kruskal-Wallis test (*H*) is labelled by SPSS as chi-square (x^2) and that of Friedman's ANOVA also as chi-square.

Conversely, categorical data are generally analysed descriptively using frequencies. Just like other data forms, relationships between categorical data can be conducted using Pearson's chi-square test (x^2). However, this test only compares the observed frequencies of the variables under consideration to the expected frequencies by chance. The expected frequency for each cell must be greater than 5. The rule for expected counts for larger contingency tables should be greater than 1 and expected counts less than 1 must not exceed 20%. If these requirements are not met, then the Fisher's exact test is recommended. The Cramer's (V) can be used to measure how strong relationship between two categorical variables.

Factor analysis is the technique to reduce large number of variables to manageable size. This technique is most appropriate where data is correlated. It examines relationships among groups of interrelated variables. It operates by representing data with fewer key factors and

thus used to identify key factors that explain correlation of a set of variables for subsequent regression analysis. The conditions for conducting factor analysis include: appropriate sample size, construction of a correlation matrix for the variables, selection of method for the factor analysis, a decision as to the number of variables to be extracted and which rotation method to be used. Besides, the Kaiser-Meyer-Olkin (KMO) test is employed to determine whether the sample is appropriate for factor analysis. This test assumes a value between 0 and 1. The closer values are to 1, the more indication that factor analysis will produce distinct and reliable factors and the opposite is true. A value of 0.5 or greater is usually considered appropriate (Jackson, 2009). Moreover, the basis for conducting factor analysis is to determine correlation between variables therefore cluster of variables that measure similar things must be significantly correlated. Where no significant correlation exists between variables under consideration, this technique will be reliable. The Bartlett's *test of sphericity* is conducted to check the level of significance between variables.

The process of rotation helps in determining related variables. The oblique rotation is recommended if factors are expected to correlate a priori else the orthogonal rotation is used (de Vaus, 2001). The selection of a method of factor analysis is also a key element that needs to be considered carefully. The selection is often depend on the aim of the analysis; that is, whether the analysis will be used to generalise beyond the study sample or to test specific hypothesis. Methods such as principal analysis and principal axis factoring hold that the sample used in the factor analysis is the population and thus the results are not to go beyond the sample. On the other hand, the confirmatory factor analysis is employed if the aim is to test for specific hypothesis (Field, 2013).

Furthermore, there are various ways of selecting factors (Bryman, 2012). Factors to be extracted can be de decided a priori, through the use of scree plot or the Kaiser's criteria. The

scree plot is a graph of the factors and their *Eigenvalues*; all factors to the left of the inflexion point are selected. Conversely, Kaiser's criteria assume that selection should be made for only factors with *Eigenvalues* greater than 1. The outcomes are then compared and the researcher decides for the appropriate result. As noted above, variables must be correlated to allow factor analysis to be carried out, however, highly correlated factors presents the problem of multicollinearity which must be avoided when it is extreme. Multicollinearity is detected from data set by checking the dominant of the R-matrix which should be greater than 0.00001. The determinant value is between 0 and 1; where 0 is perfectly correlated and 1 perfectly uncorrelated. The closer the value is to zero, the more severe the multicollinearity. In addition, the extracted factors can be tested for reliability using either spit-half reliability test or the Cronbach's alpha. These two techniques operate in almost the same manner but the Cronbach's alpha is the most widely used (Field, 2013).

4.6.2 Qualitative Data Analysis

The techniques that are commonly used in qualitative data analysis are conversation analysis (CA), discourse analysis (DA) and content analysis (Silverman, 2010; O'Leary, 2010). The CA technique allows the researcher to produce an orderly social interaction. The main principle underlying CA is that the talk follows steady and structured patterns. As argued by Silverman (2010), the contributions to current order activities are not clear unless the reference is made to its context. It emphasises the formal process through which information is communicated instead of the content of the conversation (O'Leary, 2010). According to Francis and Hester (2004) the choice of words and body language are vital for this technique. Thus, CA is more concerned with linguistic order rather than content of the data. One of the key weaknesses of this technique is that it is not suitable for semi-structured interviews since

notes taken by the researcher during such interviews cannot be used (King and Horrocks, 2009).

DA basically deals with naturally occurring data. Unlike CA, DA emphasises on the content of the data as well as its social settings (Gillham, 2005). Analysis through this technique focuses on context, variability and constructions in the information. Therefore, DA illustrates the way participant's conversational accounts of events are constructed for undertaking interactive projects. However, there are practical difficulties associated with this technique. The main disadvantage is that during interview sessions, interviewees tend to adapt to interview settings but do not react to their natural settings. Since interview settings affect responses of the interviewees and thus meaning of their responses, transcripts meant for DA should contain some element of non-linguistic aspect of the conversation that makes DA labour intensive (Silverman, 2010).

The final technique that can be used to analyse qualitative data is the content analysis. It is a procedure for analysing textual data regardless of its source. The technique makes use of categories usually derived from empirical data. The identified categories are repeatedly examined against empirical data or theory in order to make necessary changes. The aim of content analysis is to reduce data being analysed into major categories. The process allows quantification into qualitative data. Although content analysis has its shortcoming it also has several virtues making its adoption more appealing to researchers comparing to other qualitative data analysis techniques. First and foremost, it allows the processing of large amount of data covering long time span. Besides, it is relatively unambiguous and clearer to use techniques. Finally, it helps in eliminating the problems of researcher effects on the data that are inherent in other qualitative data analysis tools (Bryman, 2012).

4.7 Reliability, Validity and Ethical Issues

Reliability and validity are among the criteria for evaluating social research. Reliability refers to the level of consistency and usually concerns with the measures that are devised for concepts in social research (Bryman, 2012; Silverman, 2010). It implies the concepts can be repeated under the similar conditions at different occasions. Research reliability can be tested by using either the test-retest method, the spilt-half method, or the Cronbach's alpha. The test-retest method is where the same instrument or concept is assigned to the same group of respondents at different times or to different set of respondents. The spilt-half method as already noted, is where a single test is carried out on a sample which is then spilt into two and the results are then compared (O'Leary, 2010). Newman (2007), however, argued that it is difficult to achieve reliability requirements in qualitative research due to processes that change during the time span data collection. Thus, reliability is met by being consistent through the techniques adopted for data collection and analysis. According to Bryman (2008) and Newman (2007) piloting is one of the essential means of achieving reliability in social research.

Bryman (2008, p.171) defined validity as: "*an indicator or set of indicators that is devised to gauge a concept really measures that concept*." Silverman (2010) referred to it as the "truth;" the degree of accuracy instruments measure or findings represent the social phenomena. There are several means of establishing validity of a research. The first among them is the face validity where people with experience or expertise in the area of study are asked to decide whether the account or measure seems to mirror the concept concerned (Bryman, 2008). Concurrent validity is another technique used to validate research. It is based on comparing the indicator with existing accepted indicators of the similar concepts. Where it agrees with the existing indicators then concurrent validity is achieved. Furthermore,

predictive validity is where future indicator is used instead of pre-existing one as in the case of concurrent to conduct validity test. In addition, construct validity can be carried out to test research validity. This is where hypotheses are realised from a theory which is pertinent to the indicator (Bryman, 2012). Finally, convergent validity is based on comparing the concept to per-existing ones that were developed through other methods. As reported by (Field, 2013), research findings should be validated internally, whilst Newman (2007) suggested that different indicators that measure the same concept or aspects of the same concept should be employed to improve research validity. Similarly, Creswell (2008) recommended triangulation of data sources and analysis procedures for improvement in validity test. It must however be noted perfect reliability and validity is difficult to attain if not impossible (Newman, 2007).

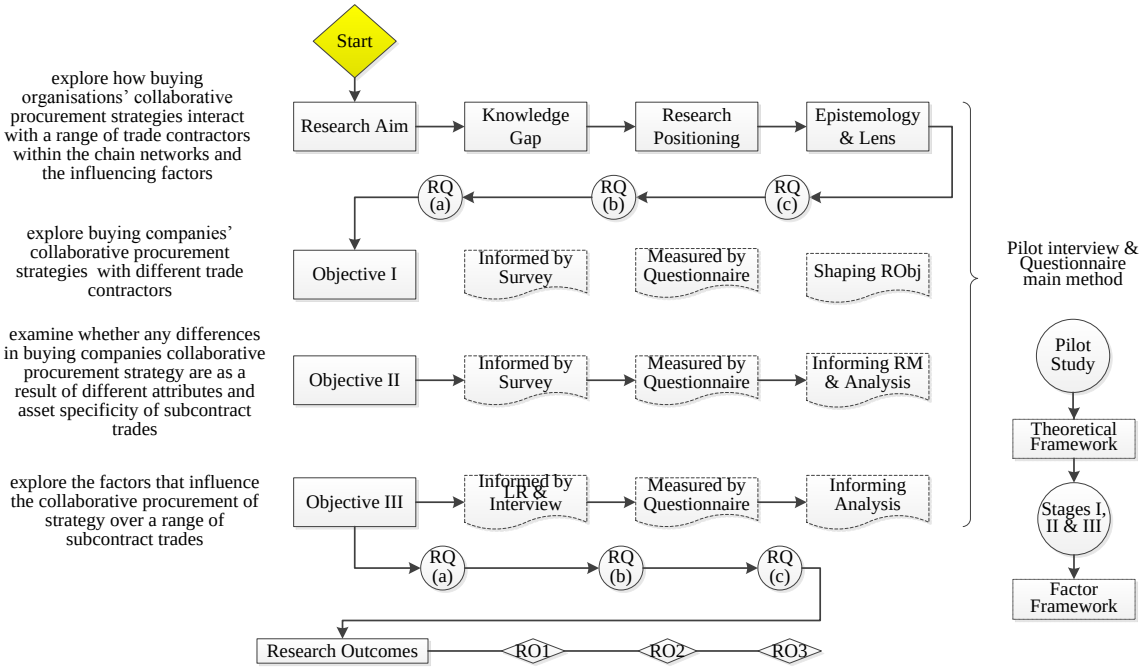
Additionally, due to growing public concerns and subsequent data protection laws (protection of the interest of participants), ethical issues in research have become increasingly significant (Descombe, 2010). Consequently, the researcher is required to act responsibly in dealing with people in carrying out the research. According to Descombe (2010) and Newman (2007) ethical requirements may also involve an authentic way of conducting the research (e.g. plagiarising or falsifying data).

4.8 Adopted Methodology

This section highlights the actual approach adopted in an attempt to investigate the study's objectives. The nature of the research objectives requires that data be gathered under different conditions and using differing data collection tools and therefore a mixed method approach was adopted.

Although mixed method has its own weaknesses: being expensive and time consuming (Fellows and Liu, 2008) and the inability of the researcher to possess the necessary skills to use both quantitative and qualitative method (Creswell, 2009), it has been successfully used in a number of recent studies (Ng *et al.*, 2009; Mason, 2007; Humphrey *et al.*, 2003).

In this study, mixed method was adopted because it has potential benefit that offers the researcher a robust data collection strategy while allowing contradictions or new perspectives to emerge as well as providing the possibility for converging results (Plowright, 2011). Also, it permits research questions for this work to be comprehensively addressed compared to using any single approach in isolation (Creswell, 2009). Furthermore, it provides grounds for the limitations associated with single method to be compensated (de Vaus, 2001). Moreover, it helps to minimise weaknesses in the measuring instrument and make operationalisation less flawed, and thus improve the reliability of the communicating (internal validity) the construct to the respondents as well as reducing the erroneous of data collected. Finally, priori knowledge of the researcher has also informed the selection this approach. The researcher also maintained a non-bias attitude throughout data collection period in order minimise the researcher's bias issue. Objectives: (i) – to explore buying companies' collaborative procurement strategy during project development with different trade contractors and (ii) - to examine whether any differences in buying companies collaborative procurement strategy are as a result of different attributes and asset specificity of subcontract trades are met using interviews and questionnaire as data collection approach and General Linear Model (GLM), cross-tabulation and factor analysis as criteria and method of analysis. The third objective is met through literature review and shaped by pilot interview. Method of analysis adopted was factor analysis using questionnaire data.



Note: LR – Literature Review; RM – Research Methodology; RO – Research Out comes; RQ – Research Questions; and Robj – Research Objectives

Figure 4.1 Research methodology flow chart

As noted earlier, a mixed method approach was adopted in this study as depicted in Figure 4.1. The main approach involved a quantitative technique to the collection and analysis of data. Prior to the main approach, a qualitative approach (pilot semi-structured interviews) was carried out and shaped the research questions and objectives. The results of literature review and the pilot study were used as a basis to inform the selection of the theoretical foundation for the study, which in turns informed the selection of research methodology.

A purposive sampling was adopted in selecting participants for the semi structured interview. This is because professionals who have had dealings with subcontractors were considered to be in best position to provide information needed in answering the research questions. Interview questions were shaped by the results of literature review and informed by the theoretical foundation. The results of the data collected from the pilot interview were used as basis to design a measuring instrument that was administered to the selected sample.

CHAPTER FIVE: DATA COLLECTION

5.0 Introduction

In Chapter Four, a mixed method approach was identified as being the most appropriate to explore the research questions. This chapter outlines the procedures followed in the design of measuring instruments, administration of the survey and concludes by identifying the quantitative analysis techniques that were applied to the data gathering approach discussed in the preceding chapter.

5.1 Conceptualisation of the Study

The literature review undertaken in Chapters Two and Three provided the basis for conceptualising the study and subsequently informed the development of instrument for data gathering as diagrammatically shown by Figure 4.1 in the preceding chapter. Prior to the development of the constructs for the study, it was decided to carry out semi-structured interviews with a number of experienced construction managers who had been responsible for managing and dealing with selection of subcontractors and their development relationships so as to gain in-depth and better understanding of the concept of collaborative supply chain application and how subcontracting firms are incorporated into their chain networks. The face-to-face interaction with these practitioners afforded the researcher real-life situations as well as perceptions about the application of collaborative supply chain and strategies developed regarding relationships with various specialist trade contractors. One of the merits of this approach is that the proximity of the interview and the relational approach with the interviewer allowed greatest flexibility in terms of the topic being investigated and

also the direction of the discussion. It also offers both the interviewer and interviewee the opportunity to explore the meaning of the questions and the answers involved. Furthermore, there is an implicit or explicit sharing and/or negotiation of understanding in the interview situation that is not often available to other data collection techniques (King and Horrocks, 2009). Not only does this approach consider appropriate for this study because the subjects under investigation were conceptualised a priori, up to a point, but also as recommended by Tashakkori and Teddlie (1998), a pragmatic approach was appropriate for the gathering of data that reveals current practice. The overall benefit of the interview as a research procedure was that it allowed both the interviewer and the interviewees to examine the meaning of the questions and the answers involved.

5.2 Pilot Interview Sample

The focus of this thesis is that the current application of the concept of collaborative supply chain procurement and how relationships with various specialist trade contractors are developed to meet the buying company's short-term and/or long-term supply needs. The phenomena to be studied required obtaining information regarding firm's relationships with their suppliers and this type of information is not available publicly. Therefore, a purposeful sampling was adopted for the selection of participants in order to get richer information (Descombe, 2010; Silverman, 2010) as discussed earlier in Chapter Four. In view of this, the participants had to have knowledge of dealing with subcontractors in order to provide accurate information.

Based on the literature review, interview questions were developed with emphasis on the role of participants in managing and developing relationships with subcontractors as well as

factors influencing their collaborative supply chain strategies. The interview schedule also sought information regarding the following areas:

- Experience of the interviewee
- Approach or strategy to subcontracting in relation to collaborative procurement
- Factors affecting the choice of strategies

This provided a guide to the interview whilst linking back to the theoretical requirements of the study (Descombe, 2010; Gillham, 2005).

The sample was drawn from a range of contracting firms with a turnover in the ranging from £10m to over £100m based in the North West of England, precisely Liverpool and Manchester. Table 5.1 shows the characteristics of the participants and their organisations.

Table 5.1 Sample characteristics of pilot qualitative data collection

Organisation turnover	Type of organisation	Interviewee's title	Years of experience
Over £100m	Main contracting	Quantity surveyor	5 years
£10m	Subcontracting	Groundworks	12 years
Over £100m	Main contracting	Construction manager	26 years
Over £100m	Main contracting	Supply chain manager	15 years
£80m	Main contracting	Project manager	18 years
Over £100m	Main contracting	Supply chain manager	8 years

The chosen organisations were informed about the subjects being studied through letters and request was made for an appointment to interview the appropriate person within each organisation. The sample (six interviews were conducted) may be non-representative but was employed due to convenience and time constraint. Watt (1980) suggested turnover as one of the indicators to measure organisations' size. This suggestion was employed in the pilot interview as it convenient suit the form of information collected.

As a good practice and to ensure ethical procedures are followed, the researcher sent out interview protocol to the participants, which among other things sought their permission to tape record the interviews for further analysis, the option was given for confidentiality however none of the informant requested that their transcripts remained confidential. The duration of the interviews range from forty to eighty minutes and were conducted in both the contractor's offices and the researcher's office. In order to ensure an element of trust is developed between the parties, the researcher established cordial relationship with the informants (Silverman, 2010). All interviews were then transcribed for further analysis; the transcripts were sent to the interviewees to check if they represented their views. This was to make sure that information provided were accurate and trustworthy (Creswell, 2007).

5.3 Pilot Interview Data Collection

The comprehensive literature review revealed that certain factors/attributes are likely to affect contractor's supply chain collaborative strategy (Ross, 2011; Akintoye and Main, 2007; Humphrey *et al.*, 2004; Chan *et al.*, 2004; Akintoye *et al.*, 2000). Therefore, in order to explore this problem further, a two phase research design was developed. The first phase involved pilot interview where a semi-structured interview approach was employed to allow in-depth and free flow of information from interviewees (see Figure 4.1 in Chapter Four). According to Seale (2004), the skill of the researcher is essential in carrying out in-depth interviews in order to gather meaningful data and suggested that expressive questions are employed to encourage participants describe their experiences and perceptions. In addition, the researcher used clarification questions where further explanations were required.

The flexibility of this approach also encouraged the interviewees to participate fully and more comprehensively (Fellows and Liu, 2008). A combination strategy was then adopted during

the interview to increase the richness of the data collected. Patton (2002) suggested that combination strategy should follow three key interview approaches: informal conversation; interview guide; and standardised open-ended are not mutually exclusive. An interview guide was used to ensure that all issues to be explored were covered during the interviews. The guide also encouraged preparation by the interviewees and ensured that all participants focused on similar topical issues. Even though interview guide may restrict the participants to freely express their opinion, this issue was dealt with by allowing interviewees to elaborate more on issues that were relevant and important to the topic through informal conversation and open-ended questions. This combined strategy provided more flexibility of the interviews and enabled more relevant data regarding practices toward supply chain and collaborative working practices to be collected in a relaxed atmosphere.

5.3.1 Pilot Interview Data Analysis

All interviews conducted with participants were transcribed verbatim. In order to interpret and explain, the data was broken down to enable it to be classified and the concepts identified as well as to create the interconnections between the concepts in order to aid clarity of data and consistency of analysis (Fellows and Liu, 2008). The computer aided qualitative data analysis software tool Nvivo 10 was utilised in coding, organising, linking and exploring the transcripts for themes and sub-themes in line with the analysis guide. This led to new results emerging.

Using comparative analysis, data were compared and contrasted and the process continues until the researcher was satisfied that no new issues were arising (Dawson, 2009; Seale, 2004). Data were analysed as the research progresses, continually refining and reorganising in light of the emerging results whilst existing research literature were consulted for further

insight into what was arising from the data. This helped to define concepts, create typologies, find associations, and seek explanations for the emerging phenomena (Ritchie, *et al.,* 2003; Baiden *et al.,* 2006). It further allowed retrospective analysis of the accounts to be carried out and a comprehensive description of the data was developed which resulted in the support of categories within the data. The following headings were used:

- Strategies and relationship tactics
- Interactions among the parties
- Attributes and factors

Buyer-supplier collaborative exchanges are influenced by the context of their market sector, the product or service they produce or provide, the resources used, and their procurement processes (Artto *et al*., 2008; Chow *et al.*, 2008; Erikksson and Laan, 2007) and that an integrative approach that considers these different levels of explanation is necessary to provide a better understanding of business exchanges. The findings from data analysis of the pilot interviews provided evidence of factors affecting contractor's collaborative supply chain strategy and integration of supplier into the chain network. The higher the level of production capacity of a specialist trade contractor, the more likely they are to be selected and fully integrated into the chain networks. This was supported by the statement from interviewee 'B':

"…..our strategy is to pick carefully subcontractors that have the capabilities to carry out the work to the quality and specifications required….. and can help us win the work at tender stage. In short, our company is as good as the subcontractors we employed and they are as good as their capability to carry out the work."

There was also evidence that strategies employed differentiate among groups of trade contractors. This was represented by the quote from participant 'A':

".....operations are spilt into categories such as critical groups and non-critical groups. The basis for these categorisations is the nature of the job using capability metrics."

Other factors uncovered during the pilot interview to have influence on the choice strategy of buying organisations were location of the project and market sector of subcontract trade. "*…..it doesn't make sense to offer a job to say bricklayer in the south when the project is in the north here…..*"

The factors identified from the literature review and confirmed during the interview were then used as a basis to design the main survey.

5.4 Questionnaire Design

The second stage that was quantitative phase involved a survey research design based on the literature review and interview findings. The questionnaire survey was designed to provide a numeric description of trends, attitudes or opinions of participants as well as contextual information about collaborative supply chains in construction projects. Data collection under questionnaire survey was divided into two phases comprises a pilot survey and main survey.

The survey sought UK contractors' opinions on collaborative supply chain strategies involving different specialist trade contractors. Webster and Sell (2007) stressed that to increase the response rate of mail survey the questionnaire should be short as well as the amount of time respondents used in completing the questionnaire. Similarly, Gorard (2003) recognised length and style of questionnaire as central factor to the success of self-administered postal questionnaires. Thus, in order to achieve the study aim and objectives

and to achieve sufficient responses much emphasis was placed on design of the measuring instruments, questionnaire layout and ordering of questions.

For the purpose of obtaining sufficient data on attitudes and perceptions, varieties of questions format were used. These included open-ended and fixed alternative questions. The fixed alternative questions were used to gather factual data on attributitional variables such as organisation type, procurement environment and individual attributes such as experience. Saunders *et al.* (2009) submitted that piloting should be conducted to provide guidance on the sampling frame, the length of time taken to complete a questionnaire, suitability on the method for gathering data and adequacy of the questionnaire.

5.4.1 Pilot Survey

A pilot survey was carried out with the aim of testing all the key aspects of the survey including access to informants, the design of the research instrument and effectiveness of the approach in collecting valid data. The questionnaire contained a variety of closed and open-ended questions, rating scales and 'forced choices' allowing for a variety of individual responses. The piloting approach follows the submission by Fowler (2008) that three main check lists: the target population possess the necessary attributes for exploring the theoretical perspectives of interest; the adopted survey design allows logical comparison to be made when the objectives put forward, and theoretical concepts can be operationalised for the purpose of deriving variables. This ensures more quality and productive of the in the piloting process. Moreover, for the piloting process to achieve its objectives the pilot survey was as similar as possible to the large-scale survey and a representative range of respondents for the piloting was selected.

The pilot survey was conducted from 15 January 2013 to 4 February 2013 involving professionals from the industry, postgraduate students and lecturers from built environment. 15 non-random pilot questionnaires were sent with a sampling size of (n=9) representing 60% response rate. Changes were consequently made to question wording, number of questions, and scaling. The process also made it possible to identify areas of misinterpretation and any ambiguous wording questions. The basis for the sampling for the pilot was by company name. For instance, initial wording of question 13 was identified by most the respondents to be difficult to understand. Upon the feedback from the pilot questionnaire, it was modified to make clear and concise (see Appendix I).

5.5 Main Questionnaire Design

The main survey was designed to be as attractive as possible; a columnar format was used with colours highlighting the questions. The header of the questionnaire included the logo of Liverpool John Moores University. Contact details of the researcher were also provided in case of confusion with regard to the aim of the survey. The questionnaire was designed to be as short as possible and to collect only information that related to the research questions. The questionnaire was six pages in length, with 17 main questions. The proforma returned with the pilots indicated that it took an average of 18 minutes to complete. The questionnaire was divided into three sections exploring supply chain relationships and requesting attribute data, behavioural data and attitudinal data. The more complex questions were presented within the middle and personal questions were kept to the end to gain the commitment of the respondents. Any ambiguous wordings and areas of misinterpretation identified during the piloting were subsequently amended. The questions were collected together to ensure that the respondents kept the research construct to mind when answering the questions and also to ensure the questionnaire was considered reliable.

Multi-item scales involving nominal, ordinal and scale were developed for each of the variables included in the study.

Which of the following best describes your organisation's field of operation? (Please tick a box)	
General contracting-Building	
General contracting-Civil Engineering	
General contracting- Civil and Building Engineering	
Others. Please indicate ……..	

Figure 5.1 Nominal scale measuring instrument format

For instance, Figure 5.1 presents the level of measurement of organisations field of operation format. The nominal categories were drawn from those recognised within the annual construction industry statistics published by the ONS (2013). This measurement was used to identify the respondents employing organisation and allow cross industry comparisons to be measured.

5. Does your organisation have a strategy to develop closer links with selected specialist trades contractors?							
Yes		No		If no, please go to question 6			
How long has this strategy been implemented? (Please tick a box)							
1-2 years		3-5 years		6-10 years		Over 10 years	
Does the strategy differentiate between subcontract trade contractors (e.g. M & E and Groundworks)?							
Yes		No		If yes, please use the space below to explain. …… ……			
Please give your opinion on the benefits, if any, you derive from your strategy by ranking the following. Please write the appropriate number. Where 5=highest; 1=lowest						Please rank	
Improvement in sharing of knowledge about construction techniques							
Guaranteed response to requests for quotations							
Reduction in overhead cost							
Improvement in alternative construction approaches and communication of cost information							
Access to specialised technologies, process capabilities, and expertise							
Reduction in liability exposure and overall construction cost							
Improvement in construction processes and experience							

Figure 5.2 Ordinal scale data gathering format

Research variable measurement at ordinal level can be ranked or- ordered categories. As with the any other form of variable measurement, the categories should be exhaustive and mutually exclusive. These measures were drawn from the literature review. Figure 5.2 illustrates how the questions were structured to gather data at a range of levels: measured at the nominal level - (does your organisation have a strategy to develop closer links? yes/no); measured at ratio scale level – (how long has this strategy been implemented?); and ordinal level- (where the respondents were asked to rank the benefits of the strategy).

7. For each of the following statements, please indicate your agreement or disagreement for not inviting more subcontractors to bid for each work package by ringing the appropriate number. 5=strongly agree; 4=agree; 3=slightly agree; 2=slightly disagree; 1=strongly disagree					
Increase in supervision of unknown subcontractor	1	2	3	4	5
Performance quality reduction	1	2	3	4	5
Need for honest appraisal	1	2	3	4	5
Rising overhead cost	1	2	3	4	5
Reduction in delivery challenges	1	2	3	4	5
Improve transfer of knowledge and experience	1	2	3	4	5

Figure 5.3 Likert scale variable measurement format

Additionally, respondents' attitudes/perceptions were measured using the Likert scale at the ordinal level. This method of gathering data allows respondents to rank their responses to questions that seek their opinion. There was no numerical difference between the categories identified. Figure 5.3 illustrates the format used. A five point Likert scale was adopted which allowed the respondent to provide a mid-range response, since it is a more appropriate means of measuring perception as it does not force the respondents to answer when they felt neutral about a construct.

Besides, the measuring instrument sought quantitative data of variables measured by a numerical scale. The numerical data required was on organisation size and used an interval scale. Figure 5.4 depicts the format used for gathering data on the size of organisations. The

indicator used to measure the size of the organisation was turnover and the categories are as shown in figure 5.4.

2. What is your organisation annual turnover in the last financial year? (Please tick a box)										
< £5m		£5-24m		£25-50m		£51-100m		>£100m		

Figure 5.4 Numerical data measurement format

The organisations size ranges from very small <£5m to large >£100m, a comprehensively used scale in construction research when developing nominal categories.

5.5.1 Sample Design

The Construction Manager, the official magazine of the Chartered Institute of Building (CIOB) and UK Kompass (2010) were selected as they provided an objective way of identifying contractors in the United Kingdom. They were key decision makers considering subcontracting and that these individual were likely to be have played key management roles in successfully completed projects involving different subcontracting trades. The population chosen for the survey was main contracting organisations in the United Kingdom. The aim to explore trends, attitudes, or opinions of participants as well as key factors influencing supply chain collaborative strategies of contracting organisations involving different specialist trade contractors and the Chartered Institute of Building (CIOB) and Kompass UK were seen as the professional bodies that companies with worldwide construction and professional expertise and experience would be members. As a result, they could be considered as a population that would represent good practice on collaborative working exchange within their various supply chain networks. A database of individual names and company addresses as well as email addresses was compiled.

According to Rea and Parker (2005), unsolicited mailed survey with the use of incentives can increase the response rate. Rea and Parker (2005) are also of the view that effort should be made in the cover letter to the survey, the reminder and any follow up procedures utilised to increase the response rate and thus, suggested the use of incentives. This study adopted the incentive approach where respondents were offered copies of the results of the analysis if requested.

5.5.2 Procedure of Follow-up

As suggested by Rea and Parker (2005), non-respondents should be identified and followed up with a letter of reminder (see Appendix IV). Each return envelope was given a reference number to enable easy identification of non-respondents. It must however be pointed out this practice was not to encourage participants to return to questionnaire through fear of identification but to maximise potential returns. The main survey was sent by mail on 15 February 2013with a return date of 01 March 2013. The cover letter emphasised the support of the participants as well as highlighting the importance of the research to the industry in general, and the value of the participants' response in particular.

5.5.3 Main Survey

As noted earlier, the main questionnaire survey was conducted on sample drawn from databases of contractors listed in both the CIOB and UK Kompass register. A total of 570 questionnaires were mailed out to participants for completion. The questionnaire package was made up of a covering letter describing the purpose of the study, a six-page questionnaire and a pre-paid envelope addressed to Liverpool John Moores University. Participants were assured of their anonymity in the covering letter. Copies of both the questionnaire and cover letter can be found at appendices II and III respectively.

A total of 65 questionnaires were returned from the initial mailing representing 11.4%. The initial response rate was considered as low. Any analysis based on this return may be considered as unreliable (O'Leary, 2010; Newman, 2007). Consequently, follow up procedures were implemented. The participants who had not responded to the initial survey were identified and in the week commencing 11 March 2013, a follow up letter was sent to them. The follow up letter included an additional copy of the questionnaire and reminder. A final total of 107 questionnaires were returned representing a response rate of 19%. This can be considered to be low response rate, however, in construction it is not unusual to report survey response of such rate. For instance, Ankrah *et al.* (2009) reported a response rate 15.42% in study entitled "factors influencing the culture of construction project organisation" whilst Akintoye and Main (2007) reported similar percentage.

5.6 Data Coding and Analysis Techniques

The 17 main questions responses were coded to give a total of over 50 variables. As stated earlier, to facilitate the analysis, SPSS was employed to provide a range of data management and statistical techniques. A sample size of 107 was used in the analysis. The statistical methods used, included chi squared, correlation, analysis of variance, and factor analysis as well as the rationale for their use is given below. The data collected by the survey fell into a number of related categories, independent or related samples.

As noted in chapter four, there is no consensus among researchers as to when parametric or non-parametric tests are used. The term parameter refers to a measure, which describes the distribution of the population such as the mean or the variance (Field, 2013). The strengths and weaknesses of both parametric and non-parametric tests as well as assumptions have already been discussed. It has however, been argued that when parametric tests are employed

an equivalent non-parametric test is utilised for comparison (Creswell, 2009; Field, 2013; Tharenou *et al.*, 2007; Gorard, 2003). The following were the selected tests and applied to the survey data during the analysis.

5.6.1 Chi-square for Independence

There are a range of tests based on the chi-square statistic, all of which involve categorical data. This statistical test is used to explore relationship between two categorical variables and compares the expected and observed. The Pearson chi squared test is a non-parametric test and was used to investigate whether there is a significant difference in response within a set/group of responses. SPSS identifies the degrees of freedom, which refers to the number of components, which are free to vary. The method for the use of the chi square test on the data set was to establish contingency tables, the convention for ascertaining the independent or categorical variable as a column was be utilised (Field, 2013). One of the conditions allowing the use of chi-square is that the lowest expected frequency in any cell should be 5 or more (Pallant, 2013), whenever this was the case the binomial test was used.

5.6.2 Correlation and Variance

A correlation can be a linear relationship between variables. It is used to describe the strength and direction of the linear relationship between two variables. On the other hand, the variance of a single variable represents the average amount that the data varies from the mean. The two types of correlation coefficient techniques to identify the correlation between variables measured at interval level and for the production of linear correlations data analysis are Pearson's *r* or Spearman's *rho*. A non-parametric test - Spearman Ranked Order correlation (*rho*) was applied to data of interval or ratio (Bryman, 2012). Interpretation of the correlation statistic technique was carried out using the coefficient of determination which gives a more

representative measure. Also, Spearman Ranked Order correlation (*rho)* was employed to measure data at ordinal level which makes up a large proportion of collected data. The use of correlation for non-parametric ordinal data was to identify linkages between ordinal data.

5.6.3 Analysis of Variance

Analysis of Variance (ANOVA) was used compare the categorical variables with more than two levels of measurement. For example, ANOVA was conducted in order to determine whether procurement strategies of the two groups of respondents (SMEs and large organisations) differ over range of specialist trade contractors during project development. It compares whether the average values or levels of one variable (the means of the dependent variable) differ significantly across categories of the independent variable. A significant *F-test* indicates that the null hypothesis can be rejected as it states that the population means are equal. It does not, however, show which the groups differ. Hence, *post-hoc* tests were conducted to aid the discussion on the data analysis.

5.6.4 Factor Analysis

Another technique applied to the data analysis was factor analysis. It is a statistical method which attempts to produce a smaller number of linear combinations of original variables in a way that captures most of the variability in the pattern of correlations (Field, 2013). It assumes that a set of variables combine to form an underlying dimension or factor, which is established by analysis of the correlations between the subjects responses on the variables under consideration. The basic descriptions of the stages of conducting a factor analysis have already been discussed along with different approaches as well as the underlying assumptions for the selection of an appropriate technique and procedure (see Chapter Four).

In construction, factor analysis has been used to categorise factors (Ankrah *et al.*, 2009; Akintoye and Main, 2007). It can be used to test hypotheses concerning the structure underlying a set of variables (Tabachnick and Fidell, 2007). One of its most useful functions is its data reduction feature, which allows a large number of variables to be reduced into factors describing general concepts. The technique was used to assess the factors that influence organisation collaborative supply chain strategy involving different specialist trade contractors.

Field (2013) identified insufficient attention given to the selection of the variables that define the domain as one of the main shortcomings of this technique. This weakness has been considered in the review of literature, where the review was repeated following the analysis in order to develop meaningful descriptions of the factors.

5.6.5 Equality of Variance

To take account of the assumption that variance in the populations being compared was the same, the Levene's test for equality of variance was used. This is based on the F statistic and significance, which states: if significance is less than 0.05 ($p<0.05$) the Levene test indicates that the variances between the two populations are not equal. On the other hand, if significance is greater than 0.05, the Levene test indicates that equal variance can be assumed. This was particularly appropriate when carrying out analysis within the general linear model as a correction factor was applied when the test for sphericity was not met.

5.6.6 Multi-variate Analysis

To explore the relationships between variables, it was necessary to calculate indices or factors rather than individual items scores to conduct multivariate analysis of the data. Table 5.2 below shows the derived variables from the measuring instrument. Total scores were

calculated for each individual and the differences between the groups on a given list were tested using one-way analysis of variance.

Table 5.2 **Derived variables from the measuring instrument**

Areas measured in the questionnaire	Items used for analysis	Description of scales and how factors were obtained
Demographics variables	Title	Eight groups
	Employer size	Four groups
	Decision making role	Four groups
	Experience	Five groups
Organisational variables	Subcontract strategy	Dichotomous
	Organisation size : Turnover	Five groups
	Number of employees	Five groups
Collaborative supply chain	Benefit	Total score of the 8 item factor
	Collaborative technique	Total score of the 7 item factor
	Performance	Total score of the 9 item factor
Subcontract trades interactions	Procurement approach	Mean score of the 2 item scale
	Strategy assessment	Total score of the 14 item factor
	Strategy differentiation	Total score of the 14 item factor for each trade

A one-way analysis of variance test was carried out which yielded an F value, and identified significant differences for a given level of significance of 0.05.

5.7 Summary

The extant literature review and in depth analysis of the pilot interview were used in the development of the constructs. The measurement of these constructs was extensively tested through piloting before the main survey was administered to ensure reliability. Multi-item scales comprising nominal, ordinal and scale were developed for variables included in the study. The descriptive statistics to be applied to the data were univariate and multivariate and have been discussed and justified. ANOVA was conducted to determine differences in the respondents' opinions and to compare whether average values of one variable (the means

of the dependent variable) differ significantly across categories of the independent variable. In order to the variability in the pattern of correlations, factor analysis was applied to the data analysis. This chapter has also identified the approach to the design, collection and analysis of the survey data provided by construction managers working in the UK. The next chapter reports on the analysis of the data and the discussion of the results.

CHAPTER SIX: RESULTS AND DISCUSSION

6.0 Introduction

This chapter presents and discusses the results from the questionnaire survey and pilot interview conducted. The results reported in this section were carried out around the number of variables used in the survey and an exploration of their potential effect on the framework was required. The analysis is presented around three themes. These are buying organisations' collaborative procurement strategies and subcontract trades, subcontracting practice and supply chain arrangements, and factors influencing contractor-subcontractor collaborative working relationships. The analysis presented in this thesis is also a meaningful summary of that was carried out during the study. The objectives of the study are restated in this section to serve as reminder. These are:

- To establish the whether current buying organisations' procurement strategies used during project development vary over a range of subcontract trades, which could be considered as a proxy measure of the asset specificity of subcontract organisations;
- To establish which subcontract trades are most affected by their inherent complexity and asset specificity; and
- To determine the factors that influence organisations' procurement strategies for specialist trade contractors.

The analysis section begins with SPSS descriptive statistics on respondents and their organisation to shed insight into relationship between respondents' organisation collaborative procurement working strategies and subcontracting.

6.1 Respondent Characteristics

Respondents were asked to provide information relating to their current role and position, how long they had held this position for in their current organisations as well as their experience in dealing with subcontractors' procurement. A summary of the respondents' characteristics are displayed in Table 6.1 below.

Table 6.1 Summary of Respondents' Characteristics

Demographic	**Categories**	**N=107**	**Valid %**
Job Title	Managing Director	10	9.9
	Supply Chain Manager	8	7.9
	Construction Manager	25	24.8
	Project Manager	15	14.9
	Quantity Surveyor	11	10.9
	Site Manager	5	5.0
	Procurement Manager	10	9.9
	Others	17	16.8
	Missing	6	
Current Position	<5	4	3.8
	5-9	17	16.3
	10-14	25	24.0
	15-20	26	25.0
	>20	32	30.8
	Missing	3	
Experience	<5	6	5.7
	5-9	7	6.7
	10-14	21	20.0
	15-20	18	17.1
	>20	53	50.5
	Missing	2	

The average years of experience the respondents had in their current position of employment was 15-20 years, nearly 56% of respondents had fifteen or more years of experience in their current position and 20% had less than ten years of experience. About 51% of the respondents had more than twenty years of experience in dealing with subcontractors and about 7% had less than ten years of experience.

Respondents were in various positions of their organisations. Table 6.1 shows that construction managers constituted the largest group (25%), followed by others, (17%), then project managers (15%), quantity surveyors (11%), procurement managers (10%), managing directors (10%), supply chain managers (8%), site managers (5%) respectively. The largest group of field of operation was contractor in civil engineering, 32 (31%), followed by contractors who carried out both building and civil engineering projects 30 (29%), building contractors 29 (28%)and other 13 (13%) of the respondents.

In order to ascertain the respondent's familiarity with their employing organisations practices and procurement of subcontractors, respondents were given five ordinal categories to identify how long they had been employed with their current employer and experience they have had in dealing with subcontractors.

Table 6.2 Cross-tabulation of field of operation and subcontract experience % within various field

		Subcontract Experience (years)					Total
		<5	5-9	10-14	15-20	>20	
Field of operation	Building Contractors			40.0%	27.8%	30.8%	28.4%
	Civil Engineering	33.%	33.3%	30.0%	22.2%	32.7%	30.4%
	Building & Civil Engineering	50.0%	50.0%	15.0%	44.4%	23.0%	28.4%
	Others	16.7%	16.7%	15.0%	5.6%	13.5%	12.8%
Total		100%	100%	100%	100%	100%	100%

These scales were included in order to ascertain the respondent's familiarity with their employing organisations practices and procurement of subcontractors. Table 6.2 above shows a cross-tabulation of field of operation and subcontract experience.

6.2 Organisational Characteristics

Respondents were required to categorise their organisations. They were given five nominal categories including a category of "other." This allowed the respondent to classify, without bias, their area of operation. The responses to this question would enable analysis of trends and practices related to each sector, types and company sizes within the construction industry.

Table 6.3 Descriptive statistics for field for operation

Field of Operation	N=107	Valid %
Building Contracting	29	27.9
Civil Engineering	32	30.8
Building Contracting & Civil Engineering	30	28.8
Others	13	12.5
Missing	3	

The results displayed in Table 6.3 show that the majority of the participants (30.8%) were in Building and Civil Engineering, followed closely by Building contracting (28.8%), General contracting (27.9%), and Other (12.5 %). The most popular types of organisation that were classified as other were specialist trade contractors and consultants. Respondents were also asked to identify their respective organisations financial turnover in the last financial year. The turnover categories have been used extensively in surveys of this kind (Ankrah *et al.*, 2009; Akintoye and Main, 2007), and allow subsequent categorisation for data analysis.

Respondents were further asked to identify their respective organisations financial turnover in the last financial year. The turnover categories have been used extensively in surveys of this kind (Ankrah et al., 2009; Akintoye and Main, 2007), and allow subsequent categorisation for data analysis. Table 6.4 below shows the categories of organisational turnover. The largest was £25-50m (31.7%), followed by £5-24m (26%) and £51-100m (23.1%). The numbers of responses in these categories were 33, 27 and 24 respectively, which was sufficient to

identify these responses as large (Levin and Rubin, 1991; Watts, 1980). The categories with low response rate (8.7%, n=25; 10.6%, n=11) for respondents employed by organisations with <5m and >£100m turnover were noted and taken into consideration in the data analysis.

Table 6.4 Summary of Organisation Turnover

	Categories (£Millions)	**N=107**	**Valid %**
Turnover	<5m	8	8.7
	5-24m	27	26.0
	25-50m	33	31.7
	51-100m	25	23.0
	>100m	11	10.6

A cross-tabulation of field of operation and organisation turnover is presented in Table 6.5 below after conflating general contracting with building contracting gave sample sizes exceeding 25 in all categories of organisation when categorised by turnover with the exception of organisations with a turnover of between <£5m and >£100m (n<25).

Table 6.5 A cross-tabulation of field of operation and organisation turnover % within organisation

		Turnover					Total
		<£5m	£5-24m	£25-50m	£51-100m	>£100m	
Type of Organisation	Building Contracting	25.0%	44.5%	24.0%	26.4%	10.0%	28.7%
	Civil Engineering	12.5%	22.2%	27.0%	35.0%	70.0%	30.7%
	Building Contracting and Civil Engineering	25.0%	14.8%	40.0%	30.8%	20.0%	27.7%
	Others	37.5%	18.5%	9.0%	8.8%		12.9%
Total		100%	100%	100%	100%	100%	100%

6.3 Subcontracting Practice and Supply Chain Relations

Respondents were asked to indicate the average number of subcontractors used in each trade during the last financial year and the average length of relationships they have had with their subcontractors. Table 6.6 contains the data about the descriptive statistics of each category. The survey shows that on average about 7 – 8 subcontractors are considered for a project. This index is almost the same in all the categories, with the exception of Mechanical and Electrical which was about 4 - 5 being the least and a highest of 7 - 8 for both Finishes and Groundwork subcontractors.

Table 6.6 Number of subcontractors used in each trade and length of relationship

	Average number of subcontractors	Average length of relationship in years
Brickwork	6 – 7	7
Groundwork	7 – 8	8
Steelwork	6 – 7	11
Mechanical and Electrical	4 – 5	14
Roofing	6 – 7	7
Finishes	7 – 8	6
Average	6 – 7	9

It is further noted from Table 6.6 that the average length of relationship was about 9 years. However the figures for both Mechanical and Electrical and Steelworks contractors exceed this index indicating that these groups of specialist trade contractors develop some forms of stable economic bonds with their main contractors whereas the other groups of subcontractors may be at either developing or maturing stage of their working relationships.

Table 6.7 presents the primary reasons for subcontracting work packages among respondents. Respondents were asked to indicate their agreement or disagreement on a five-point scale.

The question also encouraged respondents to give their own reasons if there were no reasons that were applicable to their answers. The responses to this question would provide an indication of some the motives for employing different groups for subcontractors and may also shed light on procurement approach more commonly used by main contracting organisations.

Table 6.7 The primary reasons for subcontracting

Reasons for subcontracting	Strongly agree	Agree	Slightly agree	Slightly disagree	Strongly disagree	
	% (N)	% (N)	% (N)	% (N)	% (N)	Mean
Reduce liability exposure	63.6 (68)	36.4 (39)	0 (0)	0 (0)	0 (0)	**4.64**
Reduce overhead cost	14.0 (15)	69.2 (74)	16.8 (18)	0 (0)	0 (0)	**3.97**
Reduce construction cost	12.2 (12)	57.9 (62)	30.8 (33)	0 (0)	0 (0)	**3.80**
Market volatility	5.6 (6)	56.1 (60)	38.3 (41)	0 (0)	0 (0)	**3.67**
Reduce maintenance cost	8.4 (9)	41.1 (44)	44.9 (48)	5.6 (6)	0 (0)	**3.52**
Reduce construction time	9.3 (10)	25.2 (27)	45.8 (49)	19.6 (21)	0 (0)	**3.24**
Value to the client	10.3 (11)	19.6 (21)	47.7 (51)	22.4 (24)	0 (0)	**3.18**
Better workmanship	2.8 (3)	25.2 (27)	46.7 (50)	25.2 (27)	0 (0)	**3.06**

Overall, 8 different reasons were presented to respondents. The strongest agreement was found in the need for reducing liability exposure with 63.6% of the respondents and a mean of 4.64. This was followed by reducing overhead cost with a mean of 3.97, reducing construction cost (3.80), market volatility (3.67), reducing maintenance cost (3.52), reducing construction time (3.24), value to the client (3.18) and better workmanship (3.06). The high ranking given to liability exposure gives an indication of prevalence of disputes and legal claims in the construction industry (Costantino *et al.*, 2001). One reason for the high agreement for reducing liability exposure might be that contractors have been employing the system of subcontracting to shift risks. It could also mean that contractors use more market

relationships in subcontracting than collaborative relations. However, emphasis given to construction cost signalled that where collaborative relationships may develop due technological interdependency, contractors may take advantage to reduce transaction cost.

On a Likert scale of 1-4, participants were asked to indicate the form of collaborative agreement generally employ in their relationships with subcontractors. Results in Table 6.8 demonstrate that two forms of agreements – project and strategic partnering were the popular with respondents. 69.5% (73) of the respondents regularly use project partnering with their subcontractors and 26.7% (28) use but not regularly. 19% (20) use strategic partnering regularly and just above half – 50.5% (53) use it but not regularly.

Table 6.8 Types of collaborative agreement

	Strategic partnering		**Project partnering**		**Framework arrangement**		**Alliance**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Always	20	19	73	69.5	-	-	-	-
Usually	53	50.5	28	26.7	-	-	-	-
Rarely	30	28.6	3	2.9	23	21.9	11	10.5
Never	2	1.9	1	1.0	82	78.1	94	89.5
Total	**105**	**100**	**105**	**100**	**105**	**100**	**105**	**100**

On the other hand, none of the respondents indicated that his or her organisation uses either framework arrangement or alliance form of agreement regularly or use but not regularly. 78.1% (82) showed that their respective companies do not use framework arrangement at all whilst overwhelming majority 89.5% (94) suggesting not use at all for alliance.

Again, using a Likert scale of 1-4, respondents were asked to indicate how important supply chain collaboration is to their organisation. Figure 6.1 below shows the importance of supply chain collaboration to overall business operations of main contractors. The result indicates that more than 55 out of the 107 respondents consider it critical to their business operations representing 52.4%. None of the respondent considered it "not important." 36.2% perceived it

important whilst 11.4% slightly important. Supply chain collaboration is often seen as a powerful instrument in achieving effective and efficient performance. However, collaboration can range from very shallow transactionally focused to highly integrated close relations (Leeuw and Fransoo, 2009).

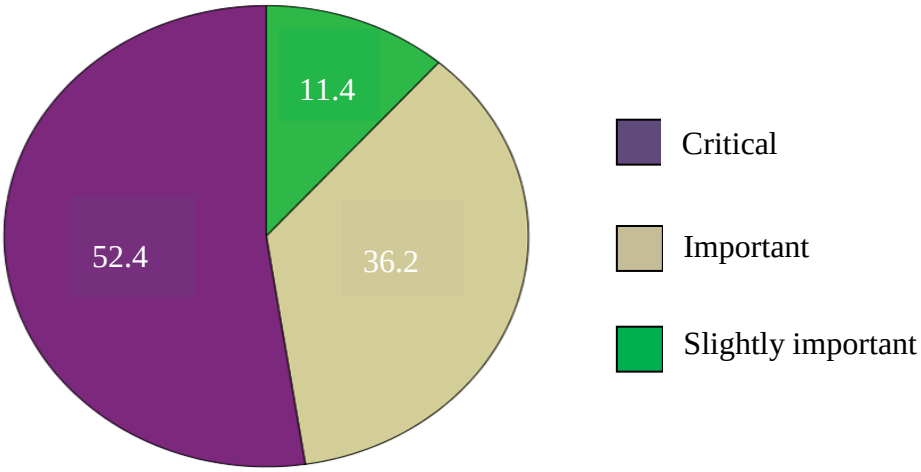


Figure 6.1 Importance of supply chain collaboration

Table 6.9 presents a cross-tabulation statistics after conflating perception on importance of supply chain collaboration with its adoption.

Table 6.9 A cross-tabulation of collaboration importance and supply chain collaboration adoption

		Supply chain collaboration				Total
		No consideration	Some discussion	Only selected elements	Adopt on all projects	
Collaboration importance	Slightly important	9	2	1	0	12
	Important	14	4	10	9	37
	Critical	9	2	30	14	55
Total		**32**	**8**	**41**	**23**	**104**

It displayed 41 respondents have adopted supply chain collaboration on "only selected elements" of projects and 23 on "all projects." Out of 104 respondents, 63 perceived collaboration as either critical or important.

Table 6.10 presents results regarding the importance of the techniques used in developing collaborative relations with subcontractors. In the survey seven different collaborative techniques were presented on five-point scale to respondents. The results showed that early involvement selection criterion is considered the most important technique to facilitate collaboration (4.26). This factor was followed by soft parameters (3.67), share gains (3.50), joint objectives (3.44), partnering facilitator (2.97), joint technology (2.90) and team building (2.30).

Table 6.10 Techniques for collaboration approach

	N	Mean
Team building	105	2.30
Joint objectives	106	3.44
Early involvement	106	4.26
Partnering facilitator	106	2.97
Share gains	105	3.50
Joint technology	105	2.90
Soft parameters	105	3.67

The high importance given to early involvement suggests that there are categories of subcontractor trades that were procured at an early stage and selected on the basis of their technical competence and collaborative ability, rather than on lowest price. It may also indicate that their inputs are critical for initial development of the project.

The survey sought data on the percentage of work secured by the organisations for four categorical subcontracting procedures. These were competition, competition with

collaboration arrangement, negotiation and negotiation with collaboration agreement. The results are shown in Table 6.11 and displayed that the most popular approach to subcontracting taken by respondent's organisations was competition (97%), followed by negotiation (94%), competition with collaboration (93%) and negotiation with collaboration (93%) respectively.

Table 6.11 Subcontracting procedures used by respondents' organisation

	N	Minimum	Maximum	Mean	Std. Deviation
Competitive	104	1	5	3.42	1.099
Competitive with collaboration	99	1	5	2.62	1.219
Negotiation	101	1	5	3.11	1.157
Negotiation with collaboration	99	1	5	2.59	1.360

Respondents were spilt into two groups (SMEs and Large firms) based on their turnover, to determine whether their responses varied with size as part of the analysis.

Table 6.12 Subcontracting procedures used respondent' groups

Arrangement	Group	N	%	Mean Rank
Competition	SME	36	34.62	59.89
	Large	68	65.38	48.59
	Total	**104**	**100**	
Competition with Collaboration	SME	36	34.62	43.43
	Large	68	65.38	57.30
	Total	**104**	**100**	
Negotiation	SME	36	35.29	61.78
	Large	66	64.71	45.89
	Total	**102**	**100**	
Negotiation with Collaboration	SME	36	36	45.33
	Large	64	64	53.41
	Total	**100**	**100**	

It has been suggested that size of an organisation can be measured in terms of turnover, number of employees, net assets and value added (Watt, 1980). Table 6.12 presents grouping based on turnover that categories respondent' organisation as SMEs with companies less than £25million and organisations with £25million or more as large. It also includes the number in each group and the mean of turnover for each group as we as percentage of respondent.

Mann Whitney U test (U) *z-statistics* and associated probability values (*p)* were conducted on the basis of the size of the firms (SME and Large) to show if the two groups differ in their strategies to subcontracting. The data were also assessed for distribution, competitive subcontracting z = -1.885 indicating that data were negatively skewed with a significance level of p=.059. The probability value (*p*) is not less than or equal to .05, therefore the result is not significant. Subcontracting procedures for negotiation with collaboration, z = -1.371 with a significance level of *p* = .170 also did not differ significantly between the groups. However, the (*p*) values for competition with collaboration and negotiation were 0.22 and 0.08 respectively. Hence, an approximate (*r*) values were calculated effect using Cohen (1988) criteria of .1=small effect, .3=medium effect, and 5=large effect to determine where the differences were.

r = z/square root of N where N = total number of cases

A Mann-Whitney U test revealed statistically significant difference in subcontracting strategy between SME (*Md* = 4.0, *n* = 36) and Large (*Md* = 3.0, *n* = 68), *U* = 897.500, *z* = -2.295, *p* = .002, *r* = -0.27 for competitive with collaboration. For negotiation SME (*Md* = 3.5, n = 36) and Large (*Md* = 3.0, *n* = 66), *U* = 810.000, *z* = -2.669, *p* = .003, *r* = -0.26. The analysis

therefore did support the assertion that SMEs subcontracting strategies differ greatly from large firms.

The data indicated that both SMEs and larger organisations were likely to use a competitive outsourcing strategy. However, large organisations were more likely to adopt more relational approaches to subcontracting. All categories of organisation secured turnover by negotiation and collaboration, however respondents employed by the larger organisations indicated more involvement than those employed by small and medium firms.

6.4 Collaborative Procurement Strategies and Subcontract Trades

In order to assess the relevance of transaction cost economic and resource-based theories to organisational behaviour during the subcontracting decision, a detailed analysis of the relationships that organisations develop with their supply chain was carried out. The respondents were asked to provide information about the percentage of work their organisations subcontracted. A six point Likert scale was used to gather the data. 26% of the respondents indicated that they subcontracted over 80% of their work, 12% indicated that they subcontracted 61-80%, 18% indicated that they subcontracted 41-60%, 9% indicated that 21-50% was subcontracted and 18% specified that their organisation subcontracted 10-20%, whilst 17% indicated that their organisations outsourced less than 10%. A Chi square test 48.972, $p<0.000$ indicated that there was an association with organisation size and level of subcontracting. The analysis showed that large companies tend to establish closer working relationships with their subcontractors than their SMEs.

Respondents were asked if their employing organisations had strategy for developing closer economic bonds with selected specialist trade contractors and suppliers and the length of time the strategy had been implemented.

Table 6.13 Collaborative supply chain strategy

	N	%
YES	57	54.8
NO	47	45.2
Total	104	100.0

The responses are provided in Table 6.13 and indicated that 55% of the respondents showed their organisations have strategies in place whilst 45% have no strategy.

83% of the number of respondents who indicated that their employing organisations had strategy in place, further specified that the strategy had been in place for more than 10 years, 12% between 6 and 10 years, 3% between 3 and 5 years, and 2% identified up to 2 years as shown in Table 6.14

Table 6.14 Years of strategy implementation

Years	N	%
1-2	1	1.7
3-5	2	3.4
6-10	7	12.1
>10	48	82.8
Total	58	100

A cross-tabulation of collaborative supply chain strategy and organisation size shown in Table 6.15 below revealed that 57 of the respondents who indicated "Yes" were large organisations representing 91% with only about 10% (*n*=6) belonging to SMEs. On the other hand, 75% (*n*=30) of the respondents who indicated "No" were from SMEs whilst 25% (*n*=10) were from large organisations.

Table 6.15 A cross-tabulation of collaborative supply chain strategy and organisation size

		Organisation size		Total
		SME	Large	
Subcontract Strategy	YES	6	57	63
	NO	30	10	40
n		36	67	103

The data was then used to place organisations into five categories of relationships: no strategy, emergent (up to 2 years), developing (3-5years), mature (6-10 years) and stable (>10 years) and then a comparison of the approaches taken by each of these organisations against organisations that did not have a strategy was carried out to assess what effect a strategy had

Respondents were further asked whether the strategy differentiates between groups of subcontracting trades and to identify the basis for such differentiation.

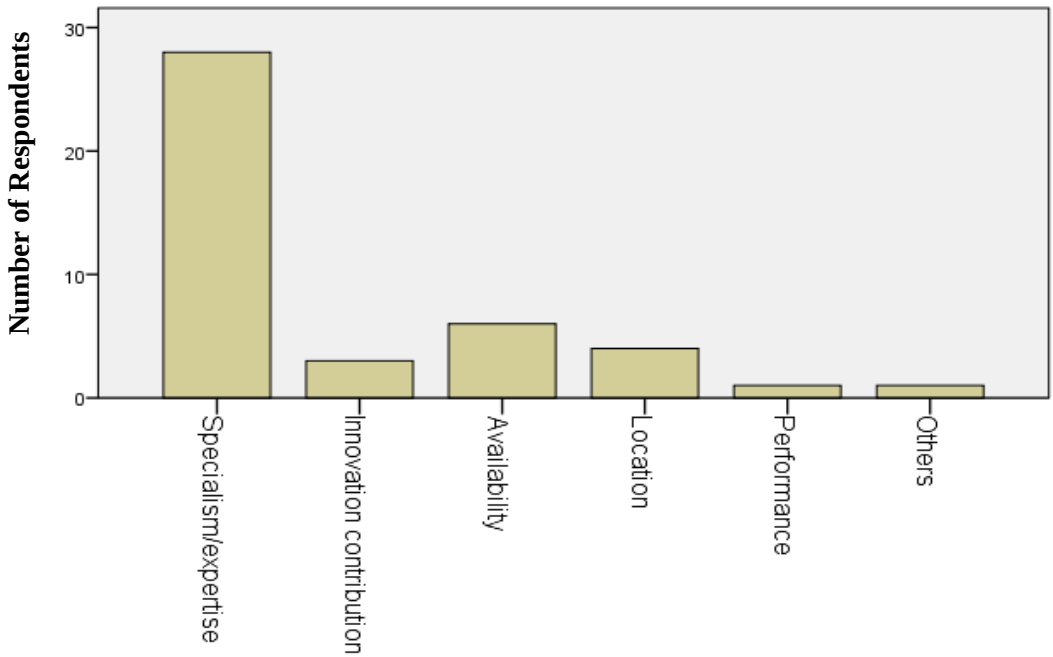


Figure 6.2 Basis for differentiation between subcontract trade groups

42 out of 57 respondents who specified that their employing organisations had strategy also indicated that their strategies differentiate representing 72% whilst only 28% indicated that their organisations do not differentiate. Varied responses were given to basis for differentiation by respondents as this question was open-ended. The results showed in figure 6.2 indicated that 65% (n=28) differentiate on the basis of specialisation or expertise the group of subcontracting trade provides, 14% (n=6) on availability or number of subcontractors to choose from, 9% (n=4) location, 7% (n=3) innovation contribution, 2% (n=1) performance and 2% (n=1) others.

The data was then used to place organisations into five categories of relationships: no strategy, emergent (up to 2 years), developing (3-5years), mature (6-10 years) and stable (>10 years) and then a comparison of the approaches taken by each of these organisations against organisations that did not have a strategy was carried out to assess what effect a strategy had on relationship development. As illustrated in Figure 6.2, organisations differentiate greatly among different groups of specialist trade contractors. The data also suggests that large organisations were more likely to vary their strategies to subcontracting than their small and medium counterparts.

Respondents were asked to specify the average number of specialist trade contractors usually invite to during project development. Figure 6.3 presents a matrix question style for gathering data. It identifies six trades and two procurement approaches. The criterion data collected was at interval level for the two nominal procurement approach categories for six nominal categories of trade contractor. The trade nominal categories were based upon the categorisation by Ross (2005) and Gray and Flanagan (1989). The data had been collected from a number of individuals and was considered as "between subjects" data.

Please state the average number of each subcontractor trade usually invite to bid through the following approaches.		
	Partnering	Traditional
Brickworks		
Groundworks		
Steelworks		
Mechanical & Electrical		
Roofing		
Finishes		

Figure 6.3 Subcontract trades specificity and procurement approach

Data such as organisational size and subcontract strategy are all categorical variables that are subject specific and used for between subject analysis. The data gathered on the number of subcontractors invited to bid for work through the two different procurement approaches was considered and analysed mainly as "within subject." The following set of analyses was carried out. Data provided by respondents on the number of subcontractors invited to bid for work for the two different procurement approaches can be considered as an independent variable and six differing trades of subcontractor (trade was also considered as an independent variable).

6.4.1 Between-Within Subject Effects – Procurement

A General Linear Model (GLM) was conducted to access whether respondents' organisation varied in their strategy to subcontracting. Procurement was identified as a factor with two different levels; project partnering and traditional on participants scores across different trade of subcontractors. The dependent variable was the derived criterion variable of average number of specialist trade contractors invited for each procurement arrangement. The % level of subcontracting was identified as a covariate. The contrasts between the means were selected as repeated. To reduce the chance of Type 1 error, the commonly used Bonferroni adjustment was selected as recommended by Field (2013).

Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, and homogeneity of variance-covariance matrices, with no serious violations noted. There was a statistically significant between SME and Large organisations on combined dependent variables, F (2, 101) = 21.91, p = .012; Wilks' Lambda = .70; partial eta squared = .30. When the results for the dependent variables were considered separately, both reached statistical significance, using a Bonferroni adjusted alpha level of .025 (0.05/2), were partnering F (1, 102) = 24. 32, p = .014, partial eta squared = .19 and traditional F (1, 102) = 15.79, p = .010, partial eta squared = .13. An inspection of the mean scores as shown Table 6.16 indicated that large organisations reported slightly higher number of subcontractors in both procurement approaches.

Table 6.16 Mean Scores for SME and large organisations across procurement approaches

	SME			Large		
Procurement Route	n	M	SD	n	M	SD
Partnering	36	2.89	.667	68	3.53	.610
Traditional	36	14.22	4.072	68	17.24	3.456

6.4.2 Procurement and Trade Between Subject Effects

In order to assess whether this model was found for the different trades for the two procurement strategies, a one way between-groups multivariate analysis of variance was performed to take into account of the different specialist trades. This can be considered a 2x6 repeated measures factorial GLM (Bryman, 2012).

The order of variables in a repeated measure is important, the traditional procurement route was found to have been used in inviting the highest number of subcontractors and this was considered as a comparator and consequently entered last in the repeated measure analysis.

The Levene's test of equality of variance was violated for both procurement and subcontract trade. Hence, a Bonferroni adjusted alpha level was set as before. There was statistically significant main effect of procurement, F (2, 101) = 21.91, p = .012, Wilks' Lambda = .70, partial eta squared = .30; a significant main effect of subcontract trade, F (1, 92) = 84.66, p < .001, Wilks' Lambda = .52, partial eta squared = .50; and a substantial interaction effect between these two variables, F (1, 92) = 8.70, p = .004, Wilks' Lambda = .91, partial eta squared = .09. When the tests of within-subjects comparisons were considered for trade, the only group to reach a significant difference was mechanical and electrical with F (1, 14) = 1.90, P < .05. An analysis of the contrasts showed that mechanical and electrical were significantly lower than other groups of subcontractors for each procurement approach. The approach above gave a general analysis of the interaction effects of trade and procurement and identified that there were differing levels of asset specificity for differing trades and procurement routes however the important intervening variable of project complexity was required to be taken into account.

A mixed between-within subjects analysis was conducted in order to assess the effect of organisational turnover on the trends identified above. The within subject variables of procurement and subcontract trade were as before and a between subject factor of organisational turnover was used.

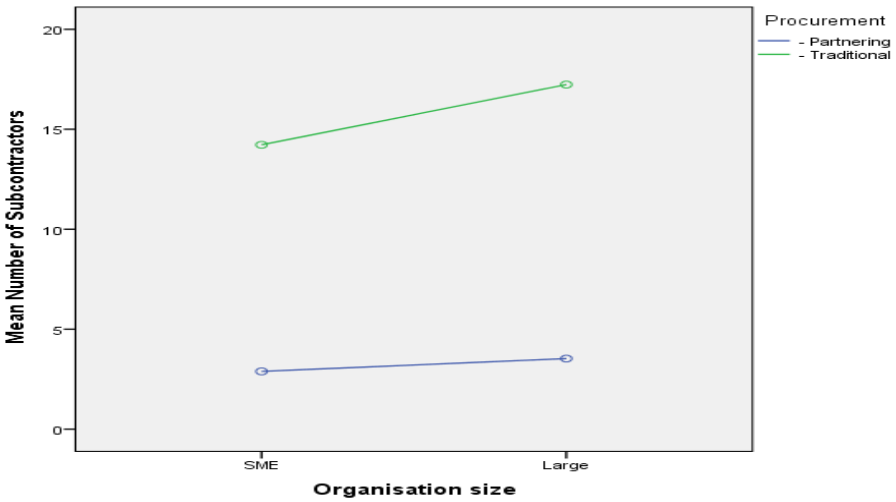


Figure 6.4 Mean number of subcontractors invited for two procurement approaches

A post hoc Bonferroni test was utilised to identify if any significant differences between the groups was found. The independent variable, turnover had a significant main effect, F (1, 102) = 1026. 72, $p < .001$; the interaction between turnover and procurement (partnering and traditional), F (1, 102) = 9.22, $p < .005$. This indicated that different organisation sizes took a significantly different approach to the two procurement arrangements tested. The plots in Figure 6.4 above illustrate the differing approaches taken by organisations for the two procurement approaches.

There was a significant interaction between organisation size and trade, Wilks' Lambda = .82, F (5, 92) = 4.17, $p < .005$. There was substantial main effect for trade, Wilks' Lambda = .88, F (5, 92) = 2.88, $p < .001$. Again, this revealed that organisations took a significantly different approach to the different subcontracting trades as illustrated in Figure 6.5[3].

[3] BW – Brickworks; FH – Finishes; GW – Groundworks; ME – Mechanical & Electrical; RF – Roofing; and SW - Steelworks

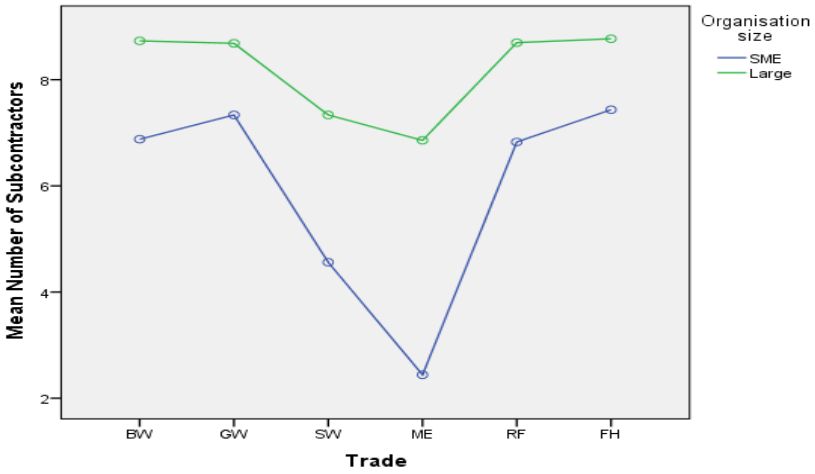


Figure 6.5 Mean numbers of subcontractors by organisation size for two approaches

The contrasts within the repeated measures GLM indicated that the mechanical and electrical specialist trade contractors group was significantly interacted upon by procurement and organisation size for both the traditional and partnering procurement routes F (1, 102) = 9.22, $p < 0.05$.

In order to establish whether organisations' procurement strategies varied with different specialist trade contractors, a cross tabulation was carried out and it was established for the following trades and procurement routes that there was a significant difference between the two procurement approaches and groups of trade.

Table 6.17 Difference for trade for two procurement approaches

Trade	**Traditional**		**Partnering**	
	x^2	*P*	x^2	*P*
Brickworks	5.125	p<0.001	2.857	p<0.001
Groundworks	4.643	p<0.001	1.951	p<0.001
Steelworks	3.650	p<0.002	1.737	p<0.001
Mechanical and Electrical	3.358	p<0.001	1.475	p<0.05
Roofing	4.894	p<0.003	2.082	p<0.001
Finishes	5.963	p<0.001	2.329	p<0.001

A Pearson's Chi square values and the measure of association Cramer's V at significance levels are illustrated in Table 6.17. It shows significant differences in the means for the number of subcontractors invited to bid for work for traditional and partnering procurement approaches between organisations of different annual turnovers. This supported the findings within the general linear model identified earlier.

A non-parametric intra organisation analysis was also required, as a method of non-parametric analysis of between subject and within subject independent variables was not found. A Mann-Whitney U test was used to investigate the difference in the number of subcontractors invited for the different specialist trades for organisations of differing turnover. The results of the data analysis depicted in Table 6.18 indicated that large organisations only differentiated for Mechanical and Electrical and Brickworks by inviting fewer numbers of subcontractors from these two groups.

Table 6.18 A Mann-Whitney U test for six trades and two turnover groups

Trade	SME	Large
Brickworks	2.17	1.88
Groundworks	2.09	2.56
Steelworks	3.78	2.74
Mechanical and Electrical	3.89	1.45
Roofing	2.77	2.66
Finishes	2.59	2.97
N	34	67

SMEs on the other hand, indicated that steelworks and Mechanical and Electrical were grouped as the highest, Roofing and Finishes grouped as the median and the lowest number invited were Brickworks and Groundworks. This differentiation among trade contractors was supported by the findings from qualitative data collection phase. It was identified that market segment was a key factor due to the issue of small numbers for some trade contractors. The quotation below by interviewee ‘C’ illustrates this point:

".....we are aware that there are few M&Es out there in the market than the other trades. The reality is that the M&Es and a couple of trades are in short of supply globally.... Therefore we tend to depend on the ones we know already....."

Consequently, the relationships established between the buying organisation and their M&E subcontractors tended to be more about understanding the nature of the organisations business and the requirements for conducting business. The interviewee in the above case also commented that his organisation acts as a market maker for these smaller firms and as such the interdependency that developed related to longer-term business survival. As a result of this interdependency, the subcontractor becomes part of the integrated supply chain.

6.5 Summary Collaborative Procurement Strategies and Subcontract Trades

The non-parametric data analysis revealed that organisational size was an intervening factor when considering the specificity of the subcontract organisation. The largest organisations with high turnovers generally turn to invite fewer numbers of subcontractors than SMEs with low turnovers. This would indicate that the project specificity of subcontractors does vary with organisational size suggesting that project complexity was a significant factor. This was further supported, when the detailed analysis suggested that the highest project specificity was indicated as being the mechanical and electrical subcontractors for large organisations with high turnovers. This would suggest that this group of specialist trade contractors are significantly influencing organisation behaviour more than other subcontract trade categories which include a design element such as steelworks.

6.6 Factors Influencing Contractor-Subcontractor Collaborative Working Relations

In order to determine whether the two groups of respondents share the same views on factors for involving in collaborative working relationships, statistical analyses based on ANOVA F-

statistics and associated probability values (*p*), were carried out. Where p is less than 0.05 it means that the two groups have different perception on that particular factor, otherwise their views are similar. Main contractors and subcontractors collaborative working relationships can be influenced by various factors as shown in Table 6.19. Statistics in Table 6. 19 show that the large organisations rated factors influencing collaboration development higher than the SMEs.

This may suggest that large firms enter into more collaborative procurement arrangements than SMEs. Akintoye and Main (2007) acknowledged that more collaborative types of procurement arrangement tend to be undertaken by large construction companies due not only to complexity and size of the contract, but also SMEs may lack the necessary resources to enter into these types of procurement arrangements. In spite of large organisations rating the factors for collaboration in construction generally higher than the SMEs, the two groups did not differ on each of the factors for collaborative working in construction development at the 0.05 significance level.

The most important factor identified by both set of respondents was "technical performance" of the subcontractor. The results support a study by Ng *et al*. (2009) that found technological capability very vital in keeping subcontracting firm in business and thus making a collaborative approach both credible and reasonable. It may also suggest that collaborative relationship in construction development between the main contractor and subcontractor is in response to taking advantage of technical skills of subcontractors or timely use of expertise by the main contracting organisation to respond to the opportunity created. This was followed by the procurement strategy of main contracting organisation.

Table 6.19 Factors influencing contractor-subcontractor collaborative working relations

Factor	Factor	Total	SME	Large	*F* Stat	*P*-Value
Technical performance of subcontractor	ColFact13	4.34	4.26	4.47	3.687	0.058
Contractor procurement route	ColFact1	4.21	4.11	4.26	0.088	0.240
Market intensity	ColFact3	4.12	4.08	4.11	0.453	0.426
Bilateral dependence	ColFact10	4.10	4.03	4.25	0.374	0.542
Project complexity	ColFact7	4.09	3.89	4.20	0.538	0.465
Subcontractor organisational capability	ColFact8	4.03	3.97	4.06	1.988	0.162
Reputation of subcontractor	ColFact9	3.93	3.83	3.98	0.144	0.705
Limited numbers	ColFact4	3.83	3.77	3.94	0.349	0.550
Subcontractor - main contractor interdependency	ColFact11	3.79	3.58	3.91	5.544	0.061
Location of project	ColFact12	3.77	3.44	3.97	0.085	0.771
Subcontractor specialisation	ColFact6	3.48	3.42	3.51	0.091	0.763
Subcontractor specificity	ColFact5	3.47	3.22	3.60	8.247	0.075
Workload of subcontractor	ColFact2	3.34	3.26	3.47	0.662	0.430
Price specificity	ColFact14	2.78	2.53	2.97	0.050	0.864

Project nature and scope was identified as useful predictor for organisations approach to the development of the subcontract business relationships. It was ranked as fifth overall important factor as shown in Table 6.19. This was illustrated by following the comments made by interviewees 'A' and 'D' respectively:

".....different project will be approached with different needs. ....main elements of the project will mean we have to focus our subcontracting efforts on subcontractors who can do that type of works....."

".....some works carry lot more risk and nature of the project actually affect our approach to subcontracting. In terms of supply chain, we have work brackets for different sizes of companies which have minimum and maximum bids. These brackets are set based on feasibility cost of the project and these companies can bid for work base on the value and the bracket they are placed...."

The above comments also suggested that differentiation may result in the context of an organisations size.

Price specificity was not ranked highly as factor for collaborative relationship in construction development between the two parties. This may tend to suggest that construction firms are gradually moving away from price as being key selection factor for project development.

In order to assess the multivariate relationships in the factor for collaborative working relationships within the construction supply chain networks, factor analysis technique was used to explore the cluster of relationships. For the appropriateness of factor analysis for factor extraction, various tests were required. These include KMO Measure of Sampling Accuracy (MSA), anti-image correlation, and Barlett Test of Sphericity.

Consequently, the factors for collaborative relationship variables included in the questionnaire were subjected to factor analysis, with principal component analysis and varimax rotation. The first stage of the analysis was to determine the strength of the relationship among the variables based on either correlation coefficient or partial correlation coefficients of the variables. As suggested by Field (2013), the partial correlations should be close to zero when factor analysis assumptions are met and that if the proportion of large coefficients are high, the use of a factor model should be reconsidered. The value of MSA must be reasonably high for a good factor analysis.

The partial correlation coefficient (same as the matrix of anti-image correlation) between the factors for collaborative working relationship is illustrated in Table 6.20 (see page 159) and indicated that the variables share common factors, as the partial correlation coefficients between pairs of variables are small when the effects of the other variables are eliminated. Data in Table 6. 20 also displayed the MSA on the diagonal of the matrix. The values of MSA are reasonably high for a good factor analysis; this ranged between 0.509 and 0.714.

Barlett's test of spericity to test the hypothesis that the correlation matrix is an identity matrix was large. The test statistical value for Barlett's test of spericity = (177.873) and the associated significant level is small (p =0.000, df =91), suggesting that the variables share common factors and thus population correlation matrix is an identity. Observation of the correlation matrix of the factors indicates that they all have significant correlation at 5 per cent level suggesting no need to eliminate any of the variables for the principal component analysis. The value of the KMO statistic is 0.608, which according to Tabachnick and Fidell (2013) is satisfactory for factor analysis. In essence, these tests show that factor analysis is appropriate for the factor extraction.

Principal component analysis was undertaken, which produced a five-factor solution with eigenvalues greater than 1, which explains 56.65 percent of the variance. Varimax orthogonal rotation of principal component analysis is then used to interpret these factors. The factor loading based on varimax rotation is shown in Table 6.21 (see page 160). Each of the variables loads heavily on to only one of the factors, and the loadings on each factor exceed 0.5.

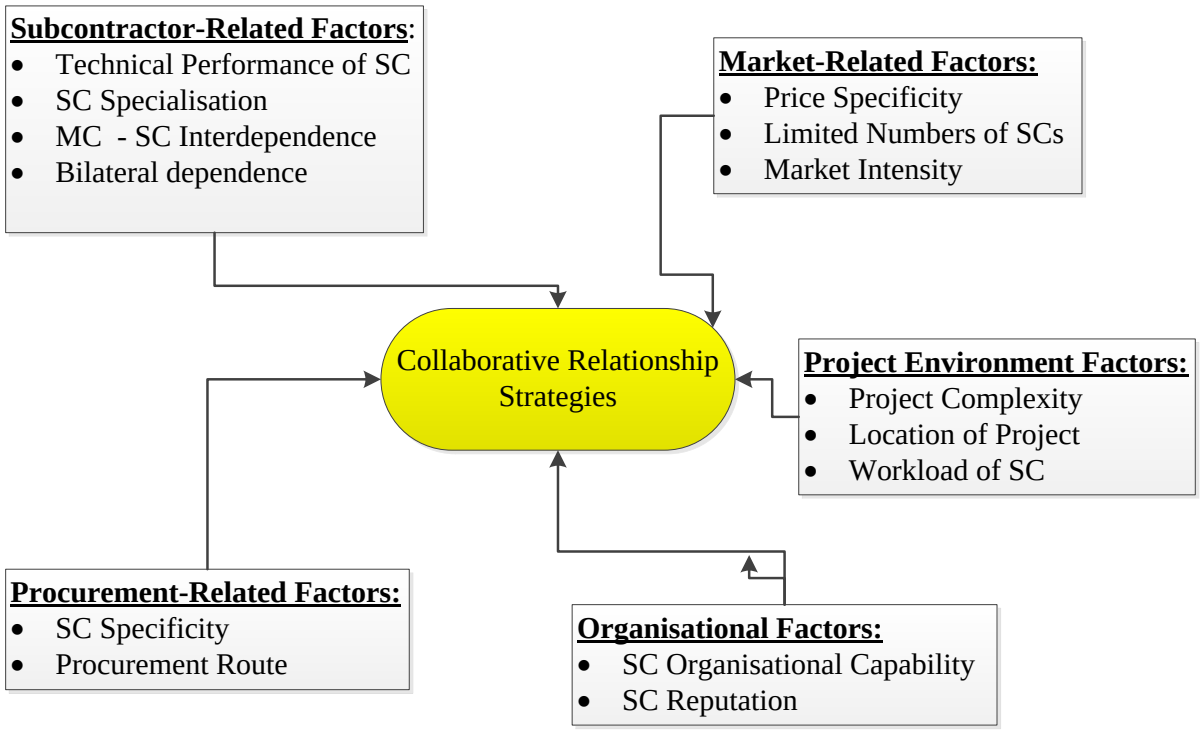
Table 6.20 Anti-image correlation matrix factors influencing contractor-subcontractor collaborative working relationship

		Fact2	Fact3	Fact4	Fact5	Fact6	Fact7	Fact8	Fact9	Fact10	Fact11	Fact12	Fact13	Fact14	Fact1
Anti-image Correlation Matrix (the MSA is shown on the diagonal) for factors for collaborative working relationship	Fact2	.537													
	Fact3	.022	.566												
	Fact4	-.048	-.240	.599											
	Fact5	.145	-.154	-.146	.591										
	Fact6	.039	-.015	.078	-.192	.562									
	Fact7	.043	-.133	.227	-.024	.044	.519								
	Fact8	-.184	.075	-.185	.002	-.151	-.036	.509							
	Fact9	.083	.008	-.019	-.160	.037	-.076	-.145	.680						
	Fact10	-.070	.007	-.103	.061	-.070	-.015	-.236	-.179	.695					
	Fact11	-.012	.135	-.081	-.053	-.025	.019	-.020	.099	.003	.714				
	Fact12	.154	.035	.172	.040	-.007	-.006	-.322	.118	.156	.002	.578			
	Fact13	-.099	.119	-.008	-.137	-.046	-.154	.223	.000	.077	-.316	-.122	.653		
	Fact14	-.002	-.069	.114	-.170	-.057	.099	-.042	.150	-.031	-.115	.056	-.359	.678	
	Fact1	-.037	-.110	-.003	-.118	.128	.020	-.092	-.065	.030	-.081	.143	-.021	.115	.594

Table 6.21 Varimax rotated matrix for Factors influencing contractor-subcontractor collaborative working relationship

			Component				
	Factors	Code	1	2	3	4	5
Subcontractor related factors	Technical performance of subcontractor	ColFact13	.735				
	Subcontractor specialisation	ColFact6	.656				
	Interdependency between subcontractor and main contractor	ColFact11	.537				
	Bilateral dependence	ColFact10	.499				
Market environment determinants	Price specificity	ColFact9		.692			
	Limited number of subcontractors	ColFact4		.530			
	Market intensity	ColFact3		.494			
Project-related factors	Project complexity	ColFact7			.504		
	Location of project	ColFact12			.447		
	Workload of subcontractor	ColFact2			.452		
Organisational factors	Subcontractor organisational capability	ColFact8				.642	
	Subcontractor reputation	ColFact14				.563	
Procurement related factors	Subcontractor specificity	ColFact5					.629
	Procurement route	ColFact1					.448
	Eigen value	**Total**	**2.43**	**1.72**	**1.40**	**1.21**	**1.08**
		Cumulative %	**18.37**	**29.68**	**39.67**	**49.89**	**56.65**

The principal factors for the use of collaborative relationships by the respondents and associated variables are readily interpretable as: subcontracting factor i.e. access to technical expertise and skills (factor 1), market environment determinants (factor 2), project environment (factor 3), organisational factors (factor 4) and procurement requirement (factor 5).



Note: MC – Main Contractor; SC - Subcontractors

Figure 6.6 Factors influencing contractor-subcontractor collaborative working relations

These factors are illustrated in Figure 6.6 and formed the basis of the factor framework. Each principal factor comprises categories of factor which are ordered in level of magnitude. The order of magnitude in subcontractor-type-related factors was found to be technical performance, speciality of subcontractor, interdependence and bilateral dependence. The magnitude order of categories in market determinants or market-related factors were found to be, price specificity, limited numbers and market intensity. The order of magnitude in project-related factors was found to be project complexity, size and scale, location of project

and workload of subcontractor. The magnitude order of categories in organisational factors was found to be subcontractor capability and reputation whilst procurement-related factors included subcontractor specificity and buying organisation procurement approach.

6.7 Analysis of Effects of Variables on Trade Contractors and Framework Exploration

In order to have insight into the relationship between each factor and trade type as well as to determine the level of influence on collaborative performance, a series of testing was carried out for each subcontract trade against each factor.

Table 6.22 Trades and variables significance

Collaboration Factor/Variable	Influence or not on subcontractor Trades Collaboration BW	GW	SW	ME	RF	FH	T
Procurement requirement				✓	✓		2
Workload of subcontractor	✓	✓	✓	✓	✓	✓	6
Market intensity	✓	✓				✓	3
Limited numbers				✓			1
Subcontractor specificity			✓	✓			2
Subcontractor specialisation				✓			1
Project complexity			✓	✓			2
Subcontractor organisational capability			✓	✓	✓		3
Price specificity	✓	✓			✓	✓	4
Bilateral dependence				✓			1
Subcontractor - contractor interdependency				✓			1
Location of project	✓	✓			✓	✓	4
Technology performance of subcontractor			✓	✓			2
Reputation of subcontractor organisation	✓	✓	✓	✓	✓	✓	6
Total	5	5	6	11	6	5	38
Notes: BW – Brickworks; GW – Groundworks; SW – Steelworks; ME – Mechanical & Electrical; RF – Roofing; FH – Finishes; T – Total							

This was to compute the total significance value for each trade. Those factors found to be significant against each trade are summarised in Table 6.22 and appendix V shows all the

generated figures. It was noticeable that M&E has the highest number of occurrences of significance. Finishes, groundwork and brickworks were found to be the least occurrence. It was also noticed that current workload of the subcontract firm and reputation of the organisation found to be significant factors on the collaborative performance of all subcontractors. These factors can be considered to be related to supply chain asset specificity, transactional uncertainty and uniqueness of skills and competence.

The second step in the framework development involves evaluating the uniqueness of each trade against the other within the chain network and marketplace. The framework of Cleveland *et al.* (1989) for production competence was adopted and extended to compute the Collaborative Performance Index[4] (CPI). Singh (2011) has also used this model to evaluate coordination index of an organisation. Based on Cleveland et al. (1989) model, CPI is given as follows:

$$Ct = \{Wi \text{ Log } K\}$$

Where:

Ct = Collaborative performance index for subcontract trade

I = Collaborative performance factor

K = Rank of collaborative performance factor

For assessing the weight to different factors and of trades collaboration performance, the total value of significant factors affecting each trade is mapped (i.e. Occurrences from 0-5 were considered fairly important, 6-10 moderate, and more than 10 extremely important). For each

[4] Collaborative Performance Index refers to key factors of trade contractors imparting on buying organisations' collaborative strategies selection.

of the fourteen collaboration performance factors, a weight is assigned. The relative weightings of these are dependent on the number of trades for occurrences of significance. The criterion for weight (Wi) is as follows:

Wi = +3 (strength/extremely important), when total score > 10

Wi = +2 (neutral/ moderate), when total score is between 6 and 10

Wi = +1 (weakness/fairly important), when total score <6

For example, say the total value of a factor for a trade collaboration performance = 4 then using the equation, it comes out to be 4/3 = 1.3; therefore, it is assigned a weight of +1.

Table 6.23 Weighted score for each trade

Trade	Weighted scores
Brickworks	1.7
Groundworks	1.7
Steelworks	2.0
Mechanical & Electrical	3.3
Roofing	2.0
Finishes	1.7

Table 6.23 presents the weighted scores for each trade. As already noted the weighted scores can be used to evaluate uniqueness of skills and competence of trade and compared with alternatives in marketplace. Trades were compared among themselves with respect to each attribute or factor hence a weight score for each trade was assigned. The procedure for evaluation was based on Analytical Hierarchy Process (AHP). The criteria used were attributes or factors affecting each trade in relation to buying organisations' collaborative strategies selection during projects development (see Table 6.22 at page 162). The final weighted results shown in Table 6.23 indicated their importance with regards to collaborative supply chain performance.

Higher CPI value signals higher transactional uncertainty and uniqueness of skills and competence. Consequently, trade contractor's asset specificity would be high and therefore potentially placing higher transaction costs upon the buying organisation. Table 6.22 (see page 164) suggests how the emergent model illustrated in Figure 6.6 (see page 161) and trades and variables significance can be combined to identify some dimensions.

Using a spectrum of formal and informal relationships and levels of uncertainty and asset specificity, a framework for collaborative working relationship for range of trade contractors can be developed to demonstrate range of relationships available to main contracting firms in their dealings with different trade contractors. This ranges from pure market relationship to alignment or full-blown relationship. These are characterised on a range factors/attributes as shown in Table 6.20. The weighted score was used in determining levels of uncertainty and asset specificity associated with each trade as well as the position on the AHP.

Figure 6.7 (see page 166) illustrates a three level framework summarising the various types of contracting relationship in construction project development. In this integrative model, Type I represents a market relationship where transactions involved are of low technical competences and uncertainty, and identifies bricklayers, groundworks and finishes (painting and decoration) as subcontractor type to this category. The primary factors influencing this category are market intensity, price, project location and reputation. Competitive tendering arrangements and price are the main consideration.

Type II represents repetitive working relations and identifies steelworks and roofing and cladding as subcontractors in this type of relationship. The key factors affecting this group are organisational capability, reputation and workload of subcontractor (see Table 6. 22).

Activities in this form of exchange require medium level of technical capabilities which in turns specifies transactional uncertainty and asset specificity involved.

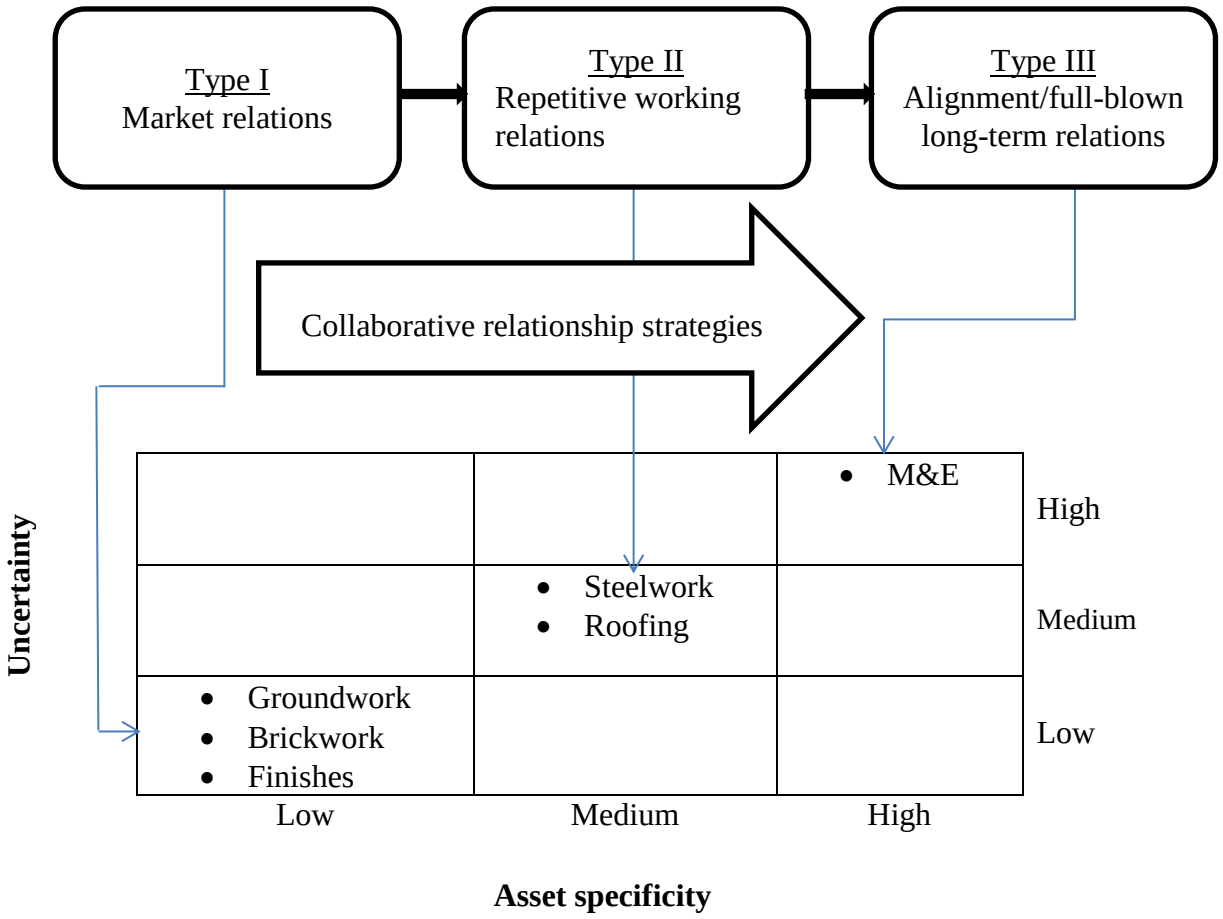


Figure 6.7 A framework of different trade contractors for temporary construction projects organisation

Type III represents a full-grown long-term relationship and identifies M&E as subcontractors in this type of relationship. It further identifies factors such as limited numbers, project complexity technological capability, interdependency, reputation and speciality. Trade contractors in this group are usually expected to have higher value engineering capability.

Their contribution to project development is therefore crucial and is associated with higher uncertainty.

As noted earlier, higher the weighted factors score the higher the uncertainty and asset specificity of a trade. It can also indicate the uniqueness of trade skills and competence. Since trades contractors are characterised by different levels of uncertainty and asset specificity, the form of governance (relationship strategy) buying organisation may adopt therefore depends on the degree of uncertainty and specificity (Eriksson, 2006; Williamson, 1981). Complex projects, for example, require high level skills and capabilities to execute (Goulding, 2012; Chow *et al.*, 2008). Similarly, limited numbers compel contracting organisations to establish cooperative relationship (Ross, 2011).

It was further observed from Figure 6.7, that brickworks, groundworks and finishes have the lowest asset specific trades and transactions between these groups of trade contractors and the main contractor were likely to be conducted on a free market. This was exemplified by participant 'E' during the first stage of data collection:

"… in situations where the supplier can be replaced easily, we try to bring down price as much as we can so we shop around…… after the project has been won we go back to our subcontractors to bring down their cost if possible. If we can get equally good subcontractor with competitive price then obviously those ones will be given attention. If we find their quotation interesting, this can lead to the work being awarded to the new bidder."

The easier a subcontractor can be replaced, the higher the focus is on market relationship and lesser the strength of the dependency.

M&E trade contractors on the other hand, were found to be the have the highest asset specificity on collaborative performance and has been demonstrated that this trade group were likely to be integrated fully into buying organisation supply chain network. Plausible reason for integration of M&E subcontractors and main contractor could be shown by Winch

(1989) who claimed that contractual uncertainty has the greatest influence on transaction costs and relationship. The above also suggests that under high uncertainty, bounded rationality limits buying organisation's ability to predict future contingencies and provide for them in a market contract, therefore transaction needs to be adopted to cope with subsequent contingencies resulting in long-term cooperation between the parties to avoid performance evaluation problems. Since these trade contractors are affected by small numbers, it would appear that the strength of the dependency developed is strong.

The grounds for long-term business relationships and expectations of continuance are fostered, due to their potential impact on overall project performance and profitability as well as ability to influence technical specifications and complex projects (Ekström *et al*., 2003; Aulakh and Gencturk, 2000). Consequently, their involvement is sought in both planning and construction stages (see Table 6.9 in page 140), and thus, the asset specificity become even higher. These issues were captured by the remarks of interviewee 'F':

".....price may be an issue but don't forget these are critical to the overall project success ....so rather than depending upon price quotation, we will look at their track records and their technical competence...."

Business relationship therefore depends on the intrinsic rewards, such as a better working environment and the opportunity for future work with the main contractor. The use of competition for these trades was perceived as the best means of minimising the buying organisation transaction costs in order to improve profitability margins. It also illustrated the degree and source of influence can be used to define and suggest trade groups can influence the type of governance structures adopted by main contracting organisation.

In sum, this study was set out to answer the following research questions: (i) do buying organisations incorporate strategic differentiation in their collaborative procurement strategies when interacting with trade contractors during projects development? (ii) do buying

organisations differ in collaborative procurement strategy to reflect on the intrinsic complexity and asset specificity specialist trade contractors? (iii) what factors influence the collaborative procurement strategies used during project development? The data analysis and discussion suggested that buying companies vary their collaborative procurement strategies in order to reduce costs and increase profitability when necessary. Three types of relationships – market, repetitive and full-grown were identified. Again, data analysis and discussion revealed that subcontractor's asset specificity and uncertainty associated with work package being subcontracted are key determinants for differentiation. Finally, the results suggested five-level factor structure: subcontractor-related factors, project-related factors, market environment determinants, organisational factors and procurement-related factors affect buying companies' collaborative procurement strategies. It was also found that the level of influence of these factors differ from one group of specialist trade to another presented in Table 6.22 in page 164.

CHAPTER SEVEN: CONCLUSIONS

7.0 Introduction

The aim of this study was to explore construction buying organisations collaborative procurement strategies and how they interact with different specialist trade contractors within their supply chain networks during project development.

Langford and Male (2001) argued that construction is a highly interconnected industry involving material components suppliers, the use of subcontractors within a geographic market and the extensive social connections that are in place between individuals who work for the various organisations in construction. It has been claimed that low entry and exit barriers exist (Ross, 2011), limited numbers of suppliers (Winch, 2001) within construction that are different to other forms of industry, these relate to a low capital requirement, and that the organisational capability that exists within organisations is difficult to protect and can be poached easily whilst the products produced are unspecific.

7.1 Findings

The results from the survey pointed to the direction that buying organisations had strategy for developing closer economic bonds specialist trade contractors and suppliers (see Table 6.12 in page 142). However, these strategies are varied depending asset specificity of subcontractor and uncertainty associated with work package as illustrated in Figure 6.7 (see page 166). Therefore buying organisations may use three different types of relationship strategies – market, repetitive and full grown relations. Findings suggested that buying organisations are tended to establish long term relationship with trade contractors of high asset specificity. The reasons accounted for this development appear to be their small number

in the market and high resources in form skill and knowledge they provide. On the other hand, supplying firms with low asset specificity are tended to be procured through market relations. High degree of entry and exit into this group of trade contractors' market and high level of availability was found to be responsible for the development. It was further discovered that procurement strategies differ with organisation size (see Figure 6.5 in page 152).

One of the advantages the system of subcontracting offers is production efficiency and organisational flexibility (benefits that are related to the market governance mechanisms). However, it adds coordination costs such as searching and gathering information about the sellers, writing, negotiating and administering contractual agreements to protect against opportunistic behaviour. The buying organisations in an attempt to reduce these administration costs and uncertainty develop closer links with a smaller number of subcontractors. The data analysis from this study revealed that main contracting organisations rely heavily upon competition when inviting subcontractors to bid for work as indicated in Table 6.11 in page 142.

The index in Table 6.5 (page 136) indicated that there are some forms of stable working relationship between main contracting organisations and their subcontractors. The approach towards the mechanical and electrical subcontractors during project development appears to be in contrast to all other specialist trades, even those that carry out design such as steelworks. The high importance given to early involvement as illustrated in Table 6.9 (page 140) suggested that these categories of subcontractor trades were procured at an early stage and selected on the basis of their technical competence and resources (unique ability), rather than on lowest price. This supported the assertion that some organisations are moving

towards a more relational approach with their supply chain. This finding can be a reason for vertical integration of a main contractor and M&E trade contractor.

Again, the data analysis suggested that organisations tend to behave differently when employing groups of trade specialists and the procurement approach, project complexity, economic factors and trade are all intervening independent variables that affect this strategic behaviour. Large contracting organisations were found to be moving towards relational approach with their supply chains. However, data analysis uncovered no evidence of parties sharing resources. The results also revealed that the lowest number invited to bid from SMEs was groundworks and brickworks. The small number for groundworks from SMEs may suggest that these firms tended to employ their own resources to carry out this work.

The analysis of interactions among the factors is provided by PCA in this study and the results form the basis of the conceptual framework. The results confirm five-level structure of the model and demonstrate the direct effect of:

- Subcontractor-related factors (e.g. expertise and skills);
- Market environment determinants;
- Project-related factors;
- Organisational factors; and
- Procurement-related factors

Project-related factors have a great impact on inter-firms working relationships and a key for project success. As observed by Kadefors (2011), where projects are complex it requires more knowledge integration and joint learning which call for changes in established ways of working, such as roles, task sequencing and decision processes. To ensure project success and costs control, as suggested in this survey has been to develop closer links with a smaller

number of subcontractors. A number of attributes affect this factor include; project complexity and size, location of project and workload of subcontractor.

A non-parametric test revealed that Mechanical and Electrical have the greatest number of occurrences of significance. This is in line with the findings of Ekstrom *et al.* (2003) who suggested that M&E is a higher asset specific trade and, as a result, it has the ability to use opportunistic behaviour to increase costs (Dow *et al.*, 2009; Kale and Arditi, 2001). Another reason for M&E significance can be attributed to their work packages (specialism) which are increasingly complex due to their size and scale as well as interactions with other works' packages on a project. This finding can be a reason for the development of long-term business relationship between a main contractor and M&E contractor. On the other hand, brickworks trade contractor have been found to be low asset specific trade. This is, particularly when the size of the Chi square value in Table 6.16 (page 149) was considered.

The study found that specialist trades contractors are characterised by different levels of uncertainty and asset specificity and the form of governance (relationship strategy) buying organisation may adopt therefore depends on the degree of uncertainty and specificity. It categorised trade contractors into three groups: high, medium and low specialised contractors. This relates to Eriksson (2006) and his findings that asset specificity has major impact on sourcing decisions. The data analysis also found that buying organisations were more likely to employ long-term working relationship when asset specificity and uncertainty are high. This may be due to bounded rationality which limits the organisation's ability to predict future contingencies and provide for them in a market contract as asserted by Williamson (1981). In order to cope with subsequent contingencies, transaction needs may be adopted through internal governance structure to avoid performance evaluation problems.

In contrast, brickworks, groundworks and finishes trade contractors were found to be low specific trades. Under circumstances of low asset specificity and uncertainty, buying organisations are able to express measure and evaluate suppliers' performance, which reduces the chance to engage in opportunistic behaviour. Therefore buying organisations are likely to employ free market as governance structure where relationships are often on temporary basis, short-term and ad hoc. This builds on the findings of Watjatrakul (2005) who states that under the condition of low asset specificity and uncertainty transaction can be adapted to cope with changed circumstances and, because of this, ex post transaction costs can be reduced. This may also be seen as opportunity for main contracting firms to benefit from economies of scale that can be obtained from the market.

The result obtained from different levels of analysis suggested that main contracting organisations vary their collaborative procurement strategies over a range of specialist trade contractors depending on the position of trade contractor's asset specificity and uncertainty associated with the project. A framework for collaborative procurement strategies has been developed for specific trade relationship with main contracting organisation and the theoretical base for the relationship development was suggested to be different levels of uncertainty, asset specificity and resources. Consequently, the buying organisations resort to selecting different form of relationships for specific trade contractors during construction project development as illustrated in Figure 6.7 (see page 166).

7.2 Conclusion

The aim of the research was to explore how buying organisations' collaborative procurement strategies interact with a range of trade contractors within the chain networks during project development.

The objectives were: (i) to explore buying companies' collaborative procurement strategies during project development with different trade contractors (ii) to examine whether any differences in buying companies collaborative procurement strategy are as a result of different attributes and asset specificity of subcontract trades; (iii) to explore the factors that influence the collaborative procurement of strategy over a range of subcontract trades; and (iv) to develop a framework.

It was found that buying organisations' collaborative procurement strategies have a bias to choose trade contractors with high asset specificity when developing long-term working relationships. A statistically significant correlation was expected amongst these different trade contractors.

The data collected for the study indicated that the large main contracting organisations were developing closer relationships with their specialist trade contractors within the supply chain network. The majority of respondents indicated that their organisations were still in the early stages of developing closer relationships. The data analysis reported from the 2x6 factorial general linear model found that the trades of mechanical and electrical as having the lowest number invited to bid for work for large organisations. A conclusion can be drawn that procurement arrangements by buying organisations are allied with partnering approach and as the supply chain collaborative strategies start to mature, a more technological interdependency may develop in future in order to exert greater costs control on subcontractors in relation to traditional approach. The specificity of this category of subcontractors for this approach could therefore be considered as being consequently higher, and related to the higher levels of bilateral dependency of the contractor on the subcontractors *ex ante* (pre-contract) involvement in the development of the project.

This assertion was supported by data analysis on the basis for differentiating between trade contractors and reasons for employing subcontractors identified by the respondents, which related to improved relationships development. The basis for differentiating between trade contractors to develop closer relationships were considered as relating to the dependence on the subcontractor to provide skills or resource required to improve the competitive position of the main contracting firm. There was no evidence of parties sharing resources. This can be viewed as a transaction asset or resource that can be used *ex post* (post-contract), to provide differential economic power between the parties, or may be appropriated by one party for use in other exchanges, which will influence ex ante relationship. This relationship asset/resource will only be released when more formal (post-contract) governance structures are in place to compensate for the investment made by the subcontracting firm. On the other hand, lowest number invited to bid from SMEs was groundworks and brickworks. The small number for groundworks from SMEs may suggest that these firms tended to employ their own resources to carry out this work.

In this study, fourteen attributes for collaborative supply chain relationships have been identified using a principal component factor analysis. These are grouped into five categories namely; Subcontractor-related factors, market environment determinants, project-related factors, organisational factors, and procurement-related factors. The variables affecting the factors were identified. Variables within each group were interrelated and intrarelated. A variable in one group can influence a variable in the others, and vice versa. A conceptual framework for collaborative procurement in supply chain has been developed. Findings of the research suggested that buying organisations' collaborative strategies differentiate on the basis of specialism, with higher asset specific trades having the greatest number of occurrences of significance and therefore tend to be integrated into the supply chain network.

The study is the first attempt to develop a conceptual framework for the purpose of investigating specific trade relationship with main contracting organisation informed by the theoretical attributes which can be used to examine the relationship governance of subcontract trades.

7.3 Contribution to Knowledge

The thesis identified and defined factors that influence buying organisation's procurement strategy over a range of subcontractor trades within the supply chain during construction project development. The identification of these factors is important to allow for a well-coordinated collaborative procurement systems based on theory, and the development of a better understanding of the pre-contract processes that will help in making supply chain responsive to client demands.

The development of construction projects requires exchange of information and product processes. This is essential in the in the early stage of project development as reported (Errasti *et al.,* 2007). The standards for construction exchanges have been developed to support the traditional sequence of construction process adopted by the traditional procurement approach. This study has found that the integrated collaborative procurement arrangements such as partnering have increased the involvement of specialist trade contractors during the initial stages of projects. Nevertheless, the use of competition by main contracting during these stages to procure specialist trade contractors may constrains the extent of involvement these trade contractors information exchange. Subcontractors that are particularly affected by these barriers to effective collaborative supply chain relationships are those that tender for projects undertaken by small and medium sized organisations. The mechanical and electrical specialist trade contractors working for large organisations using

the partnering procurement approach were found to impact greatly on buying organisations choice of procurement arrangements through their high specificity. On the other hand, both SMEs and large firms made extensive use of the market to develop relationship with other trade contractors. The use of competition for these trades was perceived as the best means of minimising the buying organisation transaction costs in order to improve profitability margins. The availability of the required skills or resource and numbers within the market for these trade contractors were identified as the factors behind the differentiation of these trades with the mechanical and electrical trade.

The need to develop interdependent organisation structures for the development of construction processes has been key aspect construction literature and the plethora of strategic industry report (Wolstenholme, 2009; Egan, 1998; 2002). The construction process requires a high level of integrative activity which has not traditionally been recognised and provided. Also, the production function should be designed to reflect the technical demands of the project and its environment. Akintoye and Main (2007) have reported the factors for successful and unsuccessful collaborative business relationships and Smyth (2005) highlighted factors that influence the efficacy of the procurement approaches. This is the first study that has considered the pre-contract economic factors that affect buying organisations collaborative procurement strategy over a range of specialist trade contractors. The literature reviewed uncovered no study that considered the existence of socio-economic factors that affect the buying organisation procurement strategy, which in turn influences the type of working relationships developed during project development. Researchers who have not differentiated by trade have previously ignored the market-related factors of small numbers availability and propensity to price. The relative specificity of the subcontract trades and the impact of the market structures of the main contracting organisation on this specificity

expanded upon in the study suggested that one size of collaborative procurement strategy does not fit all. The thesis further identified the need for more empirical study to explore the structure of markets and the frequency of use, specificity of trades and the extent of networks and their influence. Additionally, it contributed to the area of transaction economics and resource-based by suggesting that organisational collaborative relations of market determinants had an effect of specificity and resource or skills uniqueness. Finally, it provides a better understanding of these factors and takes account of the main units of production, the supply chain, and their relationship with different subcontract organisations which can assist in the design of collaborative approaches.

To be innovative, main contracting organisations need to maximise the opportunities available within the supply network. This involves, not just for large firms but also for the small occasional organisations, as the culture of networks, unsolicited subcontract bids, and competition are common as a process for selection of the subcontractor are all hindering development of an environment that encourages collaborative working relationships. The pre-qualification criteria used by clients may be used in a similar way to this study to request information from trade contractors to the supply chain and seek to place contracts with subcontracting firms that can empirically demonstrate a commitment to high project specificity of supply chain organisations. In construction, procurement is essential for development of a more effective construction industry as has been identified as having a central role in innovation and learning.

In sum, the following are considered as contribution to what is already known:

- It provides structure or basis for developing effective temporary multi-disciplinary organisational teams by identifying key factor affecting each group that is essential for the effective and efficient project management.
- It considers procurement approaches that reflect and facilitate better communication between supply chain partners by strategically differentiating subcontractors in order to achieve value enhancement and operational efficiency.
- The research outcome may assist in the design of more effective collaborative approaches with strong theoretical basis as it combined two theoretical theories.
- The findings can support a future research agenda which seeks to incorporate the need for an increase in the specificity of trade contractors
- It put forward a conceptual framework for the key trades to benchmark their performance in terms of attributes to develop capability within the supply chain networks.

7.4 Limitations of Study

The primary limitation relates to construct measurement and the population sample used. The constructs were derived from the literature search, which was limited primarily to the area of construction management. Therefore the practicality of the research outcomes may be limited to construction sector.

Although the sample drawn for the study was an authoritative sampling it was acknowledged that it may not be fully representative of the UK construction industry contractors. Likewise, the results are based on a sample of 107 respondents from the buying organisations. This allowed controlling of extraneous influences but may diminish generalisation. Furthermore, the main technique for data collection was questionnaire survey and it is possible that the

results of this study might suffer from the respondent bias. However, the researcher maintained non-bias stance throughout data collection.

Finally, it is possible that the results might have suffered from the researcher's priori knowledge and bias. The limitations of the data analysis of this phase relate to the factorability of the correlation matrices for the principal component analysis as well as the naming of the resultant factors. These limitations were controlled using the data analysis techniques identified in chapter five however the factors should be interpreted in this context.

7.5 Future Research

The factors that influence the collaborative procurement strategy during project development within the supply chain network in relation to subcontract trades have been identified within this study. It is suggested that further study be conducted to explore in details how this could assist in the design of procurement systems that enhance increased frequency of use of specific trade contractors thereby encouraging inter organisational learning at organisational level and project level.

The study focused on the identification of factors/attributes affecting organisations collaborative procurement strategy over a range of specialist trade contractors during project development and not on the measurement of the Key Performance Indicators (KPIs) for various trade contractors. A further study should be redirected to identify the KPIs, so that the causal relationships between these attributes and KPIs can be identified. The causal relationships, once identified, would be useful piece of information to develop effective collaborative procurement strategy. Not only can it assist in selecting temporary multi-disciplinary organisation project team members, but also establishing the development needs of the project team members. Additionally, the most significance of identifying the causal

relationships would be for forecasting the performance levels of each trade contractor involved in the project development, as well as the overall performance of a construction project prior to its start.

Finally, this study proposed a framework for collaborative working strategies for range of trade contractors during project development. Further research would be needed to assess the framework the framework in practice.

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APPENDIX I

Pilot Questionnaire Feedback

Thank you for the time taking to complete this questionnaire. If you would like a copy of the results of this survey, please email your address to: A.Blay-Armah@2011.ljmu.ac.uk

Please answer the following questions after you have completed the pilot survey questionnaire. Your feedback on the pilot is critical to the success of the main survey and consequently please be critical in your analysis.

1. How long did it take you to complete the questionnaire? ..... Mins.

2. If there were any questions that were ambiguous in their wording, please could you indicate the number of the question below and if possible the reasons why this was the case.

3. If any of the questions requested information that you were uncomfortable to please could you indicate the number of the question below and if possible the reasons why this was the case.

4. If any of the questions appeared irrelevant to you or your organisation please could you indicate the number of the question below and if possible the reasons why this was the case.

5. If there were any categories of response that you felt didn't match the question posed, please could you indicate the number of the question below and if possible the reasons why this was the case.

6. If you have any suggestions for improvement please include them on the reverse of this sheet.

Thank you once again for your valuable assistance; please return the completed questionnaire to me by the end of 4 February using the self-addressed envelope.

APPENDIX II

Copy of the Questionnaire

This survey aims to investigate the how the contractor develops economic working relationships with different groups of subcontracting trades and how they are invited to participate in the supply chain networks.

If any question requests information that you feel uncomfortable with releasing, please skip on to the next question.

Thank you in anticipation.

Your responses are critical to the success of the research and if you have any queries or would like a copy of the data analysis, please contact Augustine Blay-Armah on 0151 231 4149 or email A.Blay-Armah@2011.ljmu.ac.uk

Section One - Company Information

1. Which of the following best describes your organisation's field of operation? (Please tick a box)	
General contracting-Building	
General contracting-Civil Engineering	
General contracting- Civil and Building Engineering	
Others. Please indicate ……..	

2. What is your organisation annual turnover in the last financial year? (Please tick a box)
   < £5m □ £5-24m □ £25-50m □ £51-100m □ >£100m □

3. How many people does your company employ currently? (Please tick a box)
   <10 □ 10-49 □ 50-100 □ 200-500 □ >500 □

4. Please indicate the percentage of work that your organisation usually subcontracts. (Please tick a box)
   <10% □ 10-20% □ 21-40% □ 41-60% □ 61-80% □
   >80% □

5. Which of the following procurement arrangements does your organisation regularly use dealing with subcontractors?
   Bills of quantity □ Design and Build □ Prime Contracting □
   Management Contracting □ Cost Reimbursement □

Section Two - Supply Chain Collaboration

6. Does your organisation have a strategy to develop closer links with selected specialist trades contractors? Yes □ No □ If no, please go to question 6
How long has this strategy been implemented? (Please tick a box) 1-2 years □ 3-5 years □ 6-10 years □ Over 10 years □
Does the strategy differentiate between subcontracting trades (e.g. M & E and Brickworks)? Yes □ No □ If yes, please use the space below to explain. …… …… ……

Please give your opinion on the benefits, if any, you derive from your strategy by ranking the following. Please write the appropriate number. Where 5=highest; 1=lowest. Please Rank	
Improvement in sharing of knowledge about construction techniques	
Guaranteed response to requests for quotations	
Reduction in overhead cost	
Improvement in alternative construction approaches and communication of cost information	
Access to specialised technologies, process capabilities, and expertise	
Improved project delivery to required specifications and fit for intended purpose	
Reduction in liability exposure and overall construction cost	
Improvement in construction processes and experience	

7. For each of the following statements, please indicate your agreement or disagreement for not inviting more subcontractors to bid for each work package by ringing the appropriate number. 5=strongly agree; 4=agree; 3=slightly agree; 2=slightly disagree; 1=strongly disagree					
Increase in supervision of unknown subcontractor	1	2	3	4	5
Performance quality reduction	1	2	3	4	5
Need for honest appraisal	1	2	3	4	5
Rising overhead cost	1	2	3	4	5
Reduction in delivery challenges	1	2	3	4	5
Improve transfer of knowledge and experience	1	2	3	4	5

8. Please indicate how significant the following techniques for developing collaborative working arrangement with subcontractors by writing the appropriate number. **Where 5=the most significant; 1=least significant**	Please Rank
Team building	
Joint objectives	
Early involvement	
Partnering facilitator	
Sharing gains	
Joint technology	
Soft parameters (e.g. Commitment and trust)	

9. Please indicate how often your organisation usually uses the following forms of collaborative arrangements by ringing the appropriate number. Where 1=the most frequently used and 4=least used	
Strategic partnering	1 2 3 4
Project partnering	1 2 3 4
Framework arrangement	1 2 3 4
Alliance	1 2 3 4
How important is supply chain collaboration to your organisation? (Please tick one only)	
Not important □	Limited important □
Important □	Critical □

10. What percentage of subcontractors services are procured by the following? Please tick the appropriate percentage for each.					
Percentage	<10	10-19	20-49	50-79	>80
Competition					
Competition with collaboration agreement					
Negotiation					
Negotiation with collaboration agreement					
Do these percentages differ with different subcontracting trades (e.g. Steelworks and Brickwork?					
Yes □		No □			

Section Three – Subcontract Trades and Collaborative Interactions

11. Please state the average number of subcontractors you usually invite to bid for each of the following trades and the average length of relationship.		
	Number of subcontractors	Length of relationship
Brickworks		
Groundworks		
Steelworks		
Mechanical & Electrical		
Roofing		
Finishes		

12 Please state the average number of each subcontractor trades usually invited to bid for work through the following approaches.		
	Partnering	Traditional
Brickworks		
Groundworks		
Steelworks		
Mechanical & Electrical		
Roofing		
Finishes		

13 How important are the following factors upon the decision to use a particular subcontractor on a project? (Please tick one only for each factor). (√)					
	Not important	**Important**	**Fairly important**	**Very important**	**Extremely important**
The need to reduce liability exposure					
Reduction of construction cost					
Market volatility					
Reduce construction time					
Reduce equipment or maintenance cost					
Better workmanship					
Value to the client					
Reduce overhead cost					

14 When assessing contributions to project development from the following trades, please indicate your agreement or disagreement with the statement by ringing the appropriate number.				
5=strongly agree; 4=agree; 3=not sure; 2=disagree; 1=strongly disagree				
	Ability to provide accurate price quotations	Ability to provide better alternative cost specifications	Ability to provide acceptable alternative specifications	Ability to provide technology associated with the project
Brickworks	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Groundworks	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
steelworks	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Mechanical & Electrical	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Roofing	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Finishes	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

15 Please indicate how significant the following factors are upon the decision to collaborate with subcontractors on a project.	
Procurement	1 2 3 4 5
Organisational capability	1 2 3 4 5
Market intensity	1 2 3 4 5
Limited numbers	1 2 3 4 5
Subcontractor specificity	1 2 3 4 5
Subcontractor specialisation	1 2 3 4 5
Project complexity	1 2 3 4 5
Subcontractor current workload	1 2 3 4 5
Price specificity	1 2 3 4 5
Bilateral dependence	1 2 3 4 5
Interdependence	1 2 3 4 5
Project location	1 2 3 4 5
Technology performance	1 2 3 4 5
Reputation	1 2 3 4 5

16 Please indicate the effects of the following factors are upon the decision to collaborate with the following categories of subcontract trades on a project.										
	Specialised					**Non-specialised**				
Procurement	1	2	3	4	5	1	2	3	4	5
Organisational capability	1	2	3	4	5	1	2	3	4	5
Market intensity	1	2	3	4	5	1	2	3	4	5
Limited numbers	1	2	3	4	5	1	2	3	4	5
Subcontractor specificity	1	2	3	4	5	1	2	3	4	5
Subcontractor specialisation	1	2	3	4	5	1	2	3	4	5
Project complexity	1	2	3	4	5	1	2	3	4	5
Subcontractor current workload	1	2	3	4	5	1	2	3	4	5

Price specificity	1	2	3	4	5	1	2	3	4	5
Bilateral dependence	1	2	3	4	5	1	2	3	4	5
Interdependence	1	2	3	4	5	1	2	3	4	5
Project location	1	2	3	4	5	1	2	3	4	5
Technology performance	1	2	3	4	5	1	2	3	4	5
Reputation	1	2	3	4	5	1	2	3	4	5

17 **Personal Details**

(Please tick a box for each of the following questions)

Which of the following best describes your position in the company?
Director □ Supply Chain Manager □ Construction Manager □
Project Manager □ Quantity Surveyor □ Site Manager □
Procurement Manager □ Others □
How many years of experience do you have in this position?
<5 □ 5-9 □ 10-14 □ 15-20 □ >20 □
What role do you play in making the decision on subcontractor procurement?
Final decision □ Key decision maker □ Key influencer □ No input □

If you would like to take part in a short telephone interview, which investigates the current subcontracting trades into the construction supply chain, please either include your business card or write your phone number. Alternatively you can email me: A.Blay-Armah@2011.ljmu.ac.uk

Thank you for assisting us with this important project. Please return the questionnaire in the pre-paid envelope provided by

If you would like a copy of the results of this survey, please tick this box □

APPENDIX III

Cover Letter

Dear Sir/Madam,

I am writing to invite you to take part in a national UK survey on main contractor-subcontractor working relationships that I am undertaking as a research project. The objective of the study is to develop a framework that can facilitate creativity and innovation, essentially required for working collaboratively to improve performance and also obtain business benefits. I am not asking for your identity in the survey so you can be assured that your response will be anonymous and not identifiable from the analysed data.

I do hope that you can find the time to complete the questionnaire enclosed and return it to me in the self-addressed envelope by 1 May, 2013 as your response is crucial to the success of the research.

I anticipate that the ultimate results of this study can be used to assist you identifying more capable subcontractors in becoming a first rate construction firm and expanding your business.

If you have any queries, please contact me on 0151 231 4149 or email A.Blay-Armah@2011.ac.uk

Once again, thank you for your contribution.

Yours sincerely,

Augustine Blay-Armah

APPENDIX IV

Follow-up Letter

Date as postmark

Dear Sir/Madam,

Framework of Projects Temporary Relationships in Construction Survey 2013

I am writing to remind you that the closing date for the above survey has been extended to 15 March 2013.

The research aims to gather as much data as possible across all sectors of the industry from professionals therefore your response is highly valued. I have enclosed a further copy of the survey and envelope for return in case you have misplaced the original and would be most grateful if you could spare the time to complete the survey and return it to me by 15 March 2013.

If you have already returned the questionnaire, it may be caught up in the post and consequently please ignore this reminder.

Many thanks once more in anticipation of your help.

Yours sincerely,

Augustine Blay-Armah

APPENDIX V

Kruskal-Wallis Test for Individual Trades Data

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	1.464	.917	2.090	2.142	2.246	1.355
df	2	2	2	2	2	2
Asymp. Sig.	.292	.632	.035	.031	.325	.308

a. Kruskal Wallis Test

b. Grouping Variable: Subcontractor specificity

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	96	95	95	94	96	95
Median	8.00	8.00	9.00	11.00	8.00	8.00
Chi-Square	2.589[b]	.459[c]	.434[d]	2.288[e]	2.589[b]	1.784[f]
df	2	2	2	2	2	2
Asymp. Sig.	.274	.795	.035	.031	.274	.055

a. Grouping Variable: Subcontractor specificity

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.3.

c. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.2.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.9.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.2.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	2.816	3.055	2.672	3.520	2.552	1.558
df	2	2	2	2	2	2
Asymp. Sig.	.055	.058	.159	.004	.169	.102

a. Kruskal Wallis Test

b. Grouping Variable: Subcontractor specialisation

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	95	94	94	93	95	94
Median	8.00	8.00	8.00	9.00	8.00	8.00
Chi-Square	1.462[b]	3.507[c]	1.446[c]	.600[d]	1.701[e]	4.150[f]
df	2	2	2	2	2	2
Asymp. Sig.	.481	.148	.485	.004	.427	.126

a. Grouping Variable: Subcontractor specialisation

b. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

c. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.1.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.2.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.3.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	3.927	3.787	3.664	3.499	2.716	2.981
df	2	2	2	2	2	2
Asymp. Sig.	.081	.091	.013	.014	.095	.137

a. Kruskal Wallis Test

b. Grouping Variable: Project complexity

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	105	104	104	103	105	104
Median	4.00	5.00	7.00	8.00	6.00	4.00
Chi-Square	3.963[b]	3.758[c]	3.624[d]	3.601[e]	2.777[f]	2.043[g]
df	2	2	2	2	2	2
Asymp. Sig.	.206	.093	.036	.004	.151	.360

a. Grouping Variable: Project complexity

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.5.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.7.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.9.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.4.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.3.

g. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.7.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	.573	.716	1.232	1.913	2.420	.611
df	2	2	2	2	2	2
Asymp. Sig.	.718	.116	.031	.034	.011	.737

a. Kruskal Wallis Test

b. Grouping Variable: Subcontractor capability

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	106	105	105	104	106	105
Median	8.00	8.00	9.00	9.00	10.00	8.00
Chi-Square	3.684[b]	3.382[c]	3.179[d]	1.588[e]	2.499[f]	1.156[g]
df	2	2	2	2	2	2
Asymp. Sig.	.718	.116	.031	.034	.011	.561

a. Grouping Variable: Subcontractor capability

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.9.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.8.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.6.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 10.4.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.7.

g. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 11.7.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	4.991	4.883	.172	1.641	3.990	5.998
df	2	2	2	2	2	2
Asymp. Sig.	.017	.034	.918	.440	.020	.004

a. Kruskal Wallis Test

b. Grouping Variable: Price specificity

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	105	104	104	103	105	104
Median	8.00	8.00	6.00	4.00	8.00	8.00
Chi-Square	.561[b]	.693[c]	1.634[c]	2.351[d]	.304[e]	.166[f]
df	2	2	2	2	2	2
Asymp. Sig.	.017	.034	.442	.309	.020	.004

a. Grouping Variable: Price specificity

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.4.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.7.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 10.3.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.1.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 11.1.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	.307	.898	.776	6.119	.118	.539
df	2	2	2	2	2	2
Asymp. Sig.	.858	.638	.679	.017	.943	.764

a. Kruskal Wallis Test

b. Grouping Variable: Bilateral dependence

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	104	103	103	102	104	103
Median	5.00	6.00	8.00	9.00	8.00	5.00
Chi-Square	1.058[b]	.330[c]	1.753[c]	10.396[d]	.909[e]	.610[f]
df	2	2	2	2	2	2
Asymp. Sig.	.589	.848	.416	.017	.635	.737

a. Grouping Variable: Bilateral dependence

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.1.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.0.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.2.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.9.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.6.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	.977	.280	.343	3.180	2.636	.929
df	2	2	2	2	2	2
Asymp. Sig.	.614	.869	.842	.004	.268	.628

a. Kruskal Wallis Test

b. Grouping Variable: Interdependence

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	101	100	100	99	101	100
Median	7.00	8.00	9.00	11.00	8.00	6.00
Chi-Square	.277[b]	.184[c]	.167[d]	6.347[e]	1.060[f]	.071[g]
df	2	2	2	2	2	2
Asymp. Sig.	.870	.912	.920	.004	.588	.965

a. Grouping Variable: Interdependence

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.5.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.8.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.4.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.9.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.3.

g. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 10.1.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	3.056	4.396	1.496	1.734	1.585	5.276
df	2	2	2	2	2	2
Asymp. Sig.	.022	.042	.473	.334	.016	.019

a. Kruskal Wallis Test

b. Grouping Variable: Project location

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	99	98	98	97	99	98
Median	9.00	9.00	6.00	6.00	8.00	9.00
Chi-Square	3.661[b]	4.396[c]	2.112[d]	1.291[e]	1.020[f]	5.552[g]
df	2	2	2	2	2	2
Asymp. Sig.	.022	.042	.348	.343	.016	.019

a. Grouping Variable: Project location

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 10.0.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 10.2.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.4.

e. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.8.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.6.

g. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 10.3.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	3.593	3.333	6.582	7.879	4.885	4.582
df	2	2	2	2	2	2
Asymp. Sig.	.166	.189	.037	.002	.087	.066

a. Kruskal Wallis Test

b. Grouping Variable: Technology performance

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	77	77	77	76	77	76
Median	7.00	8.00	9.00	12.00	8.00	9.00
Chi-Square	2.417[b]	2.935[c]	6.296[d]	7.581[e]	2.417[b]	5.446[f]
df	2	2	2	2	2	2
Asymp. Sig.	.299	.231	.037	.002	.299	.066

a. Grouping Variable: Technology performance

b. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.7.

c. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.3.

d. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.9.

e. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	1.205	1.523	1.143	2.119	1.463	1.929
df	2	2	2	2	2	2
Asymp. Sig.	.027	.018	.040	.018	.027	.026

a. Kruskal Wallis Test

b. Grouping Variable: Reputation

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	59	59	59	59	59	59
Median	8.00	8.00	6.00	7.00	8.00	9.00
Chi-Square	1.101[b]	1.411[c]	1.049[d]	1.048[e]	1.101[b]	1.032[f]
df	2	2	2	2	2	2
Asymp. Sig.	.027	.018	.040	.017	.027	.026

a. Grouping Variable: Reputation

b. 2 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.9.

c. 2 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.4.

d. 2 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5..0

e. 2 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 5.0.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	1.328	1.715	1.541	1.377	1.586	1.880
df	2	2	2	2	2	2
Asymp. Sig.	.429	.280	.063	.002	.042	.125

a. Kruskal Wallis Test

b. Grouping Variable: Procurement

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	107	106	106	105	107	106
Median	11.00	11.00	11.00	12.00	10.00	10.00
Chi-Square	1.201[b]	1.356[c]	1.921[c]	1.169[d]	1.454[e]	2.789[f]
df	2	2	2	2	2	2
Asymp. Sig.	.429	.275	.063	.002	.042	.125

a. Grouping Variable: Procurement

b. 2 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.7.

c. 2 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.8.

d. 2 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.6.

e. 2 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.2.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	6.634	7.614	6.383	5.240	7.797	6.236
df	2	2	2	2	2	2
Asymp. Sig.	.042	.027	.041	.028	.025	.039

a. Kruskal Wallis Test

b. Grouping Variable: Subcontractor workload

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	107	106	106	105	107	106
Median	9.00	10.00	8.00	6.00	10.00	8.00
Chi-Square	1.360[b]	3.221[c]	5.836[c]	2.476[d]	1.346[e]	.720[f]
df	2	2	2	2	2	2
Asymp. Sig.	.042	.027	.041	.028	.025	.039

a. Grouping Variable: Subcontractor workload

b. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.5.

c. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.7.

d. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.9.

e. 1 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.4.

f. 2 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.2.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	3.074	3.330	.564	1.246	1.164	2.231
df	2	2	2	2	2	2
Asymp. Sig.	.026	.038	.754	.536	.415	.039

a. Kruskal Wallis Test

b. Grouping Variable: Market intensity

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	106	105	105	104	106	105
Median	8.00	9.00	6.00	4.00	7.00	8.00
Chi-Square	3.074[b]	3.330[c]	1.430[d]	.918[e]	1.782[f]	2.231[g]
df	2	2	2	2	2	2
Asymp. Sig.	.026	.038	.489	.632	.406	.039

a. Grouping Variable: Market intensity

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.9.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.2.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.0.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 8.2.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.7.

g. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.3.

Test Statistics[a,b]

	BW	GW	SW	ME	Roof	Fin
Chi-Square	1.605	1.081	1.529	6.548	2.241	.525
df	2	2	2	2	2	2
Asymp. Sig.	.448	.583	.466	.038	.326	.769

a. Kruskal Wallis Test

b. Grouping Variable: Limited numbers

Test Statistics[a]

	BW	GW	SW	ME	Roof	Fin
N	107	106	106	105	107	106
Median	8.00	8.00	6.00	10.00	8.00	8.00
Chi-Square	3.437[b]	1.320[c]	1.705[c]	4.388[d]	4.227[e]	1.049[f]
df	2	2	2	2	2	2
Asymp. Sig.	.179	.517	.426	.038	.121	.592

a. Grouping Variable: Limited numbers

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.7.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.9.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.4.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.5.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.9.

APPENDIX VI

Factor Analysis Data

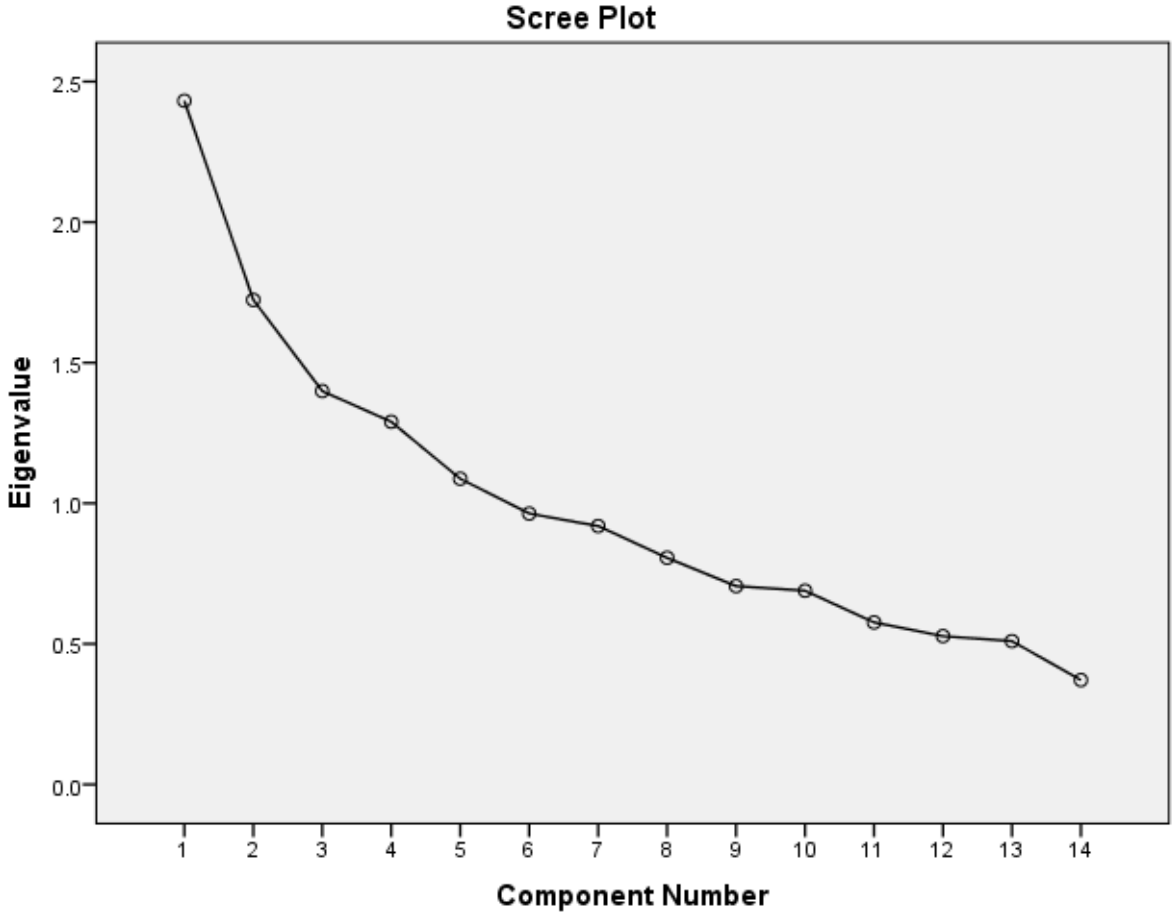
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.608
Bartlett's Test of Sphericity	Approx. Chi-Square	177.873
	df	91
	Sig.	.000

Communalities

	Initial	Extraction
Current workload	1.000	.452
Market intensity	1.000	.494
Limited numbers	1.000	.530
Subcontractor specificity	1.000	.629
Subcontractor specialisation	1.000	.656
Project complexity	1.000	.504
Subcontractor capability	1.000	.642
Price specificity	1.000	.692
Bilateral dependence	1.000	.499
Interdependence	1.000	.537
Project Location	1.000	.447
Technology performance	1.000	.735
Reputation	1.000	.563
Procurement	1.000	.448

Extraction Method: Principal Component Analysis.



Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.432	17.368	17.368	2.432	17.368	17.368
2	1.723	12.310	29.678	1.723	12.310	29.678
3	1.399	9.995	39.673	1.399	9.995	39.673
4	1.205	9.213	48.886	1.290	9.213	48.886
5	1.077	7.767	56.653	1.087	7.767	56.653
6	.964	6.884	63.537			
7	.919	6.566	70.103			
8	.806	5.757	75.860			
9	.705	5.038	80.898			
10	.689	4.922	85.820			
11	.576	4.117	89.937			
12	.527	3.767	93.704			
13	.510	3.643	97.347			
14	.371	2.653	100.000			

Extraction Method: Principal Component Analysis.

Anti-image Matrices

		Current workload	Market intensity	Limited numbers	Subcontractor specificity	Subcontractor specialisation	Project complexity	Subcontractor capability	Price specificity	Bilateral dependence	Interdependence	Project location	Technology performance	Reputation	Procurement
Anti-image Covariance	Current workload	.897	.019	-.040	.121	.035	.039	-.146	.071	-.059	-.010	.130	-.072	-.001	-.033
	Market intensity	.019	.836	-.191	-.124	-.013	-.116	.058	.007	.006	.107	.028	.083	-.053	-.095
	Limited numbers	-.040	-.191	.757	-.111	.064	.188	-.135	-.015	-.080	-.061	.134	-.005	.082	-.003
	Subcontractor specificity	.121	-.124	-.111	.770	-.159	-.020	.001	-.126	.048	-.040	.032	-.092	-.123	-.098
	Subcontractor specialisation	.035	-.013	.064	-.159	.892	.040	-.120	.031	-.059	-.020	-.006	-.033	-.045	.115
	Project complexity	.039	-.116	.188	-.020	.040	.906	-.029	-.065	-.012	.016	-.005	-.112	.078	.018
	Subcontractor capability	-.146	.058	-.135	.001	-.120	-.029	.708	-.110	-.177	-.015	-.242	.143	-.029	-.073
	Price specificity	.071	.007	-.015	-.126	.031	-.065	-.110	.812	-.144	.078	.095	.000	.112	-.056
	Bilateral dependence	-.059	.006	-.080	.048	-.059	-.012	-.177	-.144	.798	.002	.124	.053	-.023	.026
	Interdependence	-.010	.107	-.061	-.040	-.020	.016	-.015	.078	.002	.756	.001	-.210	-.083	-.066
	Project location	.130	.028	.134	.032	-.006	-.005	-.242	.095	.124	.001	.798	-.083	.041	.121
	Technology performance	-.072	.083	-.005	-.092	-.033	-.112	.143	.000	.053	-.210	-.083	.583	-.227	-.015
	Reputation	-.001	-.053	.082	-.123	-.045	.078	-.029	.112	-.023	-.083	.041	-.227	.687	.090
	Procurement	-.033	-.095	-.003	-.098	.115	.018	-.073	-.056	.026	-.066	.121	-.015	.090	.892
Anti-image Correlation	Current workload	.537[a]	.022	-.048	.145	.039	.043	-.184	.083	-.070	-.012	.154	-.099	-.002	-.037
	Market intensity	.022	.566[a]	-.240	-.154	-.015	-.133	.075	.008	.007	.135	.035	.119	-.069	-.110
	Limited numbers	-.048	-.240	.599[a]	-.146	.078	.227	-.185	-.019	-.103	-.081	.172	-.008	.114	-.003
	Subcontractor specificity	.145	-.154	-.146	.591[a]	-.192	-.024	.002	-.160	.061	-.053	.040	-.137	-.170	-.118
	Subcontractor specialisation	.039	-.015	.078	-.192	.562[a]	.044	-.151	.037	-.070	-.025	-.007	-.046	-.057	.128
	Project complexity	.043	-.133	.227	-.024	.044	.519[a]	-.036	-.076	-.015	.019	-.006	-.154	.099	.020
	Subcontractor capability	-.184	.075	-.185	.002	-.151	-.036	.509[a]	-.145	-.236	-.020	-.322	.223	-.042	-.092
	Price specificity	.083	.008	-.019	-.160	.037	-.076	-.145	.680[a]	-.179	.099	.118	.000	.150	-.065
	Bilateral dependence	-.070	.007	-.103	.061	-.070	-.015	-.236	-.179	.695[a]	.003	.156	.077	-.031	.030
	Interdependence	-.012	.135	-.081	-.053	-.025	.019	-.020	.099	.003	.714[a]	.002	-.316	-.115	-.081
	Project location	.154	.035	.172	.040	-.007	-.006	-.322	.118	.156	.002	.578[a]	-.122	.056	.143
	Technology performance	-.099	.119	-.008	-.137	-.046	-.154	.223	.000	.077	-.316	-.122	.653[a]	-.359	-.021
	Reputation	-.002	-.069	.114	-.170	-.057	.099	-.042	.150	-.031	-.115	.056	-.359	.678[a]	.115
	Procurement	-.037	-.110	-.003	-.118	.128	.020	-.092	-.065	.030	-.081	.143	-.021	.115	.594[a]

a. Measures of Sampling Adequacy(MSA)